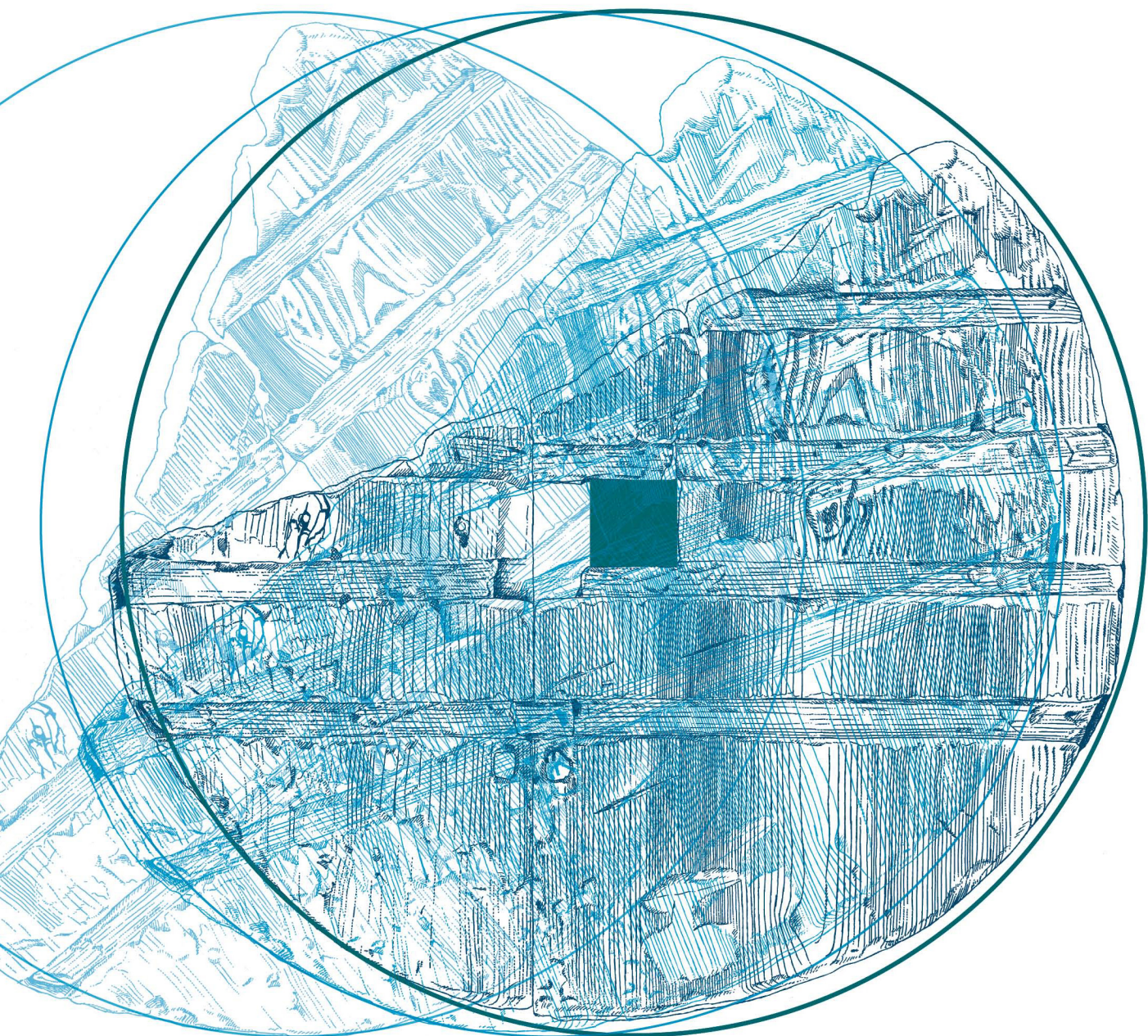


Koliščarska naselbina  
Stare gmajne in njen čas  
Stare gmajne pile-dwelling  
settlement and its era



Uredil / Edited by  
Anton Velušček



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OPERA INSTITUTI ARCHAEOLOGICI SLOVENIAE 16

Jana Horvat, Andrej Pleterski, Anton Velušček

**KOLIŠČARSKA NASELBINA STARE GMAJNE IN NJEN ČAS**

**Ljubljansko barje v 2. polovici 4. tisočletja pr. Kr.**

**STARE GMAJNE PILE-DWELLING SETTLEMENT AND ITS ERA**

**The Ljubljansko barje in the 2<sup>nd</sup> half of the 4<sup>th</sup> millennium BC**

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**Anton Velušček**



**LJUBLJANA 2009**



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## SPREMNA BESEDA IN ZAHVALA

Po objavi izsledkov raziskav koliščarskih naselbin Hočevarica pri Verdu (Velušček 2004a) in Resnikov prekop pri Igu (Velušček 2006a) je zbornik "Koliščarska naselbina Stare gmajne in njen čas – Ljubljansko barje v 2. polovici 4. tisočletja pr. Kr." že tretje delo, v katerem mednarodna skupina raziskovalcev pod vodstvom sodelavcev Inštituta za arheologijo ZRC SAZU iz Ljubljane poglobljeno obravnava problematiko koliščarske poselitve Ljubljanskega barja.

Tokrat predstavljamo rezultate raziskav koliščarskih naselbin Stare gmajne, Blatna Brezovica in Veliki Otavnik Ib, tj. naselbin iz 2. polovice 4. tisočletja pr. Kr. Na prvih dveh koliščarskih naselbinah je raziskave vodil podpisani, medtem ko so raziskave na Velikem Otavniku Ib potekale pod vodstvom Andreja Gasparija iz Vojaškega muzeja Slovenske vojske. V pričujočem zborniku smo se osredotočili v glavnem na "arheologijo" v najožjem pomenu besede, ozko naravoslovno naravnani zbornik je namreč šele v pripravi.

V zborniku "Koliščarska naselbina Stare gmajne in njen čas – Ljubljansko barje v 2. polovici 4. tisočletja pr. Kr." tako predstavljamo terensko delo in arheološko gradivo. Opravljena je bila tipološka analiza keramike z dveh najdišč, in sicer s Starih gmajn in Blatne Brezovice. Na omenjenih najdiščih so bile opravljene tudi sedimentološke analize profilov. Nasprotno pa so bile dendrokronološke raziskave opravljene na vseh treh najdiščih, na Starih gmajnah in Blatni Brezovici celo v kombinaciji z radiokarbonskim datiranjem.

Veliko pozornosti smo posvetili tudi posebej pomembnim najdbam in njihovemu preučevanju. Tako pišemo o lesenem kolesu z osjo, o dveh drevakih in o raziskavah manjših lesenih predmetov, kot so različna toporišča in otroški lok. Opravljene so bile analize talilnih posod, surovin in iskanje izvora kamnitih sekir in kamnite talilne posode, surovin in iskanje izvora žrnelj, artefaktov iz kosti in rogovja ter raziskava, konzerviranje in restavriranje barjanske preje, ki je stara približno 5100 let in edinstvena najdba te vrste in starosti pri nas.

Za najdišče Stare gmajne pri Verdu ugotavljamo, da gre za območje, ki je bilo poseljeno dvakrat, prvič v poznem 34. stoletju pr. Kr. in drugič v drugi polovici

## PREFACE AND ACKNOWLEDGEMENTS

"Stare gmajne pile-dwelling settlement and its era – the Ljubljansko barje in the 2<sup>nd</sup> half of the 4<sup>th</sup> millennium BC" monograph is, after publication of findings of researches on the pile-dwelling settlements Hočevarica near Verd (Velušček 2004a) and Resnikov prekop near Ig (Velušček 2006a), the third publication in which an international group of researchers, under management of collaborators of the Institute of Archaeology at the Scientific Research Centre of the Slovenian Academy of Sciences and Arts (ZRC SAZU) from Ljubljana, studies problems of pile-dwelling inhabitation of the Ljubljansko barje.

This time we introduce results of researches performed at pile-dwelling settlements Stare gmajne, Blatna Brezovica and Veliki Otavnik Ib, i.e. settlements dating to the 2<sup>nd</sup> half of the 4<sup>th</sup> millennium BC. The first two pile-dwelling settlements were researched under the supervision of the undersigned, while the research of Veliki Otavnik Ib was carried out under the supervision of Andrej Gaspari from the Military Museum of the Slovenian Army. The present monograph is focused mainly on "archaeology" in the narrowest sense of the word, while monograph focusing on natural science is in preparation.

In "Stare gmajne pile-dwelling settlement and its era – the Ljubljansko barje in the 2<sup>nd</sup> half of the 4<sup>th</sup> millennium BC" we present fieldwork and archaeological material. A typological determination of pottery from two sites, Stare gmajne and Blatna Brezovica, is presented. Moreover, sedimentological analyses of profiles were performed on the two sites mentioned. On the contrary, dendrochronological researches were completed on all three sites; in combination with radiocarbon dating at Stare gmajne and Blatna Brezovica.

We also devoted much attention to extremely important finds and the examination of them. Therefore, we present a wooden wheel with its axle, two logboats and researches of smaller wooden objects, such as different handles and a children's bow. Analyses of crucibles and raw materials were conducted, we searched for origins of raw materials for stone axes, crucible, querns, bone and antler artefacts and performed a research and restoration

32. stoletja pr. Kr. Naselbini sta bili postavljeni v močvirju, najverjetneje ob robu jezera, kar velja tudi za Blatno Brezovico, ki datira na začetek 31. stoletja pr. Kr. Ugotavljamo tudi, da sta bili koliščarski naselbini Veliki Otavnik Ib in mlajša naselbina na Starih gmajnah poseljeni v istem času.

Kot je torej mogoče razbrati, gre za izredno natančne datacije, ki predstavljajo pomemben korak k na leto natančnemu absolutnemu datiranju prazgodovinskih naselbin tudi na območju južno od Alp.

Pomemben prispevek tega zbornika pa je vsekakor temeljna objava lesenega kolesa in osi s Starih gmajn pri Verdu, ki predstavljata vitalna dela lesenega podvozja enega izmed najstarejših prazgodovinskih vozov nasploh. Poleg izjemne starosti preseneča predvsem tehniška dovršenost, kar nedvomno potrjuje, da je bil prazgodovinski koliščar velik opazovalec in poznavalec narave ter okolja, v katerem je živel.

Skratka, naj povzamem. Raziskave na Starih gmajnah, Blatni Brezovici in Velikem Otavniku Ib so pokazale, podobno kot sondiranja na Hočevarici in Resnikovem prekopu ter raziskave na drugih najdiščih koliščarskih naselbin Ljubljanskega barja, da je multidisciplinarno raziskovanje v moderni arheologiji nuja in ne več zgolj samo izpolnitev želje posameznika po globljem razumevanju problematike, ki nastane ob arheološkem izkopavanju. Raziskovanje teh najdišč je tako ponovno pokazalo, kako zelo malo vemo o neki lokaciji, če na njej in potem v laboratorijih ne opravimo ustreznih raziskav in analiz. Ob tem se seveda ne bom spuščal v najmodernejše in visokoletne hipoteze, ki so na vlažna tla Ljubljanskega barja še pred leti postavljale sprva plane naselbine na suhem ob rekah in nato kolišča, danes pa postavljajo zgolj plane naselbine na suhem ob rekah, a ne kolišč, ki naj bi obkrožala tedanje jezero.

Kakor koli že, ponovno poudarjam, da smo sodelavci Inštituta za arheologijo ZRC SAZU in tudi drugi raziskovalci, ki so sodelovali pri nastajanju zbornika "Koliščarska naselbina Stare gmajne in njen čas - Ljubljansko barje v 2. polovici 4. tisočletja pr. Kr." odprti za diskusijo. Toda želimo si argumentov, ki določeno tezo podpirajo, in ne pisanja v tri dni.

Zato sem zelo vesel in počaščen, da se s tega mesta lahko zahvalim vsem raziskovalcem, ki so sodelovali pri raziskovanju koliščarskih naselbin Stare gmajne, Blatna Brezovica in Veliki Otavnik Ib ter oddali prispevke za 16 zvezek zbirke *Opera Instituti Archaeologici Sloveniae*, to so: Antonio Alberti, Federico Bernardini, Vili Bukošek, Gabriella Demarchi, Katarina Čufar, Miran Erič, Andrej Gaspari, Aleksander Horvat, Jana Kolar, Bernd Kromer, Zoran Milić, Emanuela Montagnari Kokelj, Gojka Pajagič Bregar, Igor Ravbar, Matija Strlič, Tjaša Tolar, Borut Toškan, Janez Turk, Dejan Veranič in Martin Zupančič.

of the Ljubljansko barje yarn, which is c. 5100 years old and a unique find of its type and age in Slovenia.

The site Stare gmajne near Verd was populated twice, in the late 34<sup>th</sup> century BC for the first and in the second half of the 32<sup>nd</sup> century BC for the second time. Settlements were built on marshy ground, most probably on a lakeshore, which also applies to Blatna Brezovica, which dates to the beginning of the 31<sup>st</sup> century BC. We have also found out that the pile-dwelling settlement Veliki Otavnik Ib and the later settlement Stare gmajne were contemporary.

It is thus possible to insinuate that the dating is extraordinarily accurate and introduces an important step forward to precise absolute dating (one-year accuracy level) of the prehistoric settlements also in the area south of the Alps.

A basic publication of the wooden wheel with an axle, found at Stare gmajne near Verd, which are the vital parts of a wooden undercarriage of one of the oldest prehistoric carts in general, is an important contribution of these proceedings. Beside their exceptional age, the wheel and the axle are astonishingly technologically advanced, which doubtlessly confirms that a prehistoric pile-dweller was a great observer and expert of nature and environment surrounding him.

Let me summarise. Researches at Stare gmajne, Blatna Brezovica and Veliki Otavnik Ib showed, similar as sample trenching at Hočevarica and Resnikov prekop and researches of other pile-dwelling settlements of the Ljubljansko barje, that multidisciplinary research is vital in modern archaeology and it is not only a fulfilment of wishes of an individual towards a deeper understanding of problems that occur at archaeological excavation. Researches of these sites confirmed once again how little is known about a certain location, if we do not perform suitable researches and analyses on the location itself and later in laboratories. Here, I will not discuss "the most up-to-date" and "flamboyant" hypotheses, which set, still years ago settlements on dry land next to rivers and later pile-dwellings, however today only settlements on dry land next to rivers, but no pile-dwellings, which would encircle the then lake, on the damp land of the Ljubljansko barje.

Nevertheless, I am emphasizing once more, that the colleagues of the Institute of Archaeology ZRC SAZU and other scholars, which participated at the preparation of "Stare gmajne pile-dwelling settlement and its era - the Ljubljansko barje in the 2<sup>nd</sup> half of the 4<sup>th</sup> millennium BC" monograph, are well-disposed for discussion. However, we would like to hear arguments supporting a thesis and not just discussion for its own sake.

Therefore, I am delighted and honoured to have an opportunity to extend my gratitude to all those that were cooperating at the research of the pile-dwelling settlements Stare gmajne, Blatna Brezovica and Veliki Otavnik Ib and wrote the contributions for the 16 Volume

Zahvala gre tudi risarki, pripravljalki slikovnega gradiva in oblikovalki naslovnice Tamari Korošec ter Mateji Belak, ki je pripravila za tisk tabele in oblikovala zbornik.

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*Urednik zbornika, odgovorni nosilec projektov in vodja programa*

*Anton Velušček*

V Ljubljani, 2. aprila 2009

of the *Opera Instituti Archaeologici Sloveniae*: Antonio Alberti, Federico Bernardini, Vili Bukošek, Gabriella Demarchi, Katarina Čufar, Miran Erič, Andrej Gaspari, Aleksander Horvat, Jana Kolar, Bernd Kromer, Zoran Milić, Emanuela Montagnari Kokelj, Gojka Pajagič Brezar, Igor Ravbar, Matija Strlič, Tjaša Tolar, Borut Toškan, Janez Turk, Dejan Veranič and Martin Zupančič.

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*Editor, Projects and Programme Leader*

*Anton Velušček*

Ljubljana, 2<sup>nd</sup> April 2009





# 1. KOLIŠČARSKA NASELBINA STARE GMAJNE IN NJEN ČAS

Anton VELUŠČEK

# 1. STARE GMAJNE PILE-DWELLING SETTLEMENT AND ITS ERA

Anton VELUŠČEK

## Izvleček

V prispevku so predstavljeni rezultati arheološko-dendrokronoloških raziskav na koliščarskih naselbinah Stare gmajne, Blatna Brezovica in Veliki Otavnik Ib. V posebnem poglavju je tudi razprava o najdbah talilnih posod s Starih gmajn in o metalurški dejavnosti na Ljubljanskem barju.

Koliščarske naselbine Maharski prekop, Črešnja pri Bistri, Spodnje mostišče, Stare gmajne, Veliki Otavnik Ib, Blatna Brezovica in Notranje Gorice so vključene v novodefinitirano kulturno skupino Stare gmajne, ki je kronološko umeščena v čas med 36. in 31. stoletjem pr. Kr.

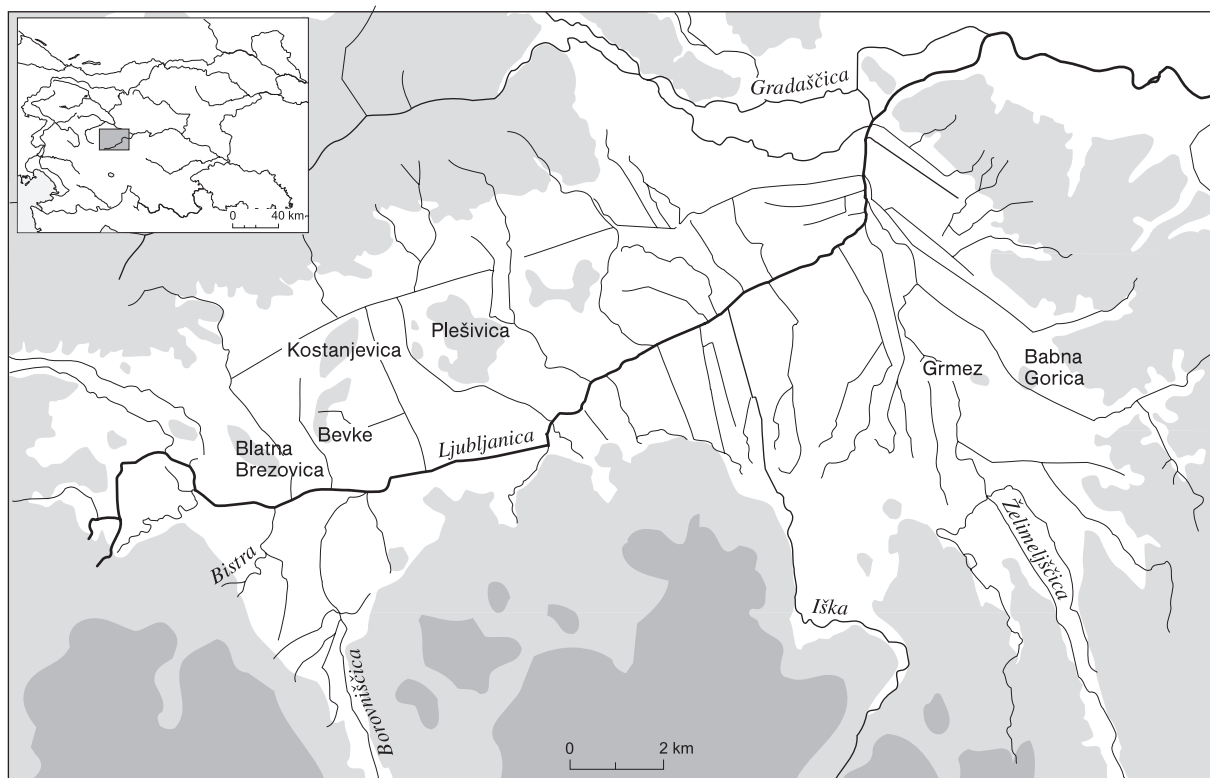
**Ključne besede:** Ljubljansko barje, Stare gmajne, Blatna Brezovica, Veliki Otavnik Ib, talilne posode in metalurgija bakra, arheološke najdbe, kulturna skupina Stare gmajne, eneolitik.

## Abstract

In this contribution, we introduce results of archaeological-dendrochronological researches at pile-dwelling settlements Stare gmajne, Blatna Brezovica and Veliki Otavnik Ib. A special chapter discusses finds of crucibles from Stare gmajne and metallurgic activity on the Ljubljansko barje.

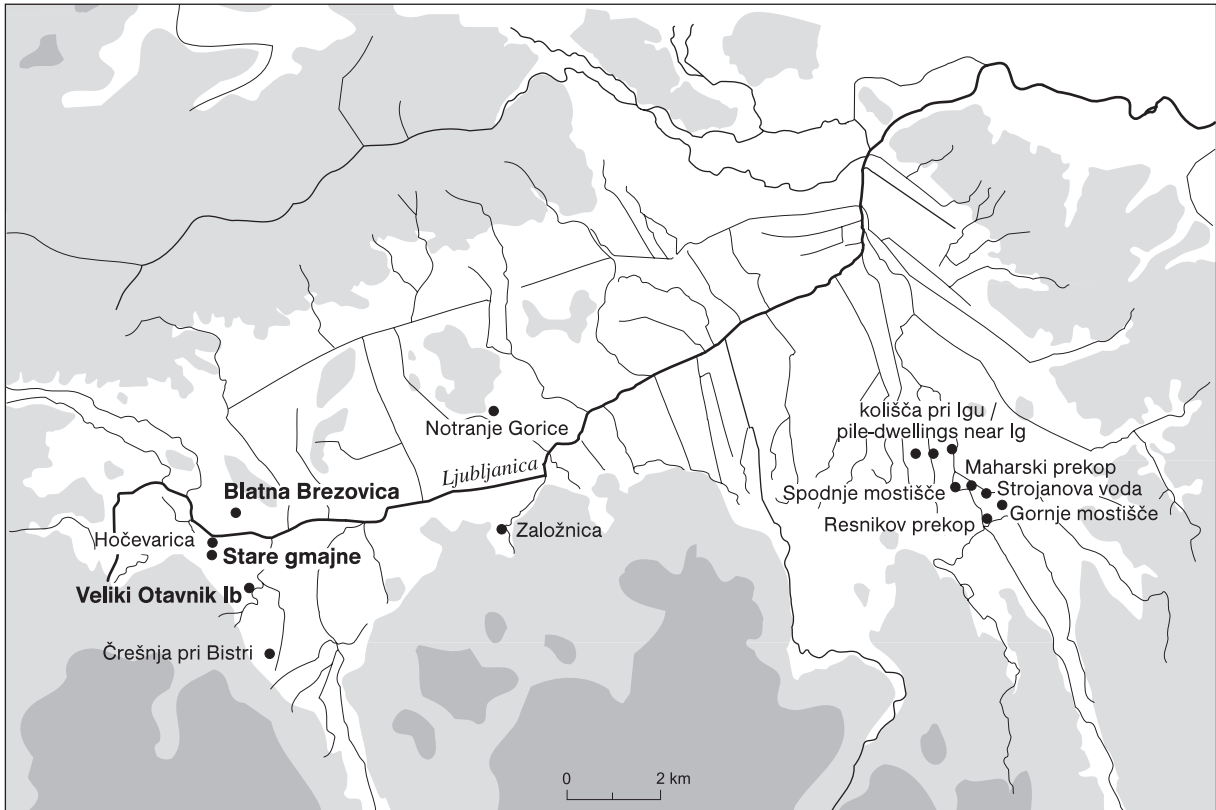
Pile-dwelling settlements Maharski prekop, Črešnja pri Bistri, Spodnje mostišče, Stare gmajne, Veliki Otavnik Ib, Blatna Brezovica and Notranje Gorice are assigned to a newly-defined Stare gmajne cultural group, dated between 36<sup>th</sup> and 31<sup>st</sup> centuries BC.

**Keywords:** the Ljubljansko barje, Stare gmajne, Blatna Brezovica, Veliki Otavnik Ib, crucibles and copper metallurgy, archaeological finds, Stare gmajne cultural group, Eneolithic.



Sl. 1.1: Ljubljansko barje.

Fig. 1.1: The Ljubljansko barje.



Sl. 1.2: V besedilu omenjene koliščarske naselbine na Ljubljanskem barju.

Fig. 1.2: The Ljubljansko barje pile-dwelling settlements, which are mentioned in text.

## 1.1 UVOD

Ljubljansko barje (*sl. 1.1*) je poplavna ravnina, ki meri približno 180 km<sup>2</sup>. Na poplavnem osredju s povprečno nadmorsko višino okoli 290 m prevladujejo travniki, nekaj je tudi gozda in njiv.<sup>1</sup> Glavna vodna žila je Ljubljanica, ki teče po sredini ravnine od jugozahoda proti severovzhodu. Pomembni vodotoki so tudi Iška, Borovniščica, Želimeljščica in Gradaščica.

Ljubljansko barje je po nastanku tektonska udorina. Kamninska osnova je zelo globoko. Iz osredja se dvigujejo osamelci Blatna Brezovica, Bevke, Kostanjevica, Plešivica, Grmez in Babna Gorica.<sup>2</sup>

Od konca ledene dobe pa vse do poznega holocena je bilo na Ljubljanskem barju jezero, ki se je skozi tisočletja postopoma krčilo.<sup>3</sup> Arheološki podatki kažejo, da njegov zadnji stadij lahko postavimo v 2. tisočletje pr. Kr., v bronzasto dobo. Okoli srede in v drugi polovici tega tisočletja se je namreč poselitvena slika popolnoma spremenila. Ljubljansko barje je najverjetneje prekrilo močvirje in nato barje. Na danes poplavni ravnini kolišč niso več

<sup>1</sup> Lovrenčak, Orožen Adamič 2001, 389.

<sup>2</sup> Pavšič 1989.

<sup>3</sup> Prim. npr. Deschmann 1875; Melik 1946; Tancik 1965; Šercelj 1966; Pavlovec 1973; Pavšič 1989; Verbič 2006; Andrič et al. 2008; Velušček, Čufar 2008.

## 1.1 INTRODUCTION

The Ljubljansko barje (*Fig. 1.1*) is a flood plain measuring c. 180 km<sup>2</sup>. Meadows, with some forest and fields, prevail on the central flood-plain with an average altitude of c. 290 m.<sup>1</sup> The main water source is the Ljubljanica, running in the southwest-northeastern direction across the middle of the plain. Also the Iška, the Borovniščica, the Želimeljščica and the Gradaščica rivers play an important role.

The Ljubljansko barje is a tectonic depression with very deep bedrock. Isolated hills rise above its central area, such as Blatna Brezovica, Bevke, Kostanjevica, Plešivica, Grmez and Babna Gorica.<sup>2</sup>

A lake existed on the Ljubljansko barje from the end of the Ice Age until the late Holocene. It was gradually withdrawing over millennia.<sup>3</sup> The archaeological records date its final stage to the 2<sup>nd</sup> millennium BC, i.e. the Bronze Age. The settlement structure completely changed in the middle and the second half of this millennium. The Ljubljansko barje was most probably covered

<sup>1</sup> Lovrenčak, Orožen Adamič 2001, 389.

<sup>2</sup> Pavšič 1989.

<sup>3</sup> E.g. Deschmann 1875; Melik 1946; Tancik 1965; Šercelj 1966; Pavlovec 1973; Pavšič 1989; Verbič 2006; Andrič et al. 2008; Velušček, Čufar 2008.



postavljali, nove naselbine so nastajale na trdinskem obrobju.<sup>4</sup>

Holocensko jezero se je torej počasi umikalo, sočasno je v zaledju nastajalo močvirje.<sup>5</sup> Na obrobju jezera so od 5. tisočletja pr. Kr. dalje gradili koliščarske naselbine. Ena izmed prvih naselbin takšnega tipa je Resnikov prekop pri Igu (*sl. I.2*). Arheološke najdbe in radiokarbonske datacije kažejo, da je kolišče živelo v drugi četrtini 5. tisočletja pr. Kr.<sup>6</sup> Po opustitvi kolišča je sledila skoraj tisočletna prekinitve v poselitvi.

V drugi četrtini 4. tisočletja pr. Kr. so nastale koliščarske naselbine horizonta keramike z brazdastim vrezom: Hočevarica,<sup>7</sup> Gornje mostišče in Strojanova voda.<sup>8</sup> Z novo poselitvijo so se pojavili tudi prvi kovinski predmeti, kot sta npr. bakreni sekiri.<sup>9</sup> Ostanki talilne posode kažejo, da so se prebivalci teh naselbin ukvarjali z metalurgijo bakra.<sup>10</sup> To je bila očitno izredno pomembna gospodarska dejavnost, saj smo podobne predmete našli tudi v nekoliko mlajši naselbini Maharski prekop.<sup>11</sup> Na metalurške pripomočke pa smo naleteli tudi na Starih gmajnah<sup>12</sup> v eni izmed naselbin, s katerimi se na Ljubljanskem barju končuje poselitveni cikel 4. tisočletja pr. Kr.

Metalurgija bakra in pozneje bronca je imela pomembno vlogo tudi v naslednjih poselitvenih ciklih, v 3. tisočletju pr. Kr.<sup>13</sup> in v prvi polovici 2. tisočletja, ko so verjetno še vedno nastajale koliščarske naselbine s t. i. pramenasto keramiko<sup>14</sup> ter tudi s kovinskimi najdbami, kot sta bodalo z območja kolišč pri Igu<sup>15</sup> in bronasta sekira z robniki iz Ljubljanice pri ustju Bistre.<sup>16</sup>

## 1.2 KOLIŠČARSKA NASELBINE STARE GMAJNE, BLATNA BREZOVICA IN VELIKI OTAVNIK Ib

### 1.2.1 STARE GMAJNE

V drugi polovici 4. tisočletja je na jugozahodu Ljubljanskega barja živela prazgodovinska naselbina Stare gmajne. Gre za kolišče razpršenega tipa,<sup>17</sup> pri katerem zahodni in vzhodni del ležita več kot 100 m narazen (*sl. I.3*).

<sup>4</sup> Velušček 2005a.

<sup>5</sup> Glej Velušček, Čufar 2008.

<sup>6</sup> Velušček 2006a.

<sup>7</sup> Velušček 2004a.

<sup>8</sup> Velušček, Čufar 2008.

<sup>9</sup> Velušček 2004b; Milič 2004; Trampuž Orel, Heath 2008.

<sup>10</sup> Velušček 2004b; Šmit 2004.

<sup>11</sup> Velušček, Greif 1998; Šmit, Nečemer 1998; za datacijo glej Velušček, Čufar 2008.

<sup>12</sup> Poglavlji 3 in 11 v tem zborniku.

<sup>13</sup> Npr. Durman 1983; Velušček, Greif 1998; Trampuž Orel, Heath 2008.

<sup>14</sup> Velušček 2004g, 79; prim. z Gaspari 2008, 57–89, t. 2: 3; 12: 1.

<sup>15</sup> Gabrovec 1983, t. 1: 6.

<sup>16</sup> Gaspari 2004, 41, sl. 6: 2.

<sup>17</sup> Poglavlje 3.3 v tem zborniku.

by marsh and later by moor. Pile-dwelling settlements were not built on a present-day flood plain any more; instead, new settlements were constructed on dry ground along the edges of the moor.<sup>4</sup>

Holocene lake was slowly withdrawing and transforming into marsh.<sup>5</sup> Pile-dwelling settlements start to occur along the edges of the lake from the 5<sup>th</sup> millennium BC onward. The pile-dwelling settlement at Resnikov prekop near Ig is chronologically the oldest (*Fig. I.2*). Archaeological finds and radiocarbon dates indicate that the pile-dwelling existed in the second quarter of the 5<sup>th</sup> millennium BC.<sup>6</sup> After the abandonment of Resnikov prekop, the Ljubljansko barje stayed unoccupied for about 1000 years.

In the second quarter of the 4<sup>th</sup> millennium BC, pile-dwelling settlement of the horizon of pottery with furrowed incisions occur: Hočevarica,<sup>7</sup> Gornje mostišče and Strojanova voda.<sup>8</sup> The first metal objects, such as two copper axes, start to appear with this settlement phase.<sup>9</sup> Remains of crucible indicate that the inhabitants were engaged in copper metallurgy.<sup>10</sup> This was obviously an extremely important economic activity, as analogous objects have also been found at the somewhat later settlement at Maharski prekop.<sup>11</sup> Metallurgic implements were also found at Stare gmajne,<sup>12</sup> which is one of the settlements dating to the last stage of the 4<sup>th</sup> millennium BC settlement cycle on the Ljubljansko barje.

Copper and later bronze metallurgy also played an important part in the settlement cycles of the 3<sup>rd</sup> 13 and in the first half of the 2<sup>nd</sup> millennium BC; pile-dwelling settlements containing so-called Litzen pottery<sup>14</sup> and metal finds, such as a dagger from the Ig pile-dwellings<sup>15</sup> and a bronze flanged axe, found in the Ljubljanica at the outflow of the Bistra river,<sup>16</sup> occur in this period.

## 1.2 PILE-DWELLING SETTLEMENTS STARE GMAJNE, BLATNA BREZOVICA AND VELIKI OTAVNIK Ib

### 1.2.1 STARE GMAJNE

<sup>4</sup> Velušček 2005a.

<sup>5</sup> See Velušček, Čufar 2008.

<sup>6</sup> Velušček 2006a.

<sup>7</sup> Velušček 2004a.

<sup>8</sup> Velušček, Čufar 2008.

<sup>9</sup> Velušček 2004b; Milič 2004; Trampuž Orel, Heath 2008.

<sup>10</sup> Velušček 2004b; Šmit 2004.

<sup>11</sup> Velušček, Greif 1998; Šmit, Nečemer 1998; for dates see Velušček, Čufar 2008.

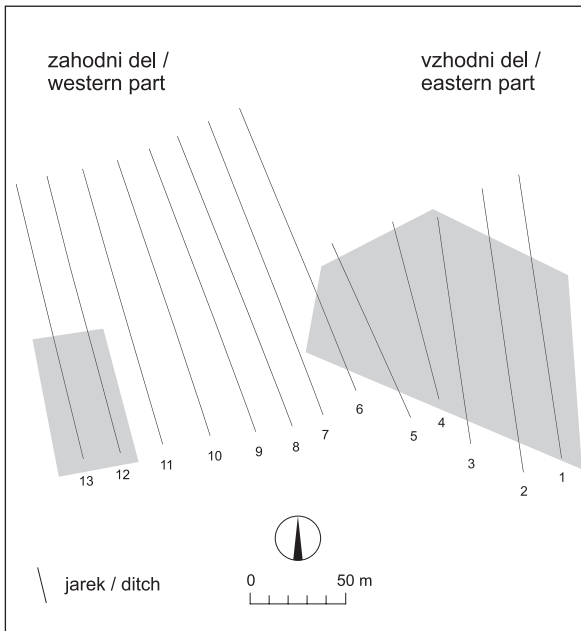
<sup>12</sup> See Chapters 3 and 11 in this monograph.

<sup>13</sup> E.g. Durman 1983; Velušček, Greif 1998; Trampuž Orel, Heath 2008.

<sup>14</sup> Velušček 2004g, 79; compare with Gaspari 2008, 57–89, Pls. 2: 3; 12: 1.

<sup>15</sup> Gabrovec 1983, Pl. 1: 6.

<sup>16</sup> Gaspari 2004, 41, Fig. 6: 2.



Sl. 1.3: Koliščarska naselbina Stare gmajne z njenim zahodnim in vzhodnim delom. Risba: T. Korošec.

Fig. 1.3: The pile-dwelling settlement Stare gmajne with its western and eastern part. Drawn by: T. Korošec.

Na podlagi dendrokronoloških raziskav nam je uspelo sestaviti eno hrastovo in dve jesenovi kronologiji.<sup>18</sup> Mlajši del radiokarbonsko datirane hrastove kronologije SG-QUSP1 kaže, da je bilo skoraj celotno območje intenzivno poseljeno več kot 50 let in da so se gradbene aktivnosti končale leta  $3109 \pm 12$  pr. Kr., kot kaže jesenova kronologija SG-FRSP1, pa celo nekaj let po tem, torej skoraj sočasno kot na 1 km oddaljeni naselbini Veliki Otavnik Ib.<sup>19</sup>

Manjše število dendrokronološko sinhroniziranih hrastovih vzorcev iz sonde 3 ter jarkov 12 in 13 tudi nakazuje, da je v drugi polovici 34. stoletja pr. Kr. na zahodnem delu Starih gmajn že obstajala manjša naselbina, ki je bila postavljena potem, ko je bila poselitev na kolišču Spodnje mostišče na drugem koncu Ljubljanskega barja že končana (sl. 1.2).

Na podlagi vzorcev sinhroniziranih v hrastovi kronologiji SG-QUSP1 s Starih gmajn smo dobili tudi vpogled, kje in kdaj so se izvajale gradbene aktivnosti. Naselbina ni bila postavljena naenkrat, temveč se je njen tloris skozi čas spreminjal. Poseljena je bila na vzhodnem in tudi zahodnem delu (glej sl. 1.3).

Natančna analiza lesa navpičnih kolov je pokazala, da so koliščarji na Starih gmajnah za nosilne kole največkrat uporabljali les jesena in hrasta, sledijo les topola, bukve, jelše in javorja. Med navpičnimi koli so z več kot 60 % prevladovali tisti s premerom od 6 do 12 cm. Približno 20 % jih je imelo premer od 12,5 do

In the second half of the 4<sup>th</sup> millennium, a prehistoric settlement Stare gmajne stood on the south-western part of the Ljubljansko barje. It is a pile-dwelling of a dispersed type,<sup>17</sup> composed of western and eastern part, located more than 100 m apart from one another (Fig. 1.3).

Based on dendrochronological researches, we constructed one oak and two ash chronologies.<sup>18</sup> The later part of the SG-QUSP1 oak chronology indicates that almost the entire area was intensely populated for more than 50 years and that building activities ended in  $3109 \pm 12$  BC or perhaps even a few years later as remitted by the SG-FRSP1 chronology, and almost simultaneously with the settlement Veliki Otavnik Ib, situated 1 km away.<sup>19</sup> Smaller number of dendrochronologically dated oak samples from trench 3 and ditches 12 and 13 also remit that a settlement existed on the western part of Stare gmajne in the second half of the 34<sup>th</sup> century. It was probably constructed after the pile-dwelling Spodnje mostišče, located on the south-eastern part of the Ljubljansko barje (Fig. 1.2), was abandoned.

Based on samples, cross-dated in the Stare gmajne SG-QUSP1 oak chronology, we also obtained information on where and when the building activities were taking place. The settlement was not constructed at once. Instead, its ground plan was changing in time. Activities within the settlement were taking place in its eastern as well as in its western part (see Fig. 1.3).

Precise analysis of vertical piles also showed that ash and oak wood were used most often for foundation piles at Stare gmajne, followed by poplar, beech, alder and maple. Over 60 % of vertical piles had a diameter of 6–12 cm. C. 20 % had a diameter of 12.5–22 cm and less than 10 % had a diameter from 23–40 cm or under 6 cm. Piles with larger diameters were generally cleaved. Wood with c. 20–50 annual rings (c. 60 %) was most regularly used for construction. Wood with more than 50 annual rings (c. 30 %) or with less than 20 annual rings (c. 10 %) was not used as often.

Generally, trunks had less than 50 annual rings, except for oak piles from older trees, which were mainly driven into ground on the eastern part of the settlement, especially in ditch 1 and trench 2, and in ditches 2–5, which contain a high percentage of cleaved piles. On the contrary, it seems that they used thinner and younger trees on the western part of the settlement. They had to cleave trunks of larger older trees in order to use them as piles. Another characteristic of this site are clusters of piles from different species of wood, which perhaps indicates that, at least in some cases, they were felled and used all at once. The latter can especially be claimed for alder, poplar and fir piles.

<sup>17</sup> See Chapter 3.3 in this monograph.

<sup>18</sup> See Chapter 7 in this monograph.

<sup>19</sup> See Chapter 6 in this monograph.

<sup>18</sup> Poglavje 7 v tem zborniku.

<sup>19</sup> Poglavje 6 v tem zborniku.

22 cm, manj kot 10 % pa premer od 23 do 40 cm ali pod 6 cm. Koli večjih premerov so bili praviloma klani. Za gradnjo je bil večinoma uporabljen les iz dreves z okoli 20–50 branikami (približno 60 %), manj pa les iz dreves z več kot 50 branikami (približno 30 %) ali z manj kot 20 branikami (približno 10 %).

Debla so torej v splošnem imela manj kot 50 branik, razen pri hrastu, kjer so kole iz starejših dreves v glavnem zabijali na vzhodnem delu naselbine, predvsem na območju jarka 1 in sonde 2, ter v jarkih 2–5, kjer je bil najden tudi velik delež klanih kolov. Nasprotno pa se zdi, da so na zahodu naselbine posegali po tanjših in mlajših drevesih, tudi hrastovih. Debla večjih starejših dreves so namreč morali razklati, kadar so jih uporabili za kole. Značilno je tudi, da so nekateri koli iz drugih vrst lesa razporejeni po skupinah, kar vsaj v nekaterih primerih morda kaže, da so jih posekali in uporabili sočasno. Slednje še posebej lahko trdimo za kole iz lesa jelše, topola in jelke.

Kot že omenjeno, je bilo v drugi polovici 4. tisočletja na Ljubljanskem barju še vedno jezero. Tezo potrjuje tudi izbira lokacije za koliščarsko naselbino Stare gmajne. Sedimentološka raziskava in analiza diatomej kažeta,<sup>20</sup> da je bilo v obdobju pred nastankom naselbine območje Starih gmajn zalito z jezerom, ki je bilo sicer plitvo in verjetno že deloma poraščeno z močvirskim rastlinstvom. V obdobju, ko je bila postavljena naselbina, pa so bile okoljske razmere že nekoliko drugačne. Kolišče je bilo postavljeno v močvirsko oz. barjansko okolje približno 600–750 m od trdinskega obrobja, kar nakazuje, da je naselbina zelo verjetno stala tik ob ali v neposredni bližini jezera. Nedaleč proč od naselbine pa se je v jezero izlivala tudi predhodnica današnje Ljubljanice.

Na povezavo med naselbino in umikajočim se jezerom kažejo tudi dendrokronološke raziskave. Najstarejši del naselbine oz. poselitev območja je dokumentirana na zahodnem delu, ki je bližje trdini, medtem ko je na vzhodnem delu v smeri proti središču Ljubljanskega barja, po teoriji v smeri proti središču jezera, dokumentirana mlajša poselitvena faza.<sup>21</sup>

Koliščarska naselbina Stare gmajne je zbudila veliko zanimanje strokovne in tudi nestrokovne javnosti predvsem zaradi izjemnih najdb: lesenega kolesa in osi,<sup>22</sup> dveh drevakov,<sup>23</sup> sekire iz žada ali eklogita,<sup>24</sup> ostankov preje,<sup>25</sup>

As mentioned before, the Ljubljansko barje had still been a lake in the second half of the 4<sup>th</sup> millennium. This thesis is furthermore confirmed by the choice of location of the pile-dwelling settlement Stare gmajne.

Based on a sedimentological research and an analysis of diatoms,<sup>20</sup> we assume that the studied area of Stare gmajne was a shallow-water lake with some parts probably covered in marsh flora.

Environmental circumstances were somewhat different in the time when the settlement was constructed. The pile-dwelling was erected in marshy or moor environment, c. 600–750 m from the fringe's solid ground, which suggests that the settlement very probably stood right next to or in the direct vicinity of the lake. Moreover, a river, predecessor of present-day Ljubjanica, was inflowing into the lake in close proximity of the settlement.

Connection between the settlement and withdrawal of the lake can also be seen in dendrochronological research. The earliest western part of the settlement is documented closer to the solid ground. Moreover, the later settlement phase is documented eastwards from the earlier settlement, which is, according to theory, the direction towards the lake at the centre of the Ljubljansko barje.<sup>21</sup>

The pile-dwelling settlement Stare gmajne evoked a great deal of amateur and scientific interest, mostly because of exceptional finds: a wooden wheel and its axle,<sup>22</sup> two logboats,<sup>23</sup> flat axe made of jade or eclogite,<sup>24</sup> remains of yarn,<sup>25</sup> children's bow<sup>26</sup> and of metallurgic implements: one stone and several clay crucibles<sup>27</sup> (Figs. 1.5, 1.6).<sup>28</sup>

We presume, based on analyses, that the wooden wheel and its axle were contemporary with the settlement and that the cart, parts of which were discovered, was made and used in the period of the later settlement phase. Radiometric dates and dendrochronological researches indicate that this was some decades *prior* to c. 3109 ± 12 BC or even a few years later.<sup>29</sup>

Discovery of undercarriage of a prehistoric cart is exceptional for more than one reason. It appears that these are the remains of an undercarriage of a two-wheeled cart or a handcart. The hub is rectangular, which indicates that the wheel and its axle turned simultaneously. This type of cart was suitable for hilly

<sup>20</sup> See Chapter 2 in this monograph.

<sup>21</sup> See Chapter 7 in this monograph.

<sup>22</sup> See Chapter 8 in this monograph.

<sup>23</sup> See Chapter 9 in this monograph.

<sup>24</sup> See Chapters 3 and 12 in this monograph.

<sup>25</sup> See Chapter 15 in this monograph.

<sup>26</sup> See Chapters 3 and 10 in this monograph.

<sup>27</sup> It is not yet known whether these are crucibles or moulds (e.g. Velušček 2008a; 2008b). The interpretation is not easy. Good comparison for the crucible from Stare gmajne is known from the Boleráz group site at Lánycsók in Hungary, which is interpreted as a crucible (Ecsedy 1977, 163, Pls. 11: 4; 12: 1; 1990, Fig. 6) or mould (Durman 2000, 95).

<sup>28</sup> See also Chapters 3 and 11 in this monograph.

<sup>29</sup> See Chapter 7.1.2 in this monograph.

<sup>20</sup> Poglavje 2 v tem zborniku.

<sup>21</sup> Glej poglavje 7 v tem zborniku.

<sup>22</sup> Poglavje 8 v tem zborniku.

<sup>23</sup> Poglavje 9 v tem zborniku.

<sup>24</sup> Poglavji 3 in 12 v tem zborniku.

<sup>25</sup> Poglavje 15 v tem zborniku.

otroškega loka<sup>26</sup> in metalurških pripomočkov: kamnita in več glinastih talilnih posod<sup>27</sup> (sl. I.5, I.6).<sup>28</sup>

Na podlagi analiz ugotovljamo, da leseno kolo in os sodita k naselbini in da je bil voz, čemur sta služili najdbi, narejen ter v uporabi v obdobju mlajše faze poselitve. Radiometrične datacije in dendrokronološke raziskave kažejo, da se je to dogajalo v desetletjih pred letom 3109 ± 12 pr. Kr. oz. nekaj let po tem letu.<sup>29</sup>

Najdba podvozja prazgodovinskega voza je izjemna iz več vidikov. Najprej se zdi, da lahko govorimo o ostankih podvozja dvokolesnega voza oz. neke vrste cize. Slednje dokazujeta pesto štirikotne oblike in os, ki se je ob uporabi vrtela skupaj s kolesom. Uporaba vozov te vrste naj bi bila primernejša za hribovito pokrajino, kamor nedvomno sodi tudi zaledje ojezerjenega Ljubljanskega barja.<sup>30</sup>

Verjetno najpomembnejša pa je tehnološka dovršenost najdbe, ki je razvidna iz izbire lesa, orientacije sestavnih delov do številnih tehniških detajlov. Prazgodovinsko kolo s Starih gmajn je bilo narejeno kot poln disk s pestom štirikotne oblike. Disk je bil sestavljen iz dveh desk, ki sta širinsko spojeni s štirimi grebenastimi letvami. Deski sta iz jesenovega lesa (*Fraxinus excelsior*) s širokimi branikami iz debla premera nad 40 cm in starosti več kot 80 let. Deblo je bilo iz drevesa večjih dimenzij. Iz debla so izdelali dve deski za obe polovici kolesa. Večja deska je bila bliže strženu, vendar ni vsebovala stržena in branik neposredno ob njem. Manjša deska je bila v drevesu bolj oddaljena od stržena, zato pri njej radialna orientacija prehaja v tangencialno. Pri tem so upoštevali splošno znano pravilo, po katerem so dimenzijsko najstabilnejše radialne deske brez stržena in juvenilnega lesa okoli njega.

Glede na razpoložljivo prazgodovinsko tehnologijo so desko iz debla zelo verjetno dobili s cepljenjem in tesanjem. Za izdelavo kolesa so potrebovali približno 80 cm dolg kos hloda z lesom brez rastnih napak. Iz njega so nato odcepili dve deski debeline nad 6 cm. Ker je kolo izdelano iz dveh desk, je bila pomembna obdelava robov, saj so ju širinsko topo spojili. Nato so izdelali štiri lastovičje utore trapezoidne oblike, ki so se izmenoma nekoliko zožali od leve proti desni oz. od desne proti levi. Tako so se izmenjevali utori, ki so imeli ožji del na levi in desni strani.

V utore so zabili enakomerno široke hrastove letve, ki so se v ožjem delu utora zagozdile. Tako izdelana lastovičja vez je omogočila, da sta bili deski trdno

<sup>26</sup> Poglavji 3 in 10 v tem zborniku.

<sup>27</sup> Ali gre za talilne posode ali kalupe, še ni povsem ugotovljeno (npr. Velušček 2008a; 2008b). Opredelitev očitno ni tako enostavna. Dobro analogijo za glinasto talilno posodo s Starih gmajn poznamo z najdišča boleraške skupine Lánycsók na Madžarskem, ki jo interpretirajo kot talilno posodo (Ecsedy 1977, 163, t. 11: 4; 12: 1; 1990, sl. 6) ali kot kalup (Durman 2000, 95).

<sup>28</sup> Glej še poglavji 3 in 11 v tem zborniku.

<sup>29</sup> Glej poglavje 7.1.2 v tem zborniku.

<sup>30</sup> Glej Schlichtherle 2002.

lands.<sup>30</sup> The hinterland of the Ljubljansko barje, where the lake still existed at that time, doubtlessly belongs to this category.

Nevertheless, the biggest value of this find is that it is technologically advanced, which was achieved with the choice of wood, orientation and handling of the wood and numerous technological details. The prehistoric wheel from Stare gmajne was made as a disc with a rectangular central opening for the hub. The disc was made of two planks joined (tongue-and-groove joint) with four battens. Planks are made of ash (*Fraxinus excelsior*) with wide annual rings, of trunk of over 40 cm in diameter and over 80 years old. The trunk belonged to a large tree. The same trunk was used to make both wheel planks. The larger one was closer to the pith, but it did not contain the pith and annual rings next to it. The smaller plank was cut further away from the pith, and that is why its radial orientation switches from radial to tangential. They followed a general rule, according to which radial planks without the pith and juvenile wood around it are dimensionally the most stable.

Considering the available prehistoric technology, the plank was most probably made by splitting (cleaving) and hewing. A c. 80 cm long piece of logwood without growth anomalies was needed for making the wheel. Two planks over 6 cm thick were then split off the log. As the wheel has been made of two planks, the handling of edges was important, because they were horizontally tongue-and-groove spliced. Then four trapezoidal-shaped dovetail grooves were made, alternating in narrowness from left to right or from right to left. As a result, grooves with narrower left and right sides were alternating.

Evenly wide battens were then fitted into the grooves. They were wedged into narrower parts of grooves. Dovetail grooves allowed solid splicing of the planks, in spite of expected contraction and swelling of wood.

The function of the four oak battens was connecting the planks. Moreover, strength of the wheel depends upon the quality of making of grooves and battens, of fitting and insertion of them.

Similar to some of the other prehistoric wheels from central Europe, also the wheel from Stare gmajne was scorched. People were scorching wood in the past to harden it and to protect it against some pests.<sup>31</sup>

A c. 125 cm long axle is entirely preserved. An axle is a bar for a rotating wheel. In this case, the wooden bar is straight and symmetrical, with a circular cross-section and rectangular terminals. The axle from Stare gmajne is made of a single piece of oak wood (*Quercus* sp.). They used a piece of straight trunk without knurs or other anomalies with a diameter of at least 20 cm.

Both end pieces have wedges fixed into the axle. They are also made of oak wood. The wheel was perhaps

<sup>30</sup> See Schlichtherle 2002.

<sup>31</sup> Schlichtherle 2002, 20.



spojeni navkljub pričakovanemu delovanju lesa. Vloga štirih grebenastih letev je torej povezovanje desk. Od kakovosti izdelave utorov in letev, njihovega prileganja in namestitve je odvisna tudi trdnost kolesa.

Podobno kot nekatera druga prazgodovinska kolesa iz Srednje Evrope je bilo tudi kolo s Starih gmajn namen-sko ožgano. Po navedbah<sup>31</sup> so v preteklosti les ožigali za povečanje trdote in zaščito pred nekaterimi škodljivci.

Približno 125 cm dolga os je ohranjena v celoti. Po definiciji je os drog, ki prenaša vrtenje. V našem primeru gre za lesen simetrično izdelan raven drog okroglega in na koncih štirikotnega preseka. Os s Starih gmajn je izdelana iz enega kosa hrastovega lesa (*Quercus* sp.). Očitno so v ta namen uporabili kos ravnega debla brez grč in drugih napak premera vsaj 20 cm.

Na obeh koncih so v os zabite zagozde. Tudi te so iz hrastovega lesa. Na enem izmed koncev se je kolo očitno snemalo, in je bila pozneje zabita manjša trska oz. zagozda iz jesenovega lesa.

Naslednji pomembni najdbi s Starih gmajn sta dva drevaka, oba narejena iz hrastovih debel.<sup>32</sup> V obeh je ohranjena prečna ojačitev. Drevak iz jarka 4 ima v ojačitev izdolben utor za leseno pregradno desko.

Na drevakih sta bili opravljeni tudi dendrokronološki raziskavi, ki sta potrdili predpostavko o sočasnosti drevakov in nasebine Stare gmajne. Drevak iz jarka 4 je iz začetnega obdobja mlajše poselitvene faze, medtem ko je drevak iz jarka 1 iz sklepnega obdobja poselitve v nasebini. Čolna torej datirata v 32. stoletje pr. Kr. Ugotovitev je pomembna tudi zato, ker med datiranimi drevaki z Ljubljanskega barja prevladujejo taki iz mlajših arheoloških obdobj, od koliščarskih pa so bili v zadnjem času najdeni le trije – dva od njih sta obravnavana drevaka s Starih gmajn.

Zanimiva najdba s Starih gmajn je tudi otroški lok, ki je bil najden v sondi 2 in se je ohranil skoraj v celoti. Dolžina znaša približno 64 cm. Na enem koncu je dobro viden utor za tetivo. Preiskava lesa je pokazala, da je bil narejen iz grčave tisine veje.<sup>33</sup>

Gre za drugi lok z Ljubljanskega barja. Lok s Hočevarice je daljši, saj meri v dolžino približno 122 cm in je izdelan kakovostneje.<sup>34</sup> Po Junkmannsovi klasifikaciji<sup>35</sup> sodi daljši lok v skupino lokov za mladostnike, medtem ko je lok s Starih gmajn tipičen primerek t. i. otroških lokov – je kratek in narejen iz veje slabše kakovosti. Namenjen naj bi bil igri.<sup>36</sup>

K lokom sodijo tudi kamnite puščične osti. Lepo število smo jih našli v sondi 2. Pojavljata se dva tipa: s kratkim pecljem in brez peclja.<sup>37</sup>

falling off the axle on one end so it had a smaller ash wood wedge added later.

Two logboats, both made of oak trunks, are also important finds from Stare gmajne.<sup>32</sup> Transverse reinforcements are preserved on both logboats. The logboat from ditch 4 has a groove carved into the reinforcement, perhaps to fix a partition plank.

Dendrochronological analyses confirmed that the two logboats were made and used in time of existence of the settlement Stare gmajne. The logboat from ditch 4 dates to the initial period of the last settlement phase, while the logboat from ditch 1 dates to the end of the last settlement phase. Both logboats date to the 32<sup>nd</sup> century BC. This is important, because most of the dated logboats from the Ljubljansko barje are younger. Only three pile-dwelling logboats have recently been discovered on the Ljubljansko barje – two of them are the logboats from Stare gmajne.

Another interesting find from Stare gmajne is a children's bow, found in trench 2 and almost entirely preserved. It is c. 64 cm long. String nock is clearly visible on one end. Analysis of wood showed that it was made of a yew branch with knurs.<sup>33</sup>

This is the second bow that was found at the Ljubljansko barje. Bow from Hočevarica is longer, measuring c. 122 cm in length and it is of a good quality.<sup>34</sup> According to Junkmanns classification<sup>35</sup> the longer bow belongs to a group of bows for adolescents, while the bow from Stare gmajne is a typical example of a so-called children's bow – it is short and made of a poor quality branch. It was used in play.<sup>36</sup>

Stone arrowheads were used with bows. A great number of them were found in trench 2. Two types occur: with a short tang and without a tang.<sup>37</sup>

In order to understand activities at the Ljubljansko barje during the 2<sup>nd</sup> half of the 4<sup>th</sup> millennium BC, analyses of stone axes, conducted by colleagues from the University of Trieste, are also important.<sup>38</sup> Let us mention the ones that came to the Ljubljansko barje from distant areas. In ditch 12 a smaller flat axe, made of jade or eclogite, was discovered. It originates from north-western Italy. Raw material of almost 1 kg heavy stone shaft-hole axe also originates from a distant area, probably from the Eastern Alps. Remains of a handle made of cornel (*Cornus* sp.) were found in a shaft-hole of this axe. Cornel wood has a high density, up to 1000 kg/m<sup>2</sup> and is consequently hard, solid, and strong. These properties are optimal for wood intended to be used for

<sup>31</sup> Schlichtherle 2002, 20.

<sup>32</sup> Poglavlje 9 v tem zborniku.

<sup>33</sup> Poglavlje 10 v tem zborniku.

<sup>34</sup> Velušček 2004b, 41–44.

<sup>35</sup> Junkmanns 1999.

<sup>36</sup> Velušček 2004b, 44 in poglavje 3 v tem zborniku.

<sup>37</sup> Glej poglavje 3 v tem zborniku: *sl.* 3.34.

<sup>32</sup> See Chapter 9 in this monograph.

<sup>33</sup> See Chapter 10 in this monograph.

<sup>34</sup> Velušček 2004b, 41–44.

<sup>35</sup> Junkmanns 1999.

<sup>36</sup> Velušček 2004b, 44 and Chapter 3 in this monograph.

<sup>37</sup> See Chapter 3 in this monograph: *Fig.* 3.34.

<sup>38</sup> See Chapter 12 in this monograph.

Za razumevanje dogajanja na Ljubljanskem barju v 2. polovici 4. tisočletja pr. Kr. so zelo pomembne tudi analize kamnitih sekir, ki so jih opravili kolegi s tržaške univerze.<sup>38</sup> Med sekirami omenimo tiste, ki so na Ljubljansko barje prišle od zelo daleč. V jarku 12 je bila najdena manjša ploščata sekira, ki je narejena iz žada ali eklogita. Njen izvor je iskati v severozahodni Italiji. Od daleč, verjetno z območja vzhodnih Alp, izvira tudi surovina za skoraj 1 kg težko kladivasto sekuro na uho, v kateri je bilo fragmentarno ohranjeno toporišče iz lesa dreva (*Cornus* sp.). Ker gre za les z visoko gostoto, do 1000 kg/m<sup>3</sup>, ki je posledično trden, trd in žilav, se zdi takšna izbira toporišča optimalna. Zaradi fine teksture in visoke gostote ga je tudi mogoče zelo gladko obdelati.<sup>39</sup>

Kot kaže analiza surovinske sestave žrnelj, prevladujejo orodja iz kremenovega peščenjaka in konglomerata.<sup>40</sup> Nahajališča takšnih kamnin so v hribovskih in neposredni bližini Ljubljanskega barja.

Zelo zanimiva je tudi analiza orodij iz kosti, rogovij in zob, ki kaže, da so koliščarji s Starih gmajn kot surovino preferenčno uporabljali kosti lovnih živali. Za izdelavo šil oz. bodal so uporabljali predvsem komolčnice in dlančnice/stopalnice. Razmeroma veliko število je tudi (pol)izdelkov iz rogovja, saj je bilo rogovje v prazgodovini zelo cenjena surovina.<sup>41</sup>

Pomembna najdba so tudi ostanki preje, ki so bili odkriti v sondi 2.<sup>42</sup> Gre za zelo kakovostno prejo organskega izvora, verjetno spredeno iz vlaken, ki jih najdemo v semenih in steblih rastlin iz družine trav (*Poaceae*).

Med najdbami s Starih gmajn je veliko keramike, pa tudi predmetov iz nežgane gline: talilna posoda, več fragmentov talilnih posod in votla utež.<sup>43</sup>

Prevladuje keramika temnosivih barvnih tonov, svetlosive ali barvno svetlejšje keramike je malo. Je krhka, ob dotiku se rada lomi. Po obliki smo jo razdelili na posodje<sup>44</sup> in na posebne oblike.<sup>45</sup>

### 1.2.1.1 STARE GMAJNE IN METALURGIJA BAKRA

Najdbe kažejo, da so se na Starih gmajnah ukvarjali tudi z metalurgijo bakra. Dve celi talilni posodi (sl. 1.5, 1.6) in več fragmentov drugih talilnih posod<sup>46</sup> je bilo najdenih v sondi 3 in v jarku 13, odsek 24 (sl. 1.4).

Natančna stratigrafska lega je dokumentirana za najdbe iz sonde 3, kjer ugotavljamo, da izvirajo iz plasti tik nad gytjto, iz režnjev 7, 6 in iz spodnjega dela režnja 5,

<sup>38</sup> Poglavlje 12 v tem zborniku.

<sup>39</sup> Poglavlje 10 v tem zborniku.

<sup>40</sup> Poglavlje 13 v tem zborniku.

<sup>41</sup> Poglavlje 14 v tem zborniku.

<sup>42</sup> Poglavlje 15 v tem zborniku.

<sup>43</sup> Poglavlje 3.2.1 v tem zborniku.

<sup>44</sup> Lonci, vrči/amfore, kupe, skleda, skodele in viseče posode.

<sup>45</sup> Zajemalke in vretenca.

<sup>46</sup> Poglavlje 3 v tem zborniku: npr. t. 3.19: 13,14.

the handle of a tool. It can be worked very smoothly due to its fine texture and high density.<sup>39</sup>

The analysis shows that quartz sandstone and conglomerate querns prevail.<sup>40</sup> Deposits of such rocks can be found on hills in the direct vicinity of the Ljubljansko barje.

Analysis of bone, antler and teeth artefacts found at Stare gmajne also proved to be very interesting; pile-dwellers preferentially used bones of hunting animals as raw material. Awls and daggers were mostly made of ulnae, metacarpals/metatarsals. A comparatively large number of antler (part-finished) products have also been found, as antler was much appreciated raw material in prehistory.<sup>41</sup>

Remains of yarn, discovered in trench 2, are another important find.<sup>42</sup> It is a high-quality yarn of organic origin, probably spun from fibres found in seeds and stems of plants belonging to the family of grasses (*Poaceae*).

A lot of pottery has been discovered at Stare gmajne. In addition, products made of unfired clay occur: an entirely preserved crucible, fragments of several other crucibles and a hollow weight.<sup>43</sup>

Dark grey pottery prevails. There is only a small amount of light grey and light-coloured pottery. Pottery is fragile and breaks easily. Pottery finds were divided into vessels<sup>44</sup> and special shapes.<sup>45</sup>

### 1.2.1.1 STARE GMAJNE AND COPPER METALLURGY

Finds indicate that the pile-dwellers from Stare gmajne were engaged in copper metallurgy. Two entirely preserved crucibles (Figs. 1.5, 1.6) and several fragments of crucibles<sup>46</sup> were discovered in trench 3 and in ditch 13, section/sector 24 (Fig. 1.4).

Accurate stratigraphic position is documented for finds from trench 3, which originate from a layer just above gytia, from deepening 7, 6 and from the lower part of deepening 5, i.e. between 288.85 m and 289.09 m.<sup>47</sup> Stone crucible, made of quartz-feldspathic siltite,<sup>48</sup> was discovered in the southern cross-section of trench 3, at the bottom of the cultural layer at z = 288.85 m a.s.l. (Fig. 1.7).<sup>49</sup>

<sup>39</sup> See Chapter 10 in this monograph.

<sup>40</sup> See Chapter 13 in this monograph.

<sup>41</sup> See Chapter 14 in this monograph.

<sup>42</sup> See Chapter 15 in this monograph.

<sup>43</sup> See Chapter 3.2.1 in this monograph.

<sup>44</sup> Pots, pitchers/amphorae, goblets, dishes, bowls and hanging vessels.

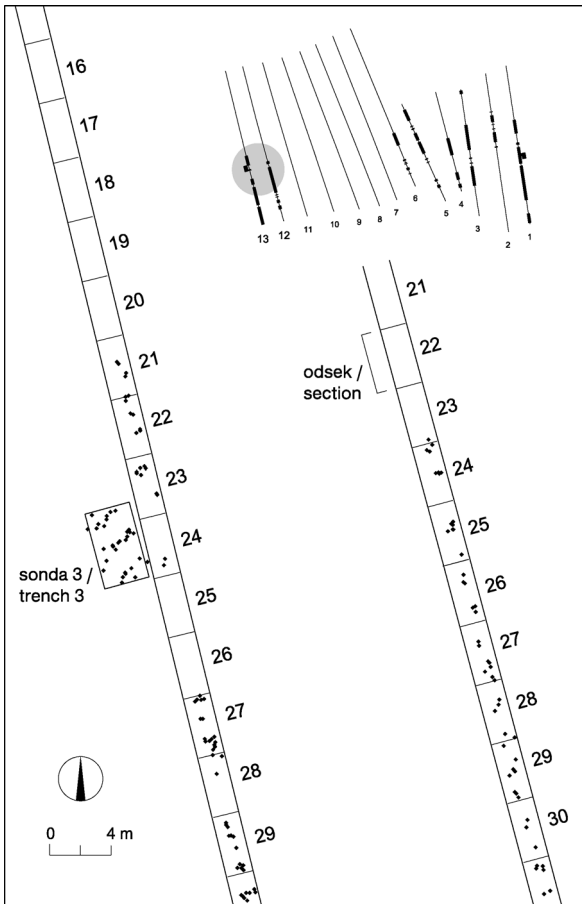
<sup>45</sup> Ladles and spindle whorls.

<sup>46</sup> See Chapter 3 in this monograph, e.g. Pl. 3.19: 13,14.

<sup>47</sup> See Chapter 3.1.2.3 in this monograph.

<sup>48</sup> See Chapter 12 in this monograph.

<sup>49</sup> See also Chapter 3.2.2.2 in this monograph: Fig. 3.39.



Sl. 1.4: Načrt naselbine Stare gmajne s podrobno prikazano situacijo na območju okoli sonde 3, kjer so posebej poudarjeni vertikalni koli. Odvodni jarek 14, prvi jarek zahodno od jarka 13, ni označen, ker v njem ni bilo arheoloških najdb in vertikalnih kolov. Risba: T. Korošec.

Fig. 1.4: Plan of the settlement Stare gmajne with detail of the area around trench 3, where vertical piles are shown in bold. Irrigation ditch 14, the first ditch westwards from ditch 13, is not marked, as it was archaeologically empty. Drawn by: T. Korošec.

tj. med višinama 288,85 m in 289,09 m.<sup>47</sup> Kamnita talilna posoda, narejena iz kremenasto glinastega muljevca,<sup>48</sup> je bila odkrita v južnem profilu sonde 3 na dnu kulturne plasti pri  $z = 288,85$  m nad morjem (sl. 1.7).<sup>49</sup>

V sondi 3 je kulturna plast zelo plastovita, kar je razvidno iz severnega dela vzhodnega profila.<sup>50</sup> Plastovitost je morda posledica njenega daljšega nastajanja. Spodnji del kulturne plasti torej lahko sodi v obdobje starejše faze poselitve, zgornji del pa se je hipotetično lahko nalagal v obdobju mlajše poselitvene faze.

Vsi natančno dokumentirani metalurški pripomočki izvirajo iz spodnjega oz. starejšega dela kulturne

<sup>47</sup> Glej poglavje 3.1.2.3 v tem zborniku.

<sup>48</sup> Poglavje 12 v tem zborniku.

<sup>49</sup> Glej še poglavje 3.2.2.2 v tem zborniku: sl. 3.39.

<sup>50</sup> Glej poglavje 3 v tem zborniku: sl. 3.10.



Sl. 1.5: Stare gmajne, jarek 13, odsek 24. Glinasta talilna posoda. Foto: D. Valoh.

Fig. 1.5: Stare gmajne, ditch 13, section 24. Clay crucible. Photo: D. Valoh.

The cultural layer in trench 3 is layered, which is visible from the northern part of the eastern cross-section.<sup>50</sup> Layering is perhaps a consequence of its long-term deposition. The lower part of the cultural layer can date to the earlier settlement phase. The upper part of the cultural layer could supposedly be deposited in the period of the later settlement phase.

All, carefully documented, metallurgic accessories originate from the lower or earlier part of the cultural layer. Majority of them were discovered deep in the layer. However, one fragment was found on top of the lower part of the cultural layer in quadrant 3, which perhaps indicates that it was resedimented from above and could be later.<sup>51</sup>

Question rises, whether a metallurgic workshop, discovered in the wider area of trench 3, existed only in the period of the earlier settlement, i.e. during the 34<sup>th</sup> century BC. Based on vertical stratigraphy, it appears that we can generally presume so. Horizontal stratigraphy, however, uncovers a different picture. Trench 3 was opened next to ditch 13, alongside section 24, which also contains vertical piles. These were furthermore

<sup>50</sup> See Chapter 3 in this monograph: Fig. 3.10.

<sup>51</sup> See Chapter 3 in this monograph: Fig. 3.10.





Sl. 1.6: Stare gmajne, sonda 3, južni profil. Talilna posoda iz kremenasto glinastega muljevca. Foto: T. Korošec.  
 Fig. 1.6: Stare gmajne, trench 3, southern cross-section. Crucible made of quartz-feldspathic siltite. Photo: T. Korošec.



Sl. 1.7: Stare gmajne, sonda 3, južni profil, z = 288,85 m. Talilna posoda iz kremenasto glinastega muljevca *in situ*. Foto: D. Veranič.  
 Fig. 1.7: Stare gmajne, trench 3, southern cross-section, z = 288.85 m. Crucible made of quartz-feldspathic siltite *in situ*. Photo: D. Veranič.



plasti. Večina med njimi je bila najdenih globlje v plasti. Za en fragment pa ugotavljamo, da je bil najden na vrhu spodnjega dela kulturne plasti v kv. 3, kar morda kaže, da je sem prišel od zgoraj in je tako lahko mlajši.<sup>51</sup>

Ob tem se vsekakor postavlja vprašanje, ali je bil na širšem območju sonde 3 metalurški obrat samo v obdobju starejše poselitve, tj. v 34. stoletju pr. Kr. Na podlagi vertikalne stratigrafije se zdi, da v večini primerov lahko sklepamo tako. Drugačno sliko pa razkriva horizontalna stratigrafija. Sonda 3 je bila zastavljena ob jarku 13 vzdolž odseka 24, v katerem smo tudi našli vertikalne kole. Slednji so bili tudi v odsekih 23, 22 in 21. Proti jugu sledi cezura, vertikalni koli so se pojavili šele v odsekih 27 in 28 (sl. 1.4). Dendrokronološke raziskave<sup>52</sup> so pokazale, da so bili vertikalni koli starejše poselitvene faze na območju jarkov 12 in 13 in v sondi 3. V jarkih 12 in 13 so bili najdeni tudi posamezni koli hrastove kronologije SG-QUSP1, ki sodijo v mlajšo poselitveno fazo. V to fazo sodijo tudi tisti jesenovi koli iz sonde 3 (kronologija SG-FRSP2), ki se dendrokronološko ujemajo z zaključnim odsekom omenjene hrastove kronologije.<sup>53</sup>

Na podlagi vertikalne in horizontalne stratigrafije ter dendronkronoloških podatkov torej lahko sklepamo, da je bilo območje, kjer je bila zastavljena sonda 3, izolirano od večjega dela naselbine tako v njeni starejši kot mlajši fazi (glej sl. 1.4). Razloge je iskati v tem, da je bil na tem območju operativen metalurški obrat. Zdi se, da so na posebej izbranem mestu na robu naselbine delovali metalurgi oz. kovači.

Iz analogij v starih kulturah Azije, Afrike in obeh Amerik vemo, da so imeli kovači pomemben položaj v družbi. M. Eliade<sup>54</sup> o enem takšnih primerov piše: *“Kovač na Javi je danas siromašan čovjek, no neki znaci govore da još uvijek ima povlašten položaj u zajednici. Zovu ga pande (stručnjak) kada je običan kovač, a empu ili kyai (gospodin, gospodar) kada je kovač oružja. No u stara vremena taljenje se smatralo tajanstvenim poslom i čitava jedna literatura nastala je u vezi s kovačem koji pravi krisove (malajski bodež) i koga često štiju poput kralja. Kovač je donedavno zauzimao počastan položaj na dvoru i u određenim prilikama mogao je zastupati cjelu zajednicu. U staro doba na Javi su odnosi između kovača i kralja bili poput onih između krvine braće. Genealogija kovača kako i genealogija kraljeva sezale su sve do bogova.”*

Pomembnega statusa pa kovači niso pridobili brez razloga. Tudi iz arheoloških virov vemo, da je bilo ukvarjati se z metalurško dejavnostjo precej nevarno početje.<sup>55</sup> Pri topljenju rude in taljenju kovine je treba doseči zelo visoko temperaturo. Tališče bakra je npr. pri 1083 °C.<sup>56</sup> Ogenj je netil iskre, ki so bile stalna grožnja naselbini.

discovered in sections 23, 22 and 21. A caesura follows towards the South, vertical piles are present again as far as sections 27 and 28 (Fig. 1.4). Dendrochronological researches<sup>52</sup> indicate that vertical piles, dating to the earlier settlement phase, occur in ditches 12 and 13 and in trench 3. Ditches 12 and 13 furthermore contain individual piles of the SG-QUSP1 oak chronology, which date to the later settlement phase. Moreover, ash piles from trench 3 (the SG-FRSP2 chronology), which dendrochronologically correspond with the finishing phase of the mentioned oak chronology, date to the later settlement phase.<sup>53</sup>

We deduce, based on vertical and horizontal stratigraphy and dendrochronological data, that the area, where trench 3 was located, was isolated from the major part of the settlement during its earlier as well as later phase (see Fig. 1.4). The reason for this is an operating metallurgic workshop, located on this area. It appears that metallurgists/metalworkers performed their activities on specially chosen location on the edge of the settlement.

Analogies from ancient Asian, African cultures and cultures of Americas indicate that metalworkers had an important status in society. M. Eliade<sup>54</sup> writes about one of these examples:

*“A metalworker on Java is a poor person today; however, some indications show that he still has a privileged position in the society. He is called pande (specialist) if he is an ordinary metalworker, or empu or kyai (lord, master) if he is manufacturing weapons. In ancient times, melting was considered a mysterious work and even a literary work was created on the subject of metalworker who makes krissees (Malayan daggers) and who is often adored as a king. Until recently, metalworker held an honourable position on court and he could represent the whole community in certain occasions. In ancient times on Java relationships between metalworker and king were as those between blood brethren. Genealogies of metalworkers, similarly as genealogies of kings, traced their ancestry as early as back to gods.”*

Metalworkers did not attain an important status for no reason. We know, also from archaeological sources, that metallurgy is a fairly dangerous activity.<sup>55</sup> High temperatures had to be achieved at smelting of ore and melting of metal. For example, melting point of copper is at 1083 °C.<sup>56</sup> Sparks were formed at combustion, which represented permanent threat to the settlement. Metallurgic process, especially when complex ore was being used, produced toxic gases, which were poisonous for metalworkers as well as the nearby surroundings.<sup>57</sup>

Social and environmental reasons exist to support a hypothesis claiming that an isolated place within set-

<sup>51</sup> Glej poglavje 3 v tem zborniku: sl. 3.10.

<sup>52</sup> Poglavje 7 v tem zborniku.

<sup>53</sup> Poglavje 7.1.2.2 v tem zborniku.

<sup>54</sup> 1983, 93.

<sup>55</sup> Npr. Ottaway 1994, 26–29.

<sup>56</sup> Matuschik 1998, 211.

<sup>52</sup> See Chapter 7 in this monograph.

<sup>53</sup> See Chapter 7.1.2.2 in this monograph.

<sup>54</sup> 1983, 93.

<sup>55</sup> E.g. Ottaway 1994, 26–29.

<sup>56</sup> Matuschik 1998, 211.

<sup>57</sup> E.g. Durman 2004, 34.

Med metalurškim procesom, še posebej ko se je uporabljala kompleksnejša ruda, so se sproščali strupeni plini, ki so zastrupljali kovača in okolico.<sup>57</sup>

Obstajajo torej razlogi, družbeni in okoljevarstveni, ki podpirajo hipotezo, da je v okviru naselbin treba iskati ločen prostor, kjer se je odvijala metalurška dejavnost. Dober primer je Gradac z “*Megaronom ljevača bakra*” na Vučedolu, ki ga je v vučedolskem obdobju od naselbine ločeval globok jarek. Na Gradacu pa ni bila samo delavnica, temveč tudi svetišče, posvečeno nekemu vučedolskemu bogu ognja ali livarstva.<sup>58</sup> Gre za prakso, za katero se zdi, da ji lahko sledimo tudi v koliščarskih naselbinah Ljubljanskega barja. Dober primer, ki potrjuje tezo, so vsekakor Stare gmajne. Izstopajoči objekti oz. območji, ki ju lahko povežemo z metalurško dejavnostjo, pa so tudi znotraj areala koliščarskih naselbin Maharski prekop in Založnica (glej *sl. I.2*).

Arheološko najdišče Maharski prekop pri Igu je med letoma 1970 in 1977 načrtno raziskovala T. Bregant.<sup>59</sup> Naselbino je sestavljalo več samostojnih koliščarskih stavb, ki so bile s kopenske strani obdane z dvojno palisado (*sl. I.8*).<sup>60</sup> Prve radiokarbonske datacije kažejo na izredno dolgo poselitveno sekvenco.<sup>61</sup> Nasprotno pa arheološke najdbe<sup>62</sup> in najnovejše radiokarbonske datacije<sup>63</sup> izpričujejo, da je naselbina obstajala krajše obdobje, kar potrjujejo tudi rezultati dendrokronoloških raziskav.<sup>64</sup>

Leta 2005 je ekipa Inštituta za arheologijo ZRC SAZU na že raziskanem območju Maharskega prekopa zastavila več sond. Tako smo na cenovno sprejemljiv način pridobili vzorce za dendrokronološke raziskave. Analiza rezultatov trenutno kaže, da je kolišče živelo približno eno generacijo v obdobju okoli leta 3500 pr. Kr.<sup>65</sup>

Pomembno je, da sta bili na Maharskem prekopu odkriti dve najdbi, ki ju povezujemo z metalurško dejavnostjo.<sup>66</sup> Bregantova ju je našla v sosednjih kvadrantih 19 in 70, ki ležita v bližini skupine treh drugače orientiranih vrst s koli, kot je sicer značilno za Maharski prekop, kjer izrazito prevladuje jugozahodno-severovzhodna orientacija (*sl. I.8*). Pomembno je tudi, da skupine kolov, ki so razporejeni v tri vrste, ustrezajo tlorisom samostojnih pravokotnih stavb.<sup>67</sup>

Potrditev in analogijo najdemo npr. nedaleč proč na sicer nekoliko mlajšem kolišču v današnji strugi Iščice.<sup>68</sup> Gre za ugotovitev, ki jo seveda lahko prenesemo tudi na skupino treh drugače orientiranih vrst s koli,

tlements, where metallurgic activities were performed. A good example here is Gradac at Vučedol with “*Megaron of the Copper Founder*”, which was separated from the settlement by a deep ditch during the Vučedol period. Not only a workshop, but also a sanctuary devoted to a certain Vučedol god of fire or casting was discovered at Gradac.<sup>58</sup> It is a tradition that we can perhaps follow also at the pile-dwelling settlements of the Ljubljansko barje. A good example confirming this thesis is Stare gmajne. Moreover, we can notice structures or areas that can be connected with metallurgic activities inside areal of the pile-dwelling settlements Maharski prekop and Založnica (see *Fig. I.2*).

Between 1970 and 1977 T. Bregant excavated the archaeological site Maharski prekop near Ig.<sup>59</sup> The settlement was constructed as a set of individual pile-dwelling houses that were enclosed by a double palisade on the side closest to dry land (*Fig. I.8*).<sup>60</sup> The first radiocarbon dates suggested an extremely long settlement sequence.<sup>61</sup> On the contrary, archaeological finds<sup>62</sup> and the latest radiocarbon dates<sup>63</sup> indicate that the settlement existed for a short period, which has also been confirmed with the results of dendrochronological researches.<sup>64</sup>

In 2005, a team from the Institute of Archaeology ZRC SAZU opened several trenches on previously investigated area of Maharski prekop. This way we gained samples for dendrochronological researches in a cost-effective manner. At present, the analysis of results indicates that the pile-dwelling existed for approximately one generation in c. 3500 BC.<sup>65</sup>

It is important that two finds, which we can assign to metallurgic activities, were discovered at Maharski prekop.<sup>66</sup> Bregant discovered them in adjoining quadrants 19 and 70, which were located close to the group of three rows of piles, oriented in a different manner as the rest of them, i.e. southwestern-northeastern orientation explicitly prevails at Maharski prekop (*Fig. I.8*). It is also important that groups of piles, arranged in three rows, form ground plans of independent rectangular houses.<sup>67</sup>

A confirmation and an analogy can be found nearby, at a somewhat later pile-dwelling, which is now located in the bed of Iščica.<sup>68</sup> It is a finding that can also be assigned to group of three differently oriented rows of piles, where we can talk about an independent,

<sup>57</sup> Npr. Durman 2004, 34.

<sup>58</sup> Durman 2004, 26, 28, 34.

<sup>59</sup> 1996, 27.

<sup>60</sup> Glej Greif 1997, 26–27; prim. z Gabrovec 1983, 30; Velušček 2001, 76–77; 2005b, 202.

<sup>61</sup> Bregant 1975, 49.

<sup>62</sup> Npr. Parzinger 1984, *sl. 7*; Velušček 2001, 93–96.

<sup>63</sup> Mlekuž et al. 2006, *tab. 1*.

<sup>64</sup> Velušček, Čufar 2008.

<sup>65</sup> Velušček, Čufar 2008.

<sup>66</sup> Velušček, Greif 1998, 32–33.

<sup>67</sup> Velušček 2001, 76, *sl. 23*; 2005b, 202.

<sup>68</sup> Velušček, Čufar, Levanič 2000, *sl. 6*.

<sup>58</sup> Durman 2004, 26, 28, 34.

<sup>59</sup> 1996, 27.

<sup>60</sup> See Greif 1997, 26–27; compare with Gabrovec 1983, 30; Velušček 2001, 76–77; 2005b, 202.

<sup>61</sup> Bregant 1975, 49.

<sup>62</sup> E.g. Parzinger 1984, *Fig. 7*; Velušček 2001, 93–96.

<sup>63</sup> Mlekuž et al. 2006, *Tab. 1*.

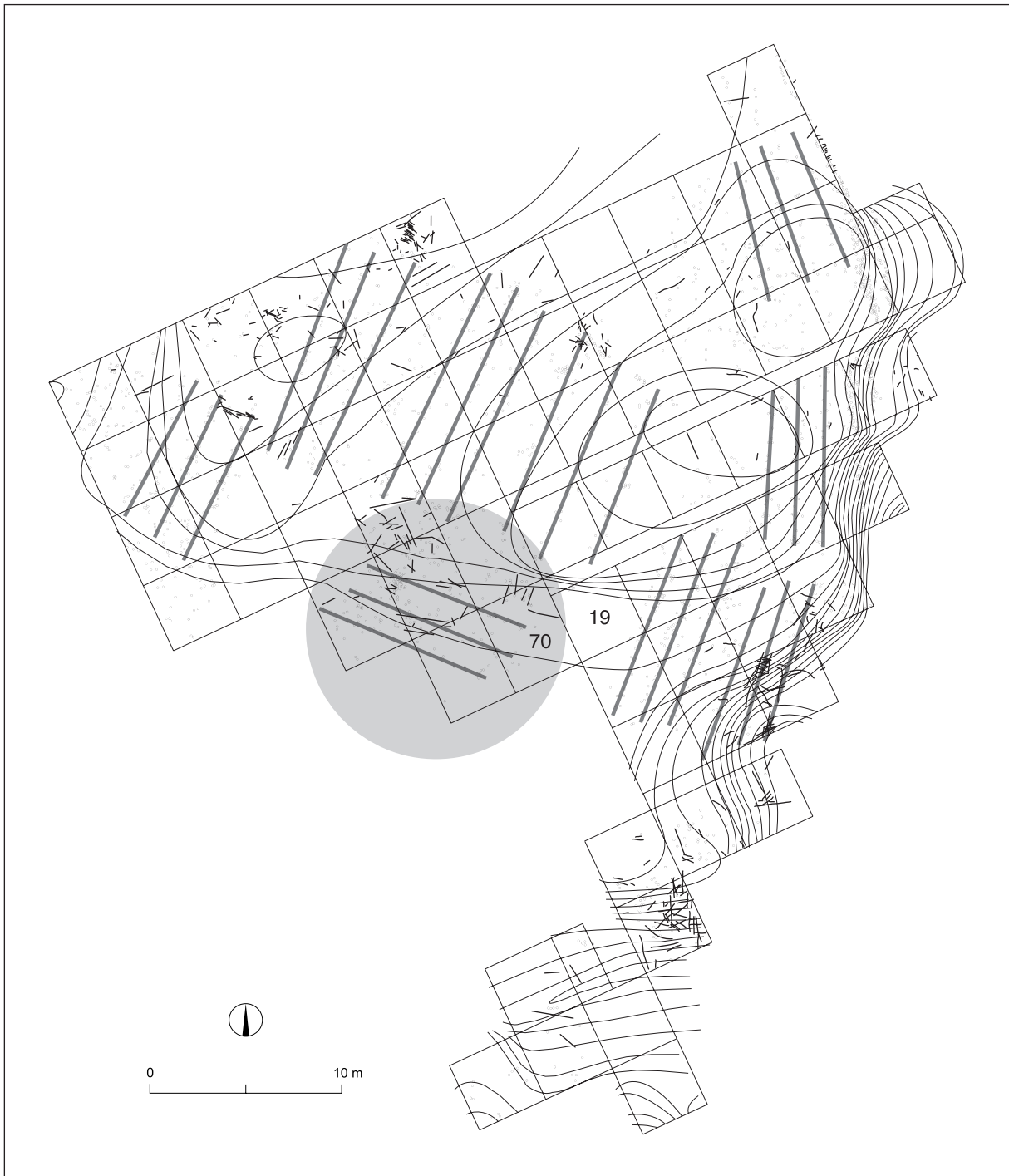
<sup>64</sup> Velušček, Čufar 2008.

<sup>65</sup> Velušček, Čufar 2008.

<sup>66</sup> Velušček, Greif 1998, 32–33.

<sup>67</sup> Velušček 2001, 76, *Fig. 23*; 2005b, 202.

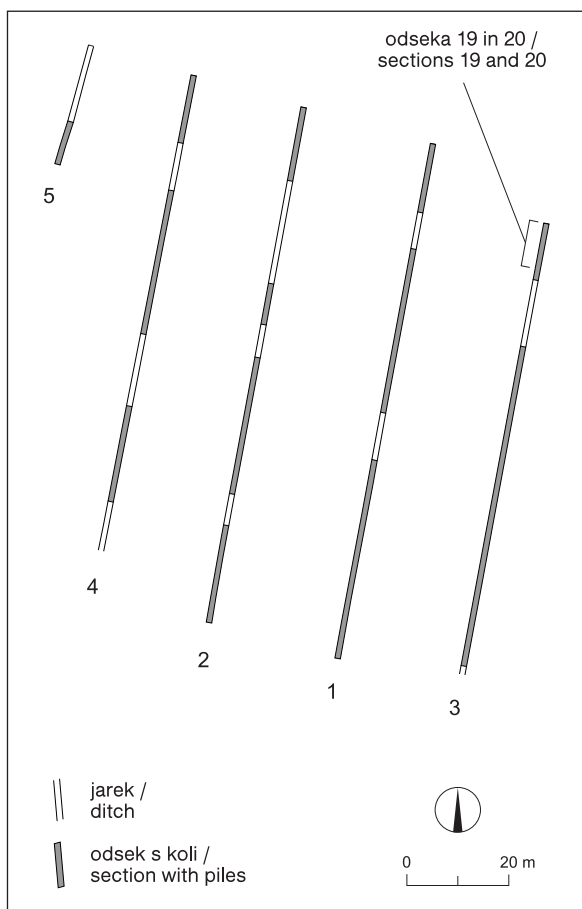
<sup>68</sup> Velušček, Čufar, Levanič 2000, *Fig. 6*.



Sl. 1.8: Maharski prekop, načrt izkopavanj 1970–1977 je po Bregant 1996. Označeno je območje domnevne livarske delavnice.  
 Fig. 1.8: Maharski prekop, excavation plan 1970–1977 after Bregant 1996. Presumed casting workshop is marked.

za katero lahko rečemo, da gre za samostojno drugače orientirano stavbo. Ob tem pa se najprej zastavi vprašanje, ali ni drugačna orientacija stavbe v bližini najdb metalurških pripomočkov zgolj navidezna. Mogoče je, da gre za kolibo, ki sploh ni sočasna z ostalimi stavbami na Maharskem prekopu, kar je sicer malo verjetno. Drugo vprašanje je, ali lege morda ni pogojeval relief oz. ovira

differently oriented structure. A question arises whether a different orientation of structures, located close to finds of metallurgic accessories, is not only virtual. It is perhaps a hut, not contemporary with the remaining structures at Maharski prekop. However, this is unlikely. The second question is, whether the position was perhaps not conditioned by the relief or some sort of a hinder,



Sl. 1.9: Načrt raziskanega območja koliščarske naselbine Založnica (po Velušček, Čufar 2003).

Fig. 1.9: Plan of the examined area of the pile-dwelling settlement Založnica (after Velušček, Čufar 2003).

kot pri stavbah, ki so bile postavljene vzdolž palisade.<sup>69</sup> Mogoče je tudi, da drugačna orientacija stavbe dejansko kaže na njen poseben status. Morda jo je uporabljal zelo pomemben član skupnosti. Predpostavljamo, da bi to lahko bil kovač oz. metalurg.

O livarski delavnici lahko govorimo tudi na Založnici. Že omenjeni fragment dvodelnega kalupa<sup>70</sup> namreč izvira iz jarka 3, z območja z odsekoma 19–20 (sl. 1.9). Toda čeprav se zdi, da je predel z odsekoma 19–20 v jarku 3 ločen od preostale naselbine, položaj domnevne livarske delavnice v okviru celotne naselbine ni tako razpoznaven kot na Starih gmajnah. Razlogov je več, naj navedemo samo najpomembnejše:

1. Na mestu odkritja fragmenta kalupa meja naselbine še ni ugotovljena.
2. Valjasti nastavek za meh je bil najden na drugem koncu naselbine – zelo verjetno izvira iz jarka Založnica,<sup>71</sup> ki teče jugozahodno oz. zahodno od na sl. 1.9 označenih jarkov.

<sup>69</sup> Velušček 2001, 76, sl. 23; 2005b, 202.

<sup>70</sup> Velušček, Čufar 2003, 129, 134, sl. 2, t. 4: 10.

<sup>71</sup> Jesse 1955, 265, t. 2: 14.

as this has been proved in the case of structures that were located alongside the palisade.<sup>69</sup> It is also possible that different orientation of structure indicates a special status of the structure itself. It was perhaps used by an important member of community. We suppose that this could well be a metalworker or a metallurgist.

In addition, Založnica had its own casting workshop. An already mentioned fragment of a bipartite mould<sup>70</sup> originates from ditch 3, from the area with sections 19–20 (Fig. 1.9). However, although it appears that the area with sections 19–20 in ditch 3 was separated from the rest of the settlement, the location of a presumed casting workshop is not as discernible in frame of the entire settlement as at Stare gmajne. Several reasons for this exist. Let us list only the most important ones:

1. On the location, where the fragment of a mould was discovered, the edge of the settlement has not yet been established.
2. Bellows nozzle was discovered on the other end of the settlement – it most probably originates from the Založnica ditch,<sup>71</sup> which runs in the south-westerly or westerly direction from ditches, marked on Fig. 1.9.

Two or even three sites at the Ljubljansko barje present rather convincing data on casting workshops: Stare gmajne, Maharski prekop and perhaps Založnica. We can definitely expect more evidence from other pile-dwellings. K. Deschmann already discovered finds, which unquestionably indicate their existence.<sup>72</sup> Unfortunately, there is no useful stratigraphic or spatial data about these finds. Moreover, finds from Hočevarica also point towards an existence of a workshop, but the trench in size of 8 m<sup>2</sup> was too small to precisely localise a casting workshop within the settlement with no determined accurate extent.<sup>73</sup>

As we can see, developments of the pile-dwelling cultures and settlements of the Ljubljansko barje were closely connected with metallurgic activity and numerous finds of this character doubtlessly prove this. It also appears that a positive correlation between production and distribution of metal objects in central Europe exists, with a brief temporal distance, with pile-dwelling settlement of the Ljubljansko barje: the Ljubljansko barje was populated during a period of larger demand for copper objects and abandoned during a period when the demand was smaller.<sup>74</sup>

At this point, we can tie the first metallurgic “boom” at the Ljubljansko barje to pile-dwellers from the 4<sup>th</sup> millennium BC. The beginning of local metallurgic production can be more precisely dated into the

<sup>69</sup> Velušček 2001, 76, Fig. 23; 2005b, 202.

<sup>70</sup> Velušček, Čufar 2003, 129, 134, Fig. 2, Pl. 4: 10.

<sup>71</sup> Jesse 1955, 265, Pl. 2: 14.

<sup>72</sup> Deschmann 1877, 475; 1878, 6–8.

<sup>73</sup> Velušček 2004b, Figs. 3.1.2, 3.1.3.

<sup>74</sup> Velušček, Greif 1998, 45–46; Velušček 2004f, 303–304; 2004g, 76–79; compare with Krause 2003, Fig. 240.



Dokaj prepričljive podatke o livarskih delavnicah imamo torej z dveh oz. s treh najdišč Ljubljanskega barja: Starih gmajn, Maharskega prekopa in morda tudi z Založnice. Zagotovo pa to niso edina kolišča, kjer jih lahko pričakujemo. Že K. Deschmann je našel najdbe, ki zagotovo kažejo na njihov obstoj.<sup>72</sup> Žal o tem ni ohranjenih nobenih uporabnih stratigrafskih ali prostorskih podatkov. Na obstoj delavnice kažejo tudi najdbe s Hočevarice, a je bila sonda, vsega 8 m<sup>2</sup>, premajhna za ožje lociranje livarske delavnice v naselbino, katere natančen obseg tudi sicer še ni ugotovljen.<sup>73</sup>

Kakor je razvidno, sta bila razvoj koliščarskih kultur in poselitev Ljubljanskega barja tesno povezana z metalurško dejavnostjo, kar nedvomno dokazujejo številne tovrstne najdbe. Zdi se tudi, da sta proizvodnja in distribucija kovinskih predmetov v Srednji Evropi v pozitivni korelaciji s koliščarsko poselitvijo Ljubljanskega barja, in to s krajšo časovno distanco: v obdobju večjega povpraševanja po bakrenih predmetih je bilo Ljubljansko barje poseljeno, v obdobju, ko se je povpraševanje zmanjšalo, pa ne.<sup>74</sup>

Po trenutnih ugotovitvah je prvi metalurški razcvet na Ljubljanskem barju povezljiv s koliščarji iz 4. tisočletja pr. Kr. Natančneje lahko postavimo začetek lokalne metalurške proizvodnje v drugo četrtino 4. tisočletja.<sup>75</sup> Njenemu razvoju lahko bolj ali manj kontinuirano oz. s krajšo cezuro sledimo do 31. stoletja. Do ponovnega razcveta metalurške dejavnosti je prišlo približno v obdobju druge in tretje četrtine 3. tisočletja pr. Kr.<sup>76</sup> in verjetno tudi ob koncu koliščarske dobe okvirno v prvi polovici 2. tisočletja, v obdobju t. i. pramenaste keramike.

Tako kot drugje so tudi na prazgodovinskem Ljubljanskem barju kovači verjetno imeli pomembno vlogo v družbi.<sup>77</sup> Ukvarjali so se namreč z dejavnostjo, ki je zahtevala veliko znanja in je bila po dojemanju sodobnikov magijska, v praksi pa je dejansko ogrožala vas in življenje vaščanov.<sup>78</sup> Zdi se, da takšen status kovača in njegove dejavnosti odseva tudi v izpostavljenosti livarske delavnice.

Na Maharskem prekopu smo opazili, da je bila stavba, v kateri oz. v bližini katere je morda deloval kovač, orientirana drugače od ostalih stavb (*sl. 1.8*). Nekoliko drugače je bilo na Starih gmajnah, kjer je bila livarska delavnica, kot smo ugotovili, jasno ločena od preostale naselbine (*sl. 1.4*), kar bi lahko veljalo tudi v primeru približno 600 do 700 let mlajšega kolišča Založnica pri Kamniku pod Krimom (*sl. 1.9*). Naj še poudarimo, da

<sup>72</sup> Deschmann 1877, 475; 1878, 6–8.

<sup>73</sup> Velušček 2004b, sl. 3.1.2; 3.1.3.

<sup>74</sup> Velušček, Greif 1998, 45–46; Velušček 2004f, 303–304; 2004g, 76–79; prim. s Krause 2003, sl. 240.

<sup>75</sup> Glej Velušček, Greif 1998, 38–41; Velušček 2004f, 298–303.

<sup>76</sup> Glej Durman 1983, 66–67; Velušček, Greif 1998, 42–44; Velušček 2005b, 206–207.

<sup>77</sup> Prim. Eliade 1983, 93–104; Durman 2004.

<sup>78</sup> Prim. z Durman 2004, 34.

second quarter of the 4<sup>th</sup> millennium.<sup>75</sup> We can more or less continuously, with only a shorter caesura, follow its development until the 31<sup>st</sup> century. Another bloom of metallurgic activity occurs approximately in period of the second and third quarters of the 3<sup>rd</sup> millennium BC.<sup>76</sup> A third boom possibly occurs at the finishing stages of the pile-dwelling era, in the first half of the 2<sup>nd</sup> millennium, in a period of so-called Litzen pottery.

As elsewhere, metalworkers probably had an important role also in the prehistoric society of the Ljubljansko barje.<sup>77</sup> Namely, they were engaged in activity that demanded much knowledge and was considered as supernatural to people around them, and was, in practice, actually endangering the settlement as well as lives of its inhabitants.<sup>78</sup> It appears that such status of metalworkers and their activities reflects also in exposure of casting workshops.

Maharski prekop shows evidence that the structure, in which or nearby which a metalworking activity was perhaps taking place, is oriented differently as the other structures (*Fig. 1.8*). A somewhat different picture can be seen at Stare gmajne, where casting workshop was discovered. Namely, it was doubtlessly separated from the remaining settlement (*Fig. 1.4*), which can perhaps also be seen at the c. 600 to 700 years later pile-dwelling Založnica near Kamnik pod Krimom (*Fig. 1.9*). Let us furthermore emphasise that the exposed position of casting workshops definitely indicates a division of labour among the pile-dwellers at the Ljubljansko barje. In addition, it appears that an elite occurred in the 2<sup>nd</sup> half of the 4<sup>th</sup> millennium BC, which, among other things, used an eminent invention, i.e. a two-wheeled cart.<sup>79</sup>

## 1.2.2 BLATNA BREZOVICA

C. 450 m to the north-east from Stare gmajne, on the left bank of the Ljubljanica is a smaller pile-dwelling settlement Blatna Brezovica (*Fig. 1.2*). Similarly as Stare gmajne, also this pile-dwelling very probably stood in marshy or moor environment, probably close to or beside the lake. Predecessor of present-day Ljubljanica river was outflowing into the lake not far from away.<sup>80</sup>

From sequences of annual ring widths of wood from the site Blatna Brezovica, which was investigated in 1953,<sup>81</sup> we constructed an oak chronology, which we could not reliably cross-date with any other chronology from the

<sup>75</sup> See Velušček, Greif 1998, 38–41; Velušček 2004f, 298–303.

<sup>76</sup> See Durman 1983, 66–67; Velušček, Greif 1998, 42–44; Velušček 2005b, 206–207.

<sup>77</sup> Compare with Eliade 1983, 93–104; Durman 2004.

<sup>78</sup> Compare with Durman 2004, 34.

<sup>79</sup> See Chapter 8 in this monograph and compare with Pétrequin, Pétrequin, Bailly 2006b, 394.

<sup>80</sup> See Chapter 4 in this monograph.

<sup>81</sup> Korošec 1963.



izstopajoč položaj livarskih delavnic kaže, da je med koliščarji na Ljubljanskem barju zagotovo obstajala delitev dela. Še več, zdi se, da lahko govorimo tudi že o pojavu elit, ki med drugim v drugi polovici 4. tisočletja pr. Kr. uporabljajo eminentno iznajdbo, tj. dvokolesni voz.<sup>79</sup>

### 1.2.2 BLATNA BREZOVICA

Približno 450 m severovzhodno od Starih gmajn leži na levem bregu Ljublanice manjša koliščarska naselbina Blatna Brezovica (*sl. I.2*). Podobno kot Stare gmajne je bilo tudi to kolišče zelo verjetno postavljeno v močvirskem oz. barjanskem okolju, najbrž v bližini jezera ali tik ob njem. Nedaleč proč se je v jezero izlivala predhodnica današnje Ljublanice.<sup>80</sup>

Iz zaporedij širin branik lesa z arheološkega najdišča na Blatni Brezovici, ki je bilo arheološko raziskano že leta 1953,<sup>81</sup> smo sestavili hrastovo kronologijo, ki pa nam je ni uspelo z zanesljivostjo sinhronizirati z nobeno drugo kronologijo z Ljubljanskega barja. Na podlagi radiokarbonskega datuma in dendrokronoloških raziskav pa sklepamo, da je bila naselbina nekoliko mlajša od konca poselitve na Starih gmajnah.<sup>82</sup>

Med vertikalnimi koli prevladuje hrastov les, ki je zastopan kar z 51 % vzorcev, sledi mu jesen z 32 % vzorcev. Približno 15 % vzorcev pripada drugim vrstam, med katerimi je prevladujoč javor (*Acer*). V lesu smo odkrili veliko rastnih anomalij, kar kaže na močne antropogene vplive v sestojih, kjer je bil posekan.

Med nekeramičnimi najdbami so žrmlje, puščične osti, konice, noži, kladivaste sekire in brusni na uho ali brez.

Natančna petrografska analiza je bila opravljena samo za brus na uho,<sup>83</sup> ki razkriva, da je bil narejen iz surovine, ki se nahaja v bližnji okolici Ljubljanskega barja,<sup>84</sup> podobno kot velja za žrmlje, ki jih je makroskopsko preučil J. Turk.<sup>85</sup> Prevladujejo žrmlje iz kremenovega konglomerata.

Čeprav Korošec o kamnitih jagodah ne poroča,<sup>86</sup> smo leta 2003 odkrili dve jagodi. V bistvu gre za ogrlična obročka. Prvi je iz bele, drugi iz črne kamnine. Na pogled sta najdbi podobni majhnim ogrličnim obročkom z ostalih najdišč Ljubljanskega barja, med katerimi naj omenimo npr. obročke s Hočevarice in Starih gmajn.

V mokrih tleh Ljubljanskega barja se zelo dobro ohranijo tudi predmeti iz lesa in drugih manj odpornih organskih materialov. Med takimi najdbami naj najprej

Ljubljansko barje. Moreover, the radiocarbon date indicates that the settlement existed during the earlier period or after the settlement Stare gmajne was abandoned.<sup>82</sup>

Oak wood prevails among vertical piles, representing 51 % of all samples, followed by ash with 32 % of samples. C. 15 % of samples belongs to other species, with maple (*Acer*) prevailing. We discovered many growth anomalies, which indicate strong anthropogenic impacts in stands, where wood was felled.

Quern stones, arrowheads, points, knives, shaft-hole axes and whetstones with or without holes were discovered among non-ceramic finds.

Detailed petrographical analysis was done only on a whetstone with a hole.<sup>83</sup> It was made of raw material originating from the immediate environs of the Ljubljansko barje.<sup>84</sup> Similar can be claimed for querns, which were macroscopically analysed by J. Turk.<sup>85</sup> Querns made of quartz conglomerate prevail.

Although Korošec did not mention stone beads,<sup>86</sup> we discovered two in 2003. They are actually necklace ringlets. One is made of white, and the other of black rock. Finds are similar to small necklace ringlets, which were found on the other sites of the Ljubljansko barje, e.g. ringlets from Hočevarica and Stare gmajne.

Wooden finds and objects from other less resistant organic materials are well preserved in wet ground of the Ljubljansko barje. We first have to mention wooden artefacts. In 1953, Korošec discovered a wooden dipper<sup>87</sup> and several fragments of unidentified wooden vessels.<sup>88</sup> Fragments of oars<sup>89</sup> and perhaps a javelin<sup>90</sup> were also discovered. The latter is a 2.20 m long wooden object, pointed on one side and with a fin of a triangular intersection on the other.

Jewellery, made of wood and bark, can also be placed among important wooden finds from Blatna Brezovica. Korošec found three beads<sup>91</sup> and some more were discovered in 2003.

Beads were made also from other parts of plants: e.g. kernels.

Korošec also notes that they came across larger pieces of fabric, woven in narrow, c. 2 cm wide bands, at excavation on Blatna Brezovica. Analysis showed that it is fibres of vegetal origin, hemp or flax.<sup>92</sup> As hemp was not known at the Ljubljansko barje during the existence of Blatna Brezovica,<sup>93</sup> it seems likely that it is flax.

<sup>79</sup> Glej poglavje 8 v tem zborniku in prim. s Pétrequin,

Pétrequin, Bailly 2006b, 394.

<sup>80</sup> Glej poglavje 4 v tem zborniku.

<sup>81</sup> Korošec 1963.

<sup>82</sup> Poglavje 7 v tem zborniku.

<sup>83</sup> Poglavje 5 v tem zborniku: *t. 5.I*: 5.

<sup>84</sup> Glej poglavje 12 v tem zborniku.

<sup>85</sup> Poglavje 13 v tem zborniku.

<sup>86</sup> Glej Korošec 1963, 25.

<sup>82</sup> See Chapter 7 in this monograph.

<sup>83</sup> See Chapter 5 in this monograph: *Pl. 5.I*: 5.

<sup>84</sup> See Chapter 12 in this monograph.

<sup>85</sup> See Chapter 13 in this monograph.

<sup>86</sup> See Korošec 1963, 25.

<sup>87</sup> Korošec 1963, *Pl. 19*: 1.

<sup>88</sup> E.g. Korošec 1963, 24, *Pl. 20*: 3.

<sup>89</sup> Korošec 1963, 24, *Pl. 20*: 1,2,7.

<sup>90</sup> Korošec 1963, 24, *Pl. 20*: 8.

<sup>91</sup> Korošec 1963, *Pl. 13*: 3–5.

<sup>92</sup> Korošec 1953, 260.

<sup>93</sup> T. Tolar, pers. comm.

omenimo lesene artefakte. Tako je leta 1953 Korošec odkril lesen korec<sup>87</sup> in več fragmentov lesenih posod.<sup>88</sup> Našli so tudi odlomke vesel<sup>89</sup> in morda tudi kopje.<sup>90</sup> Gre za 2,20 m dolg lesen predmet, na eni strani priostren, na drugi s krilcem trikotnega preseka.

Med pomembne lesene najdbe z Blatne Brezovice lahko uvrstimo tudi nakit, ki je bil narejen iz lesa oz. drevesne skorje. Tako je Korošec našel tri jagode,<sup>91</sup> h katerim moramo prišteti tudi jagode, najdene leta 2003. Jagode so bile narejene tudi iz drugih delov rastlin, npr. koščic itd.

Korošec tudi omenja, da so pri izkopavanju na Blatni Brezovici naleteli na večje kose tkanine, tkane v ožjih, pribl. 2 cm širokih trakovih. Analiza je pokazala, da so vlakna rastlinskega izvora in da pripadajo konoplji ali lanu.<sup>92</sup> Ker pa konoplje v obdobju Blatne Brezovice na Ljubljanskem barju še niso poznali,<sup>93</sup> se zdi verjetneje, da gre za ostanke tkanine iz lanu.

Na Blatni Brezovici prevladuje keramika temnosivih barvnih tonov, svetlosive ali barvno svetlejšje keramike je manj. Keramika je krhka, ob dotiku se rada lomi. Celih posod je malo, prevladujejo fragmenti s starimi prelomi. Po obliki smo keramiko razdelili na posodje<sup>94</sup> in na posebne oblike.<sup>95</sup>

### 1.2.3 VELIKI OTAVNIK Ib

Ostanki koliščarske naselbine Veliki Otavnik Ib ležijo približno 1 km jugovzhodno od kolišča Stare Gmajne (sl. 1.2). Leta 2006 so potapljači v strugi Bistre naleteli na vertikalne kole in manjše število arheoloških najdb: na redke kostne ostanke, nekaj odbitkov, odlomek žrnelj, terilni kamen in do 5 fragmentov keramike, med katero izstopa kroglasti lonček iz temnosivo žgane gline z močnimi primesmi karbonatnega peska.<sup>96</sup>

Dendrokronološka raziskava je pokazala, da med 30 vzorci lesa prevladuje s 17 vzorci hrast (*Quercus* sp.), sledijo jesen (*Fraxinus* sp.) s 6 vzorci, topol z 2–3 vzorci (*Populus* sp.), vrba (*Salix* sp.) in črna jelša (*Alnus glutinosa*).

Na podlagi dendrokronološke analize sklepamo, da je koliščarska naselbina Veliki Otavnik Ib sočasna z zaključkom življenja na koliščarski naselbini Stare Gmajne. Konec gradbene aktivnosti v okviru hrastove kronologije VO6-QUSP1 je namreč datiran v leto 3108 ± 12 pr. Kr.

<sup>87</sup> Korošec 1963, t. 19: 1.

<sup>88</sup> Npr. Korošec 1963, 24, t. 20: 3.

<sup>89</sup> Korošec 1963, 24, t. 20: 1,2,7.

<sup>90</sup> Korošec 1963, 24, t. 20: 8.

<sup>91</sup> Korošec 1963, t. 13: 3–5.

<sup>92</sup> Korošec 1953, 260.

<sup>93</sup> T. Tolar, osebna komunikacija.

<sup>94</sup> Lonci, vrči/amfore, kupe, sklode, skodele in viseče posode.

<sup>95</sup> Zajemalke, vretenca in uteži.

<sup>96</sup> Poglavlje 6 v tem zborniku.

Dark grey pottery prevails at Blatna Brezovica. There is only a small amount of light grey and light-coloured pottery. Pottery is fragile and breaks easily. There were hardly any entirely preserved vessels; sherds with old fractures prevail. Pottery finds were divided into vessels<sup>94</sup> and special forms.<sup>95</sup>

### 1.2.3 VELIKI OTAVNIK Ib

Remains of the pile-dwelling settlement Veliki Otavnik Ib are located c. 1 km to the south-east from the pile-dwelling Stare Gmajne (Fig. 1.2). In 2006, divers came across vertical piles and some archaeological finds in the bed of Bistra river: scarce bone remains, a few flakes, a quern fragment, a ground stone and 5 fragments of pottery, among which a small round pot, made of dark grey fired clay with rich additions of carbonate sand stands out.<sup>96</sup>

Dendrochronological research showed, that oak (*Quercus* sp.) prevails with 17 samples of 30 altogether, followed by 6 samples of ash (*Fraxinus* sp.) and 2–3 samples each of poplar (*Populus* sp.), willow (*Salix* sp.) and black alder (*Alnus glutinosa*).

Based on dendrochronological analysis, we presume that the pile-dwelling settlement Veliki Otavnik Ib was contemporary with the last stages of the pile-dwelling settlement Stare Gmajne. Building activities at Veliki Otavnik Ib according to oak chronology terminated in 3108 ± 12 BC.

## 1.3 CULTURAL PICTURE: THE STARE GMAJNE CULTURAL GROUP

Dating of archaeological excavation sites from the Neolithic and Eneolithic periods was, until recently, based upon vertical stratigraphy and typological analysis of ceramic finds, which are the most common finds on archaeological sites of these periods and are frequently also the most informing.<sup>97</sup>

Much has changed in the last few years. New dates of archaeological sites and cultures are more and more based upon, where this is possible, natural history methods. Radiometric dating is one of them. Radiocarbon dating became very popular in Slovenia.<sup>98</sup> Since 1995, we are also using dendrochronology at the research of the pile-dwelling settlements at the Ljubljansko barje. This

<sup>94</sup> Pots, pitchers/amphorae, goblets, dishes, bowls and hanging vessels.

<sup>95</sup> Ladles, spindle whorls and weights.

<sup>96</sup> See Chapter 6 in this monograph.

<sup>97</sup> See e.g. Praistorija jugoslavenskih zemalja 2 and 3, Sarajevo 1979.

<sup>98</sup> See e.g. Budja 1993, 7–28; Guštin 2005b, 7–22; Mlekuž, Budja, Ogrinc 2006, 253–271; Žižek 2006, 129–140; Bonsall et al. 2007, 727–740.

### 1.3 KULTURNA SLIKA: KULTURNA SKUPINA STARE GMAJNE

Še nedavno je datiranje arheoloških najdišč iz neolitkega in eneolitkega obdobja<sup>97</sup> temeljilo na vertikalni stratigrafiji in oblikovni analizi keramičnih najdb, ki so na arheoloških najdiščih tistega časa najpogostejše, velikokrat tudi najbolj izpovedne.

V zadnji letih se je na tem področju marsikaj spremenilo. Nove datacije arheoloških najdišč in kultur vedno bolj temeljijo, kjer je to mogoče, na naravoslovnih metodah. Ena izmed njih je radiometrično datiranje. Tako je v Sloveniji postalo zelo priljubljeno radiokarbonsko datiranje.<sup>98</sup> Od leta 1995 pa pri raziskovanju koliščarskih naselbin na Ljubljanskem barju uporabljamo tudi dendrokronologijo, s katero se ukvarjajo kolegi z Oddelka za lesarstvo BF Univerze v Ljubljani pod vodstvom K. Čufar.<sup>99</sup>

Dendrokronološko metodo smo uporabili tudi pri raziskovanju lesa s koliščarskih naselbin Stare gmajne, Blatna Brezovica in Veliki Otavnik Ib.<sup>100</sup> Ker pa v Sloveniji kronologije za 4. tisočletje pr. Kr. še niso absolutno datirane, tj. sinhronizirane z eno izmed standardnih kronologij, smo za datiranje uporabili tudi radiokarbonsko metodo. Tako pridobljeni podatki kažejo, da naselbine sodijo v drugo polovico 4. tisočletja pr. Kr. Še več, hrastova kronologija SG-QUSP1 kaže, da je bilo območje, kjer leži koliščarska naselbina Stare gmajne, najprej poseljeno v drugi polovici 34. stoletja pr. Kr. ter nato za več kot 50 let tudi v obdobju, ki se konča z letom 3109 ± 12 pr. Kr., po jesenovi kronologiji SG-FRSP1 pa celo nekaj let kasneje. V obdobju, ki je sočasno z mlajšo naselbinsko fazo na Starih gmajnah, je torej v bližini obstajalo kolišče Veliki Otavnik Ib in nekoliko kasneje tudi kolišče Blatna Brezovica.

Tezo o sočasnosti oz. skorajšnji sočasnosti kolišč potrjujejo tudi keramične najdbe. O keramiki z Velikega Otavnika Ib ni skoraj nobenih podatkov.<sup>101</sup> Drugače pa je v primeru Starih gmajn in Blatne Brezovice, kjer je keramičnih najdb veliko in so si tudi zelo podobne. Prevladuje keramika temnosivih barvnih tonov. Številni so npr. lonci z razčlenjenimi držaji.<sup>102</sup> Tudi sicer je na obeh koliščih velika podobnost med lonci,<sup>103</sup> skledami.<sup>104</sup> Na obeh

is carried out by colleagues from Biotechnical Faculty of the University of Ljubljana, under management of K. Čufar.<sup>99</sup>

Dendrochronological procedure was also used at research of wood from the pile-dwelling settlements Stare gmajne, Blatna Brezovica and Veliki Otavnik Ib.<sup>100</sup> However, 4<sup>th</sup> millennium BC chronologies in Slovenia are not absolutely dated, i.e. synchronised with one of the standard chronologies. Consequently, we also used radiocarbon procedure in order to date our finds. Data, gained with these procedures show that settlements originate from the second half of the 4<sup>th</sup> millennium BC. Moreover, the SG-QUSP1 oak chronology remits, that the area of the pile-dwelling settlement Stare gmajne was firstly populated in the second half of the 34<sup>th</sup> century BC and, for over 50 years, also in period finishing with 3109 ± 12 BC or even a few years later, according to the SG-FRSP1 ash chronology. The nearby pile-dwelling Veliki Otavnik Ib was contemporary with the later settlement phase at Stare gmajne; moreover, the pile-dwelling Blatna Brezovica was erected a few years later.

Simultaneity or near simultaneity of the pile-dwellings can furthermore be confirmed with ceramic finds. There is almost no information on pottery from Veliki Otavnik Ib.<sup>101</sup> Nevertheless, Stare gmajne and Blatna Brezovica contain many pottery finds, which are also very analogous. Dark grey pottery prevails. Great amounts of e.g. pots containing so-called lugs with slashed decoration have been found.<sup>102</sup> A great resemblance can be seen among pots<sup>103</sup> and dishes<sup>104</sup> of both pile-dwellings. Ladles with solid handles yielded from both sites.<sup>105</sup> Moreover, also decoration is similar.<sup>106</sup>

The two sites are similar to one another. It is necessary to mention the absence of handled vessels at Blatna Brezovica. However, these are forms, which are not frequent at Stare gmajne either.<sup>107</sup>

Stare gmajne yielded more dishes of types S9 and S15 with long lugs with slashed decoration or a slashed cordon.<sup>108</sup> Similar dishes have also been found at Blatna

<sup>97</sup> Glej npr. Praistorija jugoslavenskih zemalja 2 in 3, Sarajevo 1979.

<sup>98</sup> Glej npr. Budja 1993, 7–28; Guštin 2005b, 7–22; Mlekuž, Budja, Ogrinc 2006, 253–271; Žižek 2006, 129–140; Bonsall et al. 2007, 727–740.

<sup>99</sup> Npr. Čufar, Levanič 1998, 63–73.

<sup>100</sup> Poglavji 6 in 7 v tem zborniku.

<sup>101</sup> Glej poglavje 6 v tem zborniku.

<sup>102</sup> Npr. poglavji 3: t. 3.1: 9; 3.4: 5,7; 3.9: 4 itd., in 5 v tem zborniku: t. 5.3: 5; 5.4: 3; 5.5: 1; 5.8: 7; 5.10: 5; Korošec 1963, t. 21: 8; 27: 1–5 itd.

<sup>103</sup> Prim. poglavji 3: sl. 3.12–3.14, in 5 v tem zborniku: sl. 5.10–5.13.

<sup>104</sup> Prim. poglavji 3: sl. 3.16, 3.17, in 5 v tem zborniku: sl. 5.14–5.16.

<sup>99</sup> E.g. Čufar, Levanič 1998, 63–73.

<sup>100</sup> See Chapters 6 and 7 in this monograph.

<sup>101</sup> See Chapter 6 in this monograph.

<sup>102</sup> See e.g. Chapters 3: *Pls.* 3.1: 9; 3.4: 5,7; 3.9: 4 etc., and 5 in this monograph: *Pls.* 5.3: 5; 5.4: 3; 5.5: 1; 5.8: 7; 5.10: 5; Korošec 1963, *Pls.* 21: 8; 27: 1–5

<sup>103</sup> Compare Chapters 3: *Figs.* 3.12–3.14, and 5 in this monograph: *Figs.* 5.10–5.13.

<sup>104</sup> Compare Chapters 3: *Figs.* 3.16, 3.17, and 5 in this monograph: *Figs.* 5.14–5.16.

<sup>105</sup> See Chapters 3: *Fig.* 3.19: Z1, and 5 in this monograph: *Fig.* 5.17: Z1.

<sup>106</sup> Compare Chapters 3: *Figs.* 3.27, 3.28, and 5 in this monograph: *Figs.* 5.23–5.26.

<sup>107</sup> See e.g. Chapter 3 in this monograph: *Pl.* 3.19: 9–12.

<sup>108</sup> See e.g. Chapter 3 in this monograph: *Pls.* 3.3: 1,2; 3.6: 1,5,6.

najdiščih smo našli tudi zajemalke s polnim držajem.<sup>105</sup> Velika podobnost je tudi v ornamentu.<sup>106</sup>

Razlike med najdiščema niso velike. Omeniti je treba odsotnost posod z ročaji na Blatni Brezovici. Gre za oblike, ki tudi na Starih gmajnah niso pogoste.<sup>107</sup>

Na Starih gmajnah je bilo več skled tipov S9 in S15, z dolgim razčlenjenim držajem oz. razčlenjenim rebrom.<sup>108</sup> Podobne sklede smo našli tudi na Blatni Brezovici, a so maloštevilne in praviloma neornamentirane oz. brez držaja.<sup>109</sup>

Pomembne so tudi primerjave z drugimi najdišči na Ljubljanskem barju. Podobnosti je najti predvsem v naselbinah Hočevarica,<sup>110</sup> Maharski prekop,<sup>111</sup> Črešnja pri Bistri<sup>112</sup> in Notranje Gorice.<sup>113</sup>

Razlike so majhne. Na Hočevarici, ki najbolj izstopa, so poznali brazdasti vrez, ki ga na ostalih najdiščih nismo zasledili.<sup>114</sup> Prav tako sta s Hočevarice tip lonca in vrč, ki ju na ostalih najdiščih nismo našli.<sup>115</sup>

Kakor koli že, nekoliko več podobnosti med Starimi gmajnami in Blatno Brezovico je v delu najdb z Notranjih Goric, kjer so tudi npr. razmeroma pogosti lonci z razčlenjenimi držaji.<sup>116</sup> Zdi se, da gre za obliko, ki na Maharskem prekopu ni bila preveč priljubljena,<sup>117</sup> na Hočevarici pa takšne vrste posodja sploh niso poznali.<sup>118</sup> Niz dveh razčlenjenih reber pod ustjem nam je znan samo z Maharskega prekopa,<sup>119</sup> na ostalih najdiščih takega ornamenta ni bilo najti.

Dolgi razčlenjeni držaji oz. razčlenjena rebra na posodah povezujejo predvsem Stare gmajne<sup>120</sup> in Notranje Gorice.<sup>121</sup> V manjšem številu so jih našli tudi na Maharskem prekopu<sup>122</sup> in na Blatni Brezovici.<sup>123</sup>

Do podobne slike pridemo tudi, če upoštevamo vertikalno razporeditev najdb iz sonde 3 in horizontalno stratigrafijo Starih gmajn. Kakor omenjeno, ugotovili smo dve naselbinski fazi: prva je omejena na zahodni del, druga pa pokriva celotno naselbino. Spodnji reznji od 8 do 6 v sondi 3<sup>124</sup> nedvomno sodijo k spodnjemu delu kulturne plasti, torej v naselbinsko fazo, katere ostanki

Brezovica; however, they are scarce, unornamented or with no lugs as a rule.<sup>109</sup>

Comparisons with other sites of the Ljubljansko barje are also important. Resemblance can be seen above all in settlements such as Hočevarica,<sup>110</sup> Maharski prekop,<sup>111</sup> Črešnja pri Bistri<sup>112</sup> and Notranje Gorice.<sup>113</sup>

Differences are small. Hočevarica, which differs the most, contains pottery with furrowed incision, which does not occur on other sites.<sup>114</sup> Moreover, Hočevarica yielded a type of a pot and jug that are not present on the remaining sites.<sup>115</sup>

Nevertheless, it appears that Stare gmajne and Blatna Brezovica show more resemblance to some of the finds from Notranje Gorice, where also e.g. pots containing lugs with slashed decoration occur fairly regularly.<sup>116</sup> It seems that this is a form, which is not very popular at Maharski prekop<sup>117</sup> and does not occur at all at Hočevarica.<sup>118</sup> Pairs of slashed cordons, attached under rims, are only present at Maharski prekop.<sup>119</sup> This type of ornament is not known on other sites.

Long lugs with slashed decoration or slashed cordons on vessels occur mostly at Stare gmajne<sup>120</sup> and Notranje Gorice.<sup>121</sup> Some of them have also been found at Maharski prekop<sup>122</sup> and Blatna Brezovica.<sup>123</sup>

Similar can be seen if we consider vertical distribution of finds from trench 3 and horizontal stratigraphy of Stare gmajne. As already mentioned, two settlement phases were discovered: the first one is limited on the site's western part and the second one covers the entire site. Lower deepening, nos. 8 to 6 in trench 3,<sup>124</sup> doubtlessly form the lower part of the cultural layer, i.e. the settlement phase dates to the 34<sup>th</sup> century BC<sup>125</sup> and it is chronologically closer to the Maharski prekop pile-dwelling and not to the later settlement phase at Stare gmajne.

In order to prevent mixing of finds from different periods in the analysis, we performed the comparison of finds from deepening<sup>126</sup> mentioned above, with finds from the eastern part of the settlement Stare gmajne, from irrigation ditches 1–6, and trenches 1 and 2,<sup>127</sup> and

<sup>105</sup> Poglavji 3: *sl. 3.19: Z1*, in 5 v tem zborniku: *sl. 5.17: Z1*.

<sup>106</sup> Prim. poglavji 3: *sl. 3.27, 3.28*, in 5 v tem zborniku: *sl. 5.23–5.26*.

<sup>107</sup> Npr. poglavje 3 v tem zborniku: *t. 3.19: 9–12*.

<sup>108</sup> Npr. poglavje 3 v tem zborniku: *t. 3.3: 1,2; 3.6: 1,5,6 itd.*

<sup>109</sup> Poglavje 5 v tem zborniku: *t. 5.6: 3*.

<sup>110</sup> Velušček 2004a.

<sup>111</sup> Bregant 1974a; 1974b; 1975; Velušček 2001.

<sup>112</sup> Velušček et al. 2004.

<sup>113</sup> Harej 1976; 1980.

<sup>114</sup> Velušček 2004c, t. 4.1.5: 12; 4.1.11: 13; 4.1.12.

<sup>115</sup> Npr. Velušček 2004c, t. 4.1.3; 4.1.7: 2.

<sup>116</sup> Harej 1980, t. 2: 1,10; 6: 1–4 itd.

<sup>117</sup> Prim. Bregant 1974a; 1974b; 1975; Velušček 2001.

<sup>118</sup> Prim. Velušček 2004c, 169–183.

<sup>119</sup> Npr. Bregant 1975, t. 33: 15; 36: 9.

<sup>120</sup> Npr. poglavje 3 v tem zborniku: *t. 3.2: 8; 3.3: 1,2*.

<sup>121</sup> Harej 1976, t. 1: 5,8; 2: 5,7; 4: 1; 1980, t. 4: 4,8; 5: 10; 6: 3,4.

<sup>122</sup> Bregant 1975, t. 23: 6; 27: 1,4; 29: 12.

<sup>123</sup> Npr. Korošec 1963, t. 21: 8; 25: 9; 27: 10; 32: 1.

<sup>124</sup> Glej poglavje 3.1.2.3 v tem zborniku.

<sup>109</sup> See Chapter 5 in this monograph: *Pl. 5.6: 3*.

<sup>110</sup> Velušček 2004a.

<sup>111</sup> Bregant 1974a; 1974b; 1975; Velušček 2001.

<sup>112</sup> Velušček et al. 2004.

<sup>113</sup> Harej 1976; 1980.

<sup>114</sup> Velušček 2004c, Pls. 4.1.5: 12; 4.1.11: 13; 4.1.12.

<sup>115</sup> E.g. Velušček 2004c, Pls. 4.1.3; 4.1.7: 2.

<sup>116</sup> Harej 1980, Pls. 2: 1,10; 6: 1–4 etc.

<sup>117</sup> Compare with Bregant 1974a; 1974b; 1975; Velušček 2001.

<sup>118</sup> Compare with Velušček 2004c, 169–183.

<sup>119</sup> E.g. Bregant 1975, Pls. 33: 15; 36: 9.

<sup>120</sup> See e.g. Chapter 3 in this monograph: *Pls. 3.2: 8; 3.3: 1,2*.

<sup>121</sup> Harej 1976, Pls. 1: 5,8; 2: 5,7; 4: 1; 1980, Pls. 4: 4,8; 5: 10; 6: 3,4.

<sup>122</sup> Bregant 1975, Pls. 23: 6; 27: 1,4; 29: 12.

<sup>123</sup> E.g. Korošec 1963, Pls. 21: 8; 25: 9; 27: 10; 32: 1.

<sup>124</sup> See Chapter 3.1.2.3 in this monograph.

<sup>125</sup> Compare with Chapter 7 in this monograph.

<sup>126</sup> See Chapter 3 in this monograph: *Pls. 3.29–3.32*.

<sup>127</sup> See Chapter 3 in this monograph: *Pls. 3.1–3.13*.



so se odlagali v 34. stoletju pr. Kr.<sup>125</sup> in ki je kronološko bližje kolišču Maharski prekop kot mlajša naselbinska faza Starih gmajn.

Da pa v analizi ne bi prišlo do medsebojnega mešanja najdb iz različnih obdobj, smo za primerjavo najdbam iz omenjenih režnjev<sup>126</sup> vzeli najdbe z vzhodnega dela naselbine Stare gmajne, iz odvodnih jarkov 1–6 ter sond 1 in 2,<sup>127</sup> pa tudi z Blatne Brezovice,<sup>128</sup> saj gre za kolišče, ki je zelo verjetno nekoliko mlajše od najmlajše poselitvene faze na Starih gmajnah. Če objavljeno gradivo pozorno preučimo,<sup>129</sup> med medsebojno primerjanimi keramičnimi najdbami ne opazimo bistvenih razlik.

Enako kot velja za Stare gmajne in Blatno Brezovico, velja tudi za celotno skupino obravnavanih najdišč. Tezo, ki zagovarja tipološko podobnost, potrjujejo radiokarbonske datacije in rezultati dendrokronoloških raziskav, ki kažejo, da so si naselbine kronološko blizu. Še več, na podlagi teh raziskav lahko na Ljubljanskem barju koliščarske naselbine iz 4. tisočletja razvrstimo po naslednjem kronološkem vrstnem redu: Hočevarica,<sup>130</sup> Maharski prekop, Črešnja pri Bistri in Spodnje mostišče, Stare gmajne, Veliki Otavnik Ib in Blatna Brezovica.<sup>131</sup> Problematične ostajajo Notranje Gorice, kjer radiokarbonski datumi<sup>132</sup> kažejo, da je bilo najdiščno območje večkrat poseljeno v različnih dobah, in sicer od 4. tisočletja pr. Kr. dalje, kar potrjujeta tudi tipološki analizi keramike.<sup>133</sup>

Govorimo o obdobju med 36. in 31. stoletjem pr. Kr., ko je v srednjem Podonavju dominirala badenska kultura.<sup>134</sup> H. Parzinger<sup>135</sup> je najdišča, kot so Maharski prekop, Blatna Brezovica in Notranje Gorice, uvrstil v horizonta Ljubljansko barje III in IV. Njihov razvoj pa naj bi bil vzporeden razvoju badenske kulture v srednjem Podonavju. Horizont III je primerljiv z boleraško stopnjo, medtem ko je horizont IV mlajši in je sočasen z nadaljevanjem razvoja badenske kulture.

V študiji o prostorski razporeditvi keramike na Maharskem prekopu smo pokazali,<sup>136</sup> da najdbe z Maharskega prekopa lahko uvrstimo v horizont, ki je sočasen z boleraško stopnjo. Gre za ugotovitev, ki se je kasneje potrdila z dendrokronološkimi raziskavami, da je naselbina živel približno za dobo ene generacije v obdobju okoli leta 3500 pr. Kr.<sup>137</sup>

also from Blatna Brezovica,<sup>128</sup> as it is a pile-dwelling that is very probably somewhat later from the latest settlement phase of Stare gmajne. If we carefully consider the published material,<sup>129</sup> it appears that there are no essential differences between the compared ceramic finds.

Nevertheless, the same as applies to Stare gmajne and Blatna Brezovica is also valid for the entire group of sites that we studied. A thesis, which supports the typological resemblance, is furthermore confirmed by radiocarbon dates and results of dendrochronological researches, which indicate that the settlements are chronologically close to one another. Moreover, based on these researches, the Ljubljansko barje pile-dwelling settlements from the 4<sup>th</sup> millennium can be placed into chronological order as follows: Hočevarica,<sup>130</sup> Maharski prekop, Črešnja pri Bistri and Spodnje mostišče, Stare gmajne, Veliki Otavnik Ib and Blatna Brezovica.<sup>131</sup> A question remains at Notranje Gorice; radiocarbon dates<sup>132</sup> indicate that the site was populated several times from the 4<sup>th</sup> millennium BC onwards, which has also been confirmed by typological analyses of pottery.<sup>133</sup>

This is the period between the 36<sup>th</sup> and 31<sup>st</sup> centuries BC, i.e. period when the Baden culture dominated the central Danubian area.<sup>134</sup> H. Parzinger<sup>135</sup> categorised the sites, such as Maharski prekop, Blatna Brezovica and Notranje Gorice to the horizons of the Ljubljansko barje III and IV. Their development was considered to be parallel to the development of the Baden culture in the central Danubian area. The horizon III is comparable to the Boleráz group, while the horizon IV is later and contemporary with the continuation of development of the Baden culture.

A spatial distribution of pottery from Maharski prekop demonstrated<sup>136</sup> that the finds have to be classified as a single horizon, which is parallel to the Boleráz group. Dendrochronological researches later confirmed that the settlement existed for approximately one generation in c. 3500 BC.<sup>137</sup>

If we compare the material from Stare gmajne and Blatna Brezovica – similar applies to all the other sites studied – with the Baden culture material,<sup>138</sup> we can notice that we cannot place the Baden culture on the

<sup>128</sup> See Chapter 5 in this monograph: *Pls. 5.1–5.11* and Korošec 1963, Pls. 17: 13 to Pl. 32.

<sup>129</sup> See Chapters 3 and 5 in this monograph.

<sup>130</sup> Velušček 2004e, 290–295.

<sup>131</sup> See Chapter 7 in this monograph.

<sup>132</sup> Harej 1980, 89.

<sup>133</sup> E.g. Parzinger 1984, 40; Velušček 2004d, 225–228.

<sup>134</sup> See e.g. Raetzl-Fabian, Furholt 2006, Figs. 3 and 4.

<sup>135</sup> 1984.

<sup>136</sup> Velušček 2001.

<sup>137</sup> Velušček, Čufar 2008.

<sup>138</sup> Compare with e.g. Torma 1973, 483–502; Němejcova-Pavuková 1979, 17–55; 1981, 261–296; 1984, 75–146; Cheben 1984, 147–177; Baxa, Kaminská 1984, 179–194; Mayer 1995, 161–176; 1996; Ruttkay 1995, 145–160; Barna 2003, 97–142; Kalicz 2003, 39–47; Schmitsberger 2004, 135–196.

<sup>125</sup> Prim. s poglavjem 7 v tem zborniku.

<sup>126</sup> Glej poglavje 3 v tem zborniku: *t. 3.29–3.32*.

<sup>127</sup> Glej poglavje 3 v tem zborniku: *t. 3.1–3.13*.

<sup>128</sup> Glej poglavje 5 v tem zborniku: *t. 5.1–5.11* in Korošec 1963, t. 17: 13 do t. 32.

<sup>129</sup> Glej poglavji 3 in 5 v tem zborniku.

<sup>130</sup> Velušček 2004e, 290–295.

<sup>131</sup> Poglavje 7 v tem zborniku.

<sup>132</sup> Harej 1980, 89.

<sup>133</sup> Npr. Parzinger 1984, 40; Velušček 2004d, 225–228.

<sup>134</sup> Glej npr. Raetzl-Fabian, Furholt 2006, sl. 3 in 4.

<sup>135</sup> 1984.

<sup>136</sup> Velušček 2001.

<sup>137</sup> Velušček, Čufar 2008.



Če primerjamo gradivo s Starimi gmajni in Blatne Brezovice, podobno pa velja tudi za vsa ostala obravnavana najdišča, z gradivom badenske kulture,<sup>138</sup> je razvidno, da na Ljubljanskem barju ne moremo govoriti o badenski kulturi, temveč se pojavljajo keramične oblike in ornament, ki spominjajo nanjo.<sup>139</sup> Nasprotno pa S. Dimitrijevič<sup>140</sup> celo piše o boleraških importih na Maharskem prekopu.

Še več, zdi se, da je treba izvor večjega števila oblik iskati v domačem okolju na Hočevarici oz. na najdiščih horizonta keramike z brazdastim vrezom v osrednji in vzhodni Sloveniji.<sup>141</sup> Ob tem pa je zaznati zunanje vplive, najprej iz kroga badenske kulture. Naj zato med keramičnimi najdbami naštejemo nekatere očitnejše badenske elemente: Maharski prekop,<sup>142</sup> Stare gmajne<sup>143</sup> in Blatna Brezovica.<sup>144</sup>

Veliko analogij je splošno badenskih, vendar pa tudi iz boleraškega kroga oz. iz obdobja zgodnje badenske kulture<sup>145</sup> kot tudi iz obdobja klasične badenske kulture.<sup>146</sup>

Še večja podobnost za najdbe z omenjenih najdišč na Ljubljanskem barju je v inventarju z Mondseeja, kjer pa so najdišča kronološko premalo občutljiva.<sup>147</sup> Največ analogij je najti predvsem v okviru koliščarske postaje See.<sup>148</sup> Razpršeni radiokarbonski datumi kažejo na čas okoli srede 4. tisočletja pr. Kr.: 4910 ± 130 uncal BP, 4800 ± 90 uncal BP, 4750 ± 90 uncal BP in 4660 ± 80 uncal BP.<sup>149</sup>

Parzinger je pri keramiki z Maharskega prekopa, Blatne Brezovice in Notranjih Goric opozoril tudi na analogije v severni Italiji, predvsem iz kroga kultur Rivoli, Lagozza in v skupine Spilamberto.<sup>150</sup> Slednje velja tudi za Stare gmajne.<sup>151</sup> Na analogije v okviru vzhodnojadran-

<sup>138</sup> Prim. z npr. Torma 1973, 483–502; Němejcova-Pavúková 1979, 17–55; 1981, 261–296; 1984, 75–146; Cheben 1984, 147–177; Baxa, Kaminská 1984, 179–194; Mayer 1995, 161–176; 1996; Ruttikay 1995, 145–160; Barna 2003, 97–142; Kalicz 2003, 39–47; Schmitsberger 2004, 135–196.

<sup>139</sup> Glej še npr. Bregant 1975, 44; Parzinger 1984, 36–40. 1979a, 179.

<sup>141</sup> Velušček 2004d.

<sup>142</sup> Maharski prekop (Bregant 1974b, npr. t. 7: 13; 1975, npr. t. 13: 3,5; 14: 11; 16: 19; 17: 16,18; 21: 2,5; 24: 11; 25: 2; 27: 5; 28: 7; 30: 8; 31: 1; 32: 10,11,14; 33: 5,15; 36: 9; 37: 14; 38: 1), Notranje Gorice (Harej 1976, npr. t. 1: 7; 2: 6; 4: 2,3,5; 7: 12).

<sup>143</sup> Poglavje 3 v tem zborniku: npr. t. 3.1: 3; 3.5: 2,8–10; 3.10: 5; 3.11: 3; 3.15: 14,15; 3.19: 4,5,11; 3.20: 5; 3.24: 8,17; 3.28: 6; 3.32: 7.

<sup>144</sup> Korošec 1963, npr. t. 23: 1; 24: 9; 30: 1; 31: 15; 32: 1,3.

<sup>145</sup> Prim. poglavje 3 v tem zborniku: t. 3.11: 3, in Ecsedy 1982, sl. 20.

<sup>146</sup> Prim. Stare gmajne (poglavje 3 v tem zborniku: t. 3.28: 6) in Nagykanizsa – Billa (Barna 2003, t. 18: 3), kjer gre za najdišče, ki je preliminarno datirano v klasično fazo badenske kulture (Barna 2003, 117).

<sup>147</sup> Glej Ruttikay 1990, 111–121, in prim. z Lochner 1997.

<sup>148</sup> Lochner 1997.

<sup>149</sup> Po Lochner 1997, 64.

<sup>150</sup> Parzinger 1984, 37–39.

<sup>151</sup> Prim. poglavje 3 v tem zborniku: t. 3.9: 4; 3.10: 7, in Parzinger 1984, t. 10: 18.

Ljubljansko barje. Instead, forms of pottery and ornament, resembling the Baden examples, occur.<sup>139</sup> On the contrary, S. Dimitrijevič<sup>140</sup> writes that the imports of the Boleráz group occur at Maharski prekop.

Furthermore, it appears that the origin of a number of forms has to be looked for in close proximity, at Hočevarica or at the sites of central and eastern Slovenia, which contain a horizon of pottery with furrowed incision.<sup>141</sup> Other impacts, mainly of the Baden culture, can also be seen. To list some of the more obvious Baden elements among pottery: Maharski prekop,<sup>142</sup> Stare gmajne<sup>143</sup> and Blatna Brezovica.<sup>144</sup>

Many analogies can generally be ascribed to the Baden culture; however, analogies can be found in the Boleráz group or the period of the Early Baden culture,<sup>145</sup> as well as in the period of the Classical Baden culture.<sup>146</sup>

Even greater resemblance of finds from the mentioned sites on the Ljubljansko barje can be seen in the assemblage from Mondsee, where sites are insufficiently chronologically sensitive.<sup>147</sup> Most analogies can be found at the pile-dwelling station See,<sup>148</sup> dispersed radiocarbon dates place this settlement to the c. mid 4<sup>th</sup> millennium BC: 4910 ± 130 uncal BP, 4800 ± 90 uncal BP, 4750 ± 90 uncal BP and 4660 ± 80 uncal BP.<sup>149</sup>

Parzinger also noted north Italian analogies to pottery from Maharski prekop, Blatna Brezovica and Notranje Gorice, mainly in the circle of the Rivoli and Lagozza cultures and in the Spilamberto group.<sup>150</sup> The latter is also valid at Stare gmajne.<sup>151</sup> Moreover, Dimitrijevič noted analogies to Maharski prekop in the East Adriatic Nakovana culture.<sup>152</sup>

Nevertheless, pottery from the studied sites of the Ljubljansko barje, from Hočevarica to Blatna Brezovica, can doubtlessly be placed into the 4<sup>th</sup> millennium. It, as a fact, elementarily distinguishes from the so-called

<sup>139</sup> See also e.g. Bregant 1975, 44; Parzinger 1984, 36–40. 1979a, 179.

<sup>141</sup> Velušček 2004d.

<sup>142</sup> Maharski prekop (Bregant 1974b, e.g. Pl. 7: 13; 1975, e.g. Pls. 13: 3,5; 14: 11; 16: 19; 17: 16,18; 21: 2,5; 24: 11; 25: 2; 27: 5; 28: 7; 30: 8; 31: 1; 32: 10,11,14; 33: 5,15; 36: 9; 37: 14; 38: 1), Notranje Gorice (Harej 1976, e.g. Pls. 1: 7; 2: 6; 4: 2,3,5; 7: 12).

<sup>143</sup> See Chapter 3 in this monograph: e.g. Pls. 3.1: 3; 3.5: 2,8–10; 3.10: 5; 3.11: 3; 3.15: 14,15; 3.19: 4,5,11; 3.20: 5; 3.24: 8,17; 3.28: 6; 3.32: 7.

<sup>144</sup> Korošec 1963, e.g. Pls. 23: 1; 24: 9; 30: 1; 31: 15; 32: 1,3.

<sup>145</sup> Compare Chapter 3 in this monograph: Pl. 3.11: 3 and Ecsedy 1982, Fig. 20.

<sup>146</sup> Compare Stare gmajne (Chapter 3 in this monograph: Pl. 3.28: 6) and Nagykanizsa – Billa (Barna 2003, Pl. 18: 3), which is preliminary dated to the Classical Baden culture (Barna 2003, 117).

<sup>147</sup> See Ruttikay 1990, 111–121 and compare with Lochner 1997.

<sup>148</sup> Lochner 1997.

<sup>149</sup> After Lochner 1997, 64.

<sup>150</sup> Parzinger 1984, 37–39.

<sup>151</sup> Compare Chapter 3 in this monograph: Pls. 3.9: 4; 3.10: 7 and Parzinger 1984, Pl. 10: 18.

<sup>152</sup> 1979b, 375–376.

ske nakovanske kulture pa je na primeru Maharskega prekopa opozoril že Dimitrijević.<sup>152</sup>

Kakor koli že, keramiko z obravnavanih najdišč Ljubljanskega barja, od Hočevarice pa vse do Blatne Brezovice, lahko z gotovostjo uvrstimo v 4. tisočletje. Dejstvo je, da se bistveno razlikuje od t. i. lasinjske<sup>153</sup> in vučedolske keramike.<sup>154</sup> Prva je bila v uporabi v drugi polovici 5. oz. morda še na začetku 4. tisočletja pr. Kr., druga pa v prvi polovici 3. tisočletja.<sup>155</sup>

Teza je podprta tudi z vertikalnimi stratigrafijami najdišč, kot so Gradec pri Mirni,<sup>156</sup> Moverna vas,<sup>157</sup> Ajdovska jama<sup>158</sup> in Malečnik,<sup>159</sup> kjer ležijo plasti s keramiko iz 5. tisočletja pod plastmi s keramiko iz 4. tisočletja oz. iz obdobja horizonta keramike z brazdastim vrezom, kamor sodi tudi najdišče Hočevarica, ki je, kot omenjeno, na Ljubljanskem barju prvo v nizu najdišč iz 4. tisočletja.

Na pomembno stratigrafsko sekvenco naletimo tudi v jamskem najdišču Podmol pri Kastelcu v zahodni Sloveniji. V skupkih od I oz. od skupka M do E so keramične najdbe, ki so primerljive z najdbami iz 4. tisočletja pr. Kr. na Ljubljanskem barju.<sup>160</sup> Navedeni skupki pa so stratigrafsko mlajši od skupkov z neolitsko keramiko ter starejši od skupkov s keramiko poznoeneolitske/zgodnjebronastodobne ljubljanske kulture.

V tem trenutku se torej zdi, da smo najbližje Parzingerjevi tezi, da v keramičnih najdbah z Maharskega prekopa, Blatne Brezovice in dela Notranjih Goric, kar posledično velja tudi za Stare gmajne, nahajamo analogije tako v okviru boleraške stopnje badenske kulture kot v obdobju klasične badenske kulture pa tudi v drugih kulturah 4. tisočletja pr. Kr. v severni Italiji,<sup>161</sup> na Bavarskem<sup>162</sup> itd.<sup>163</sup> Slednje nedvomno kaže na odprtost Ljubljanskega barja za zunanje vplive z vseh strani.

Kljub vsemu pa se zdi, da so trenutno znana najdišča z zelo podobno keramiko, kot jo poznamo npr. na Starih gmajnah, samo na Ljubljanskem barju, kar je verjetno posledica stanja raziskav in ne odraz dejanskega stanja. Zato je smiselno, da jih, seveda brez Hočevarice, Gornjega mostišča in Strojanske vode, ki so vključeni v horizont keramike z brazdastim vrezom, vključimo v skupino, ki naj jo krstno imenujemo **kulturna skupina Stare gmajne**, pri čemer je treba poudariti, da se zača-

Lasinja<sup>153</sup> and Vučedol pottery.<sup>154</sup> The former was used in the second half of the 5<sup>th</sup>, or perhaps still at the beginning of the 4<sup>th</sup> millennium BC, and the latter in the first half of the 3<sup>rd</sup> millennium.<sup>155</sup>

This thesis is furthermore supported with vertical stratigraphy of the excavation sites such as: Gradec near Mirna,<sup>156</sup> Moverna vas,<sup>157</sup> Ajdovska jama<sup>158</sup> and Malečnik.<sup>159</sup> There, layers with pottery from the 5<sup>th</sup> millennium, lie beneath the layers with pottery from the 4<sup>th</sup> millennium or from the period of horizon of pottery with furrowed incision. Hočevarica, which is, as mentioned above, the earliest among the sites from the 4<sup>th</sup> millennium at the Ljubljansko barje, also belongs to this horizon.

Important stratigraphic sequence can also be seen at the cave site Podmol near Kastelec in western Slovenia. In assemblages starting at I or M to E, we notice ceramic finds that are comparable to the Ljubljansko barje finds, which date to the 4<sup>th</sup> millennium BC.<sup>160</sup> The listed assemblages are stratigraphically later from the assemblages containing Neolithic pottery and earlier from the assemblages containing Late Eneolithic/Early Bronze Age pottery of the Ljubljana culture.

It thus looks like, that, for the moment, we are the closest to Parzinger's thesis; i.e. pottery from Maharski prekop, Blatna Brezovica and some from Notranje Gorice can be compared with the Boleráz horizon of the Baden culture, with the Classical Baden culture and also with the other 4<sup>th</sup> millennium BC cultures in northern Italy,<sup>161</sup> Bavaria<sup>162</sup> etc.<sup>163</sup> The latter doubtlessly shows openness of the Ljubljansko barje for external impacts. The above is consecutively valid also for Stare gmajne.

In spite, it appears that sites with analogous pottery, such as pottery known from e.g. Stare gmajne, only occur at the Ljubljansko barje at the moment. However, this is most probably a consequence of state of researches and does not reflect a genuine situation. Excluding Hočevarica, Gornje mostišče and Strojanska voda, which are categorised to the horizon of pottery with incised decoration, it makes sense to classify them to a group, which we identify as **the Stare gmajne cultural group**. However, we have to emphasize that the provisional expression

<sup>152</sup> 1979b, 375–376.

<sup>153</sup> Prim. z Žižek 2006, 129–140.

<sup>154</sup> Prim. s Korošec, Korošec 1969.

<sup>155</sup> Npr. Forenbaher 1993, 247, sl. 2 in 6; Stadler 1995, tab. 2; Guštin 2005b, sl. 4.

<sup>156</sup> Dular et al. 1991.

<sup>157</sup> Npr. Budja 1992.

<sup>158</sup> Korošec 1975; glej še Velušček 2004d, 243–245.

<sup>159</sup> Strmčnik Gulič 2006, 195–2001.

<sup>160</sup> Turk et al. 1993, t. 2: 14–8: 11; Velušček 2004d, 251–253; prim. z npr. Montagnari Kokelj, Greif, Presello 2002, 51.

<sup>161</sup> Npr. Rivoli in Lagozza.

<sup>162</sup> Skupini Altheim in Cham.

<sup>163</sup> Parzinger 1984, 36–40; glej še Dimitrijević 1979b, 375–376 itd.

<sup>153</sup> Compare with Žižek 2006, 129–140.

<sup>154</sup> Compare with Korošec, Korošec 1969.

<sup>155</sup> E.g. Forenbaher 1993, 247, Figs. 2 and 6; Stadler 1995, Tab. 2; Guštin 2005b, Fig. 4.

<sup>156</sup> Dular et al. 1991.

<sup>157</sup> E.g. Budja 1992.

<sup>158</sup> Korošec 1975; see also Velušček 2004d, 243–245.

<sup>159</sup> Strmčnik Gulič 2006, 195–2001.

<sup>160</sup> Turk et al. 1993, Pls. 2: 14–8: 11; Velušček 2004d, 251–253; compare with e.g. Montagnari Kokelj, Greif, Presello 2002, 51.

<sup>161</sup> E.g. Rivoli and Lagozza.

<sup>162</sup> Altheim and Cham groups.

<sup>163</sup> Parzinger 1984, 36–40; see also Dimitrijević 1979b, 375–376 etc.

sen izraz **maharski facies**, ki ga je pred desetletji uvedel Dimitrijević,<sup>164</sup> zdi manj posrečen.<sup>165</sup>

Razloga za takšno poimenovanje kulturne skupine sta naslednja:

1. Ime Stare gmajne za novodefinirano kulturno skupino se zdi smiselno zaradi dejstva, da gre za naselbinsko območje, ki je, kar je tudi dendrokronološko ugotovljeno, najverjetneje bilo poseljeno dalj časa in je vezni člen med zgodnjimi naselbinami, kot so Maharski prekop, Črešnja pri Bistri in Spodnje mostišče ter poznima koliščema Veliki Otavnik Ib in Blatna Brezovica.<sup>166</sup>

2. Z uporabo takšnega imena se izognemo tudi zamenjevanju s Parzingerjevo delitvijo,<sup>167</sup> v kateri so najdiščna imena Maharski prekop, Blatna Brezovica in Notranje Gorice že uporabljena za kronološki sistem.

Značilnosti, ki opredeljujejo kulturno skupino Stare gmajne, so: izrazito prevladuje redukcijsko žgana keramika, številne so bikonične sklede,<sup>168</sup> predvsem na mlajših najdiščih je veliko tudi loncev z razčlenjenimi držaji. Značilne so tudi zajemalke s polnim držajem. Ročajastih posod je zelo malo, kar velja tudi za ornamentirane posode, če ne upoštevamo razčlenjenih držajev, ki imajo poleg uporabne funkcije zagotovo tudi dekorativno. Pojavljajo se razčlenjena rebra, vrezani linijski motivi, zastopano je tudi vtiskovanje.

Pomembna značilnost kulturne skupine je metalurgija bakra. V tem trenutku so dokazi za metalurško dejavnost na Maharskem prekoku<sup>169</sup> in na Starih gmajnah.<sup>170</sup> Glede na to, da so ostale naselbine minimalno oz. površno raziskane, pa takšno dejavnost lahko pričakujemo tudi drugje na Ljubljanskem barju.

Analiza surovinske sestave glajenih kamnitih orodij iz Ljublanice pri Hočevarici,<sup>171</sup> Starih gmajn, Blatne Brezovice, Notranjih Goric in Maharskega prekopa<sup>172</sup> kaže, da so v obdobju od druge do zadnje četrtine 4. tisočletja pr. Kr. večji del surovin pridobivali v bližnji in daljni okolici Ljubljanskega barja, nekaj surovine je bilo z območij v vzhodnih Alpah, z Visokih Tur, dragoceni primerki, kot sta dve majhni ploščati sekiri, prva iz Ljublanice,<sup>173</sup> druga s Starih gmajn,<sup>174</sup> pa sta prišli iz severozahodne Italije, posamezni primerki tudi z območja Banije, mejnega področja med Hrvaško ter Bosno in Hercegovino.

<sup>164</sup> 1979a, 179; 1979b, 375–376.

<sup>165</sup> Dimitrijević (1979b, 375–376) je najdbe z Maharskega prekopa interpretiral kot mešanico lasinjskih in jadranskih eneolitskih elementov, najdišče pa uvrstil v t. i. maharski facies ter ga datiral v boleraško stopnjo badenske kulture.

<sup>166</sup> Glej poglavje 7 v tem zborniku.

<sup>167</sup> 1984.

<sup>168</sup> Glej poglavji 3.2.1.1.4 in 5.3.2.1.2 v tem zborniku.

<sup>169</sup> Velušček, Greif 1998.

<sup>170</sup> Poglavje 1.2.1.1 v tem prispevku.

<sup>171</sup> Bernardini et al. 2006–2007, 53–73.

<sup>172</sup> Peloi 1996–1997 in poglavje 12 v tem zborniku.

<sup>173</sup> Bernardini et al. 2006–2007, sl. 2: 7.

<sup>174</sup> Poglavje 3 v tem zborniku: t. 3.16: 13.

**Maharski prekop facies**, proposed by Dimitrijević decades ago,<sup>164</sup> does not seem appropriate.<sup>165</sup>

There are two reasons for proposing this name:

1. Stare gmajne seems a reasonable term to describe a newly-defined cultural group, due to the fact, that it is a settlement that was most probably populated for a long time, which is also dendrochronologically documented. Furthermore, it connects the early settlements, such as Maharski prekop, Črešnja pri Bistri and Spodnje mostišče and the late pile-dwellings Veliki Otavnik Ib and Blatna Brezovica.<sup>166</sup>

2. With the use of this term we differentiate from Parzinger's classification<sup>167</sup> where names as Maharski prekop, Blatna Brezovica and Notranje Gorice were used for chronological system.

Characteristics, defining the Stare gmajne cultural group are: reduced ware explicitly prevails, biconical dishes are numerous,<sup>168</sup> a lot of pots with lugs with slashed decoration occur, mostly on later sites. Ladles with solid handles are also characteristic. Only a small amount of handled vessels, which also applies to ornamented vessels, occur, if we do not consider lugs with slashed decoration that definitely also have decoratively function apart from the useful one. Slashed cordons, etched lines in shape of incised decoration and impressing are also represented.

Copper metallurgy is an important feature of this cultural group. So far, Maharski prekop<sup>169</sup> and Stare gmajne<sup>170</sup> have yielded evidence for metallurgic activity. However, considering that other settlements are minimally or superficially researched, we could also expect such activity elsewhere at the Ljubljansko barje.

Analysis of raw material of polished stone tools from the Ljublanica at Hočevarica,<sup>171</sup> Stare gmajne, Blatna Brezovica, Notranje Gorice and Maharski prekop<sup>172</sup> indicates that, in the period from the second to the last quarter of the 4<sup>th</sup> millennium BC, most of the raw material was gained nearby and in wider surroundings of the Ljubljansko barje, some of raw material originates from the Eastern Alps, from Hohe Tauern, valuable specimens, such as two small flat axes, one from the Ljublanica<sup>173</sup> and the other from Stare gmajne,<sup>174</sup> originate from north-western Italy, and individual specimens also came from Banija, the boundary area between Croatia and Bosnia and Herzegovina.

<sup>164</sup> 1979a, 179; 1979b, 375–376.

<sup>165</sup> Dimitrijević (1979b, 375–376) interpreted finds from Maharski prekop as a mixture of the Lasinja and Adriatic Eneolithic elements, categorised the site in the so-called Maharski prekop facies and dated it to the Boleráz group of the Baden culture.

<sup>166</sup> See Chapter 7 in this monograph.

<sup>167</sup> 1984.

<sup>168</sup> See Chapters 3.2.1.1.4 and 5.3.2.1.2 in this monograph.

<sup>169</sup> Velušček, Greif 1998.

<sup>170</sup> See Chapter 1.2.1.1 in this monograph.

<sup>171</sup> Bernardini et al. 2006–2007, 53–73.

<sup>172</sup> Chapter 12 in this monograph and Peloi 1996–1997.

<sup>173</sup> Bernardini et al. 2006–2007, Fig. 2: 7.

<sup>174</sup> See Chapter 3 in this monograph: Pl. 3.16: 13

Omenjene analize ponovno dokazujejo, da v 4. tisočletju pr. Kr. Ljubljansko barje s samosvojo kulturno skupino Stare gmajne očitno ni bilo vase zaprt svet, kar se nedvomno kaže tudi v opaznem vplivu pri izdelovanju keramike, pa tudi v izjemni najdbi, kot je del podvozja prazgodovinskega voza, ki je v času, ko je bil narejen, zagotovo bil prvovrstna atrakcija in pomemben statusni simbol.

#### 1.4 SKLEP

Na podlagi radiokarbonskih datacij in dendrokronoloških raziskav lahko rečemo, da so v drugi četrtini 4. tisočletja pr. Kr. na Ljubljanskem barju živeli ljudje, ki so se ukvarjali z metalurgijo bakra. Njihova prisotnost je bila, tako se zdi, bolj ali manj kontinuirana vse do zadnje četrtine 4. tisočletja, ko je življenje na Starih gmajnah, Velikem Otavniku Ib in Blatni Brezovici zamrlo.

Koliščarske naselbine, kot so Notranje Gorice, Maharski prekop, Črešnja pri Bistri, Spodnje mostišče, Stare gmajne, Veliki Otavnik Ib in Blatna Brezovica, smo uvrstili v novodefinirano kulturno skupino Stare gmajne. Absolutno kronološko govorimo o času med 36. in 31. stoletjem pr. Kr.

Značilnost kulturne skupine Stare gmajne je, da je nadaljevala tradicijo, ki so jo v osrednjo Slovenijo in na Ljubljansko barje prinesli nosilci keramike z brazdastim vrezom. Skupina je bila hkrati dovzetna za novosti, med katerimi je treba izpostaviti leseno kolo z osjo s Starih gmajn, ki nedvomno dokazuje vrhunsko znanje in tudi, da so prazgodovinski mojstri zelo dobro poznali naravo.

Po mnenju F. Bernardinija in sodelavcev<sup>175</sup> je Ljubljansko barje v 4. tisočletju pr. Kr. prevzelo osrednjo posredniško vlogo med severovzhodnoitalijanskim ozemljem in Podonavjem ter med Balkanom in vzhodnoalpskim svetom. Razloge je iskati v povpraševanju po bakrovi rudi. Prav upad "zanimanja" za baker<sup>176</sup> v drugi polovici 4. tisočletja pa je bržkone bil eden izmed glavnih vzrokov, da je Ljubljansko barje od zgodnjega 31. stoletja dalje za več stoletij ponovno opustelo.<sup>177</sup>

The analyses mentioned prove yet again that, in 4<sup>th</sup> millennium BC, the Ljubljansko barje with its unique Stare gmajne cultural group, was obviously not a recluse world. This is doubtlessly also reflected in noticeable impact of pottery making and in exceptional finds, such as a part of an undercarriage of a prehistoric cart, which was definitely a first-rate attraction and an important status symbol of its time.

#### 1.4 CONCLUSION

Radiocarbon dates and dendrochronological researches show that people, engaging in copper metalurgy, were present at the Ljubljansko barje in the second quarter of the 4<sup>th</sup> millennium BC. They were more or less continuously present until the last quarter of the 4<sup>th</sup> millennium, when Stare gmajne, Veliki Otavnik Ib and Blatna Brezovica were abandoned.

Pile-dwelling settlements such as Notranje Gorice, Maharski prekop, Črešnja pri Bistri, Spodnje mostišče, Stare gmajne, Veliki Otavnik Ib and Blatna Brezovica were categorised as the newly-defined Stare gmajne cultural group. Absolute chronologically speaking, this is the time between 36<sup>th</sup> and 31<sup>st</sup> centuries BC.

What is characteristic for the Stare gmajne cultural group is a continuation of tradition, brought to central Slovenia and to the Ljubljansko barje by people that used pottery with furrowed incision. At the same time, the group is responsive to novelties such as a wooden wheel with an axle from Stare gmajne, which has to be emphasized as it doubtlessly proves top-level skills and prehistoric masters, which were familiar with the environment surrounding them.

According to F. Bernardini et al.,<sup>175</sup> the Ljubljansko barje takes over a key role as a mediator between north-eastern Italian region and the Danubian area and between the Balkans and the Eastern Alps in 4<sup>th</sup> millennium BC; the reason being copper ore. Decline in "interest" for copper<sup>176</sup> in the second half of the 4<sup>th</sup> millennium seems like one of the main causes that the Ljubljansko barje became desolated for many centuries after the early 31<sup>st</sup> century.<sup>177</sup>

<sup>175</sup> Poglavje 12 v tem zborniku.

<sup>176</sup> Npr. Maran 1998; Cevey et al. 2006.

<sup>177</sup> Glej Velušček 2004g, 77–79.

<sup>175</sup> See Chapter 12 in this monograph.

<sup>176</sup> E.g. Maran 1998; Cevey et al. 2006.

<sup>177</sup> See Velušček 2004g, 77–79.



## 2. SEDIMENTOLOŠKA METODA UGOTAVLJANJA PALEOOKOLJSKIH RAZMER NA LJUBLJANSKEM BARJU, PRIMER STARIH GMAJN

Janez TURK & Aleksander HORVAT

## 2. SEDIMETOLOGICAL METHOD FOR DETERMINATION OF PALAEOENVIRONMENTAL CONDITIONS AT THE LJUBLJANSKO BARJE. CASE STUDY: STARE GMAJNE

Janez TURK & Aleksander HORVAT

### Izvleček

Sedimente iz dveh med seboj približno 100 m oddaljenih profilov smo razdelili na več nivojev (vzorcev) ter jih mikroskopsko pregledali in določili kvantitativno mineraloško sestavo. Na podlagi te analize in granulometrije ter analize diatomelj v izbranih nivojih smo skleпали na sedimentacijska okolja. Skupna debelina analiziranih sedimentov ni presegala 1,6 m (profil: SG-12). V tem sedimentnem zaporedju smo ločili pozno jezersko fazo, močvirsko fazo in humusne sedimente, ki se odlagajo v današnjem času, po izsušitvi Ljubljanskega barja. Zanimivo je, da v profilu SG-6 močvirski sedimenti oz. šota manjka, saj humus leži neposredno na gytiji.

**Ključne besede:** granulometrija, jezerski sedimenti, močvirska sedimentacija, barje, humus, diatomeje, Stare gmajne, Ljubljansko barje, Slovenija.

### Abstract

We distributed sediments from two profiles, taken approximately 100 m from one another, to more levels (samples), studied them microscopically and appointed quantitatively mineralogical composition. Based on this analysis, granulometry and analysis of diatoms in levels chosen, we assumed on sedimentary environments. Total thickness of analysed sediments was not greater than 1.6 m (profile: SG-12). In this sedimentary sequence we distinguished the late lake phase of development, marsh phase of development and the humus sediments. Deposition of latter sediments is recent, i.e. after the Ljubljansko barje was dried out. It is interesting, that marsh sediments/peat lacks do not appear in profile SG-6, as the humus lies directly on top of gyttia.

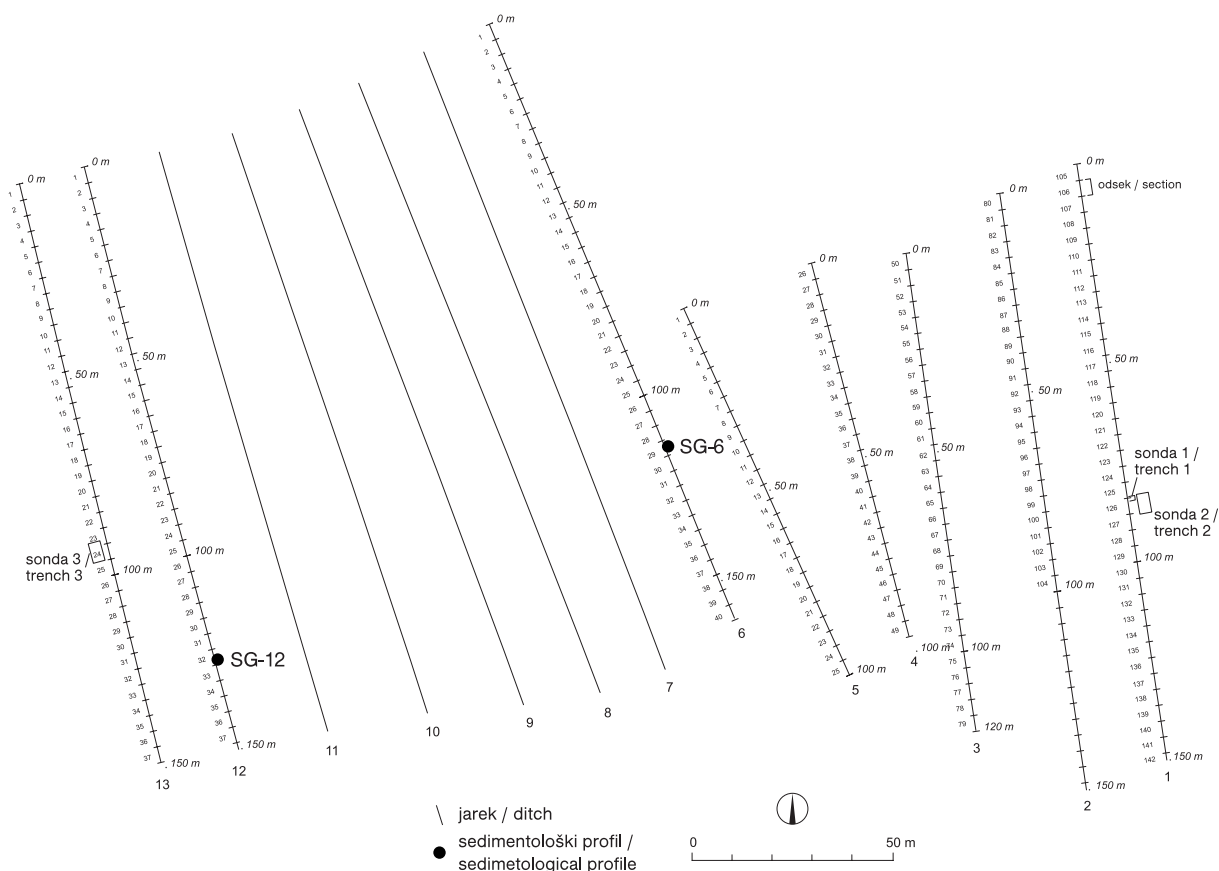
**Keywords:** granulometry, lake sediments, marsh sedimentation, moor, humus, diatoms, Stare gmajne, the Ljubljansko barje, Slovenia.

### 2.1 UVOD

Ljubljansko barje je zapolnjena tektonska udornina, ki je z vseh strani obdana z okoliškimi hribovji, le na severu se odpira proti Ljubljanskemu polju, kjer sega vse do južnih obronkov Ljubljane. Po površju Ljubljanskega barja tečejo reka Ljubljanica in njeni številni pritoki, med katerimi so pomembnejši Podlipščica, Bistra, Borovniščica, Iška, Iščica in Želimeljščica. Površina Barja je skoraj popolnoma ravna in zato je odtok vode počasen. Hkrati je vrhnji del sedimentov za vodo neprepusten. Zaradi

### 2.1 INTRODUCTION

The Ljubljansko barje is an infilled tectonic depression, surrounded by hills. Depression is opened only on the northern side, towards the Ljubljansko polje, where it stretches all the way to the southern margin of Ljubljana. The most important stream in Ljubljansko barje is the River Ljubljanica. It has numerous tributaries such as Podlipščica, Bistra, Borovniščica, Iška, Iščica and Želimeljščica. Surface of the Barje is almost entirely flat and therefore the water drains slowly. Moreover, the top



Sl. 2.1: Načrt kolišča Stare gmajne z vrisanimi profiloma SG-12 in SG-6. Pripravila: T. Korošec.

Fig. 2.1: Plan of the pile-dwelling Stare gmajne with profiles SG-12 and SG-6. Prepared by: T. Korošec.

vseh teh vzrokov je bilo ozemlje zamočvirjeno.<sup>1</sup> Šele v zadnjih stoletjih je človek z melioracijo Ljubljansko barje izsušil.

Tektonska udornina je nastala pred približno dvema milijonoma let in je v celoti zapolnjena s kvartarnimi sedimenti, večinoma rečnega, jezerskega in močvirskega izvora.<sup>2</sup> Kamninska osnova na dnu udornine je sestavljena iz zgornjetriasnih dolomitov in jurskih apnencev na južnem, osrednjem in zahodnem delu ter triasnih in karbonsko-permskih skrilavih glinovcev in peščenjakov na severnem in vzhodnem delu udornine. Kvartarni sedimentni pokrov je zastopan s prodnatimi, glinenimi in šotnimi plastmi. Skupna debelina teh sedimentov znaša do 150 m.<sup>3</sup>

Spodnji del kvartarnih sedimentov sestavljajo prodno-peščeni nanosi potokov, ki so prekinjeni z vmesnimi glinasto-meljastimi plastmi. Vrhnji del predstavljajo jezerske in močvirske usedline (heterogene plasti gline, organski ostanki in šota), ki so prav tako prekinjeni s posameznimi prodno-peščeni nanosi lokalnih potokov.<sup>4</sup>

part of the sediments is impermeable; due to these causes the area was marshy.<sup>1</sup> It was only in the last centuries when the Ljubljansko barje was meliorated.

The depression was formed approximately two million years ago and it is entirely infilled with Quaternary sediments, mostly of river, lake and marsh origin.<sup>2</sup>

Stone base of the depression is built of Upper Triassic dolomites and of Jurassic limestones on southern, central and western part and of Triassic and Carboniferous-Permian mudstones and of sandstones on northern and eastern part of the depression. Quaternary sediment cover is represented with gravelly, clayey and peaty layers. Total thickness of these sediments is up to 150 m.<sup>3</sup>

The lower part of the Quaternary sediments is composed of gravelly sandy stream deposits with interbeds of clayey siltstone layers. Lake and marsh sediments present the top part (heterogeneous layers of clay, organic remains and peat), with interbeds of gravelly sandy deposits discharged by the local streams.<sup>4</sup>

<sup>1</sup> Mencej 1989.

<sup>2</sup> Pavšič 1989.

<sup>3</sup> Mencej 1989.

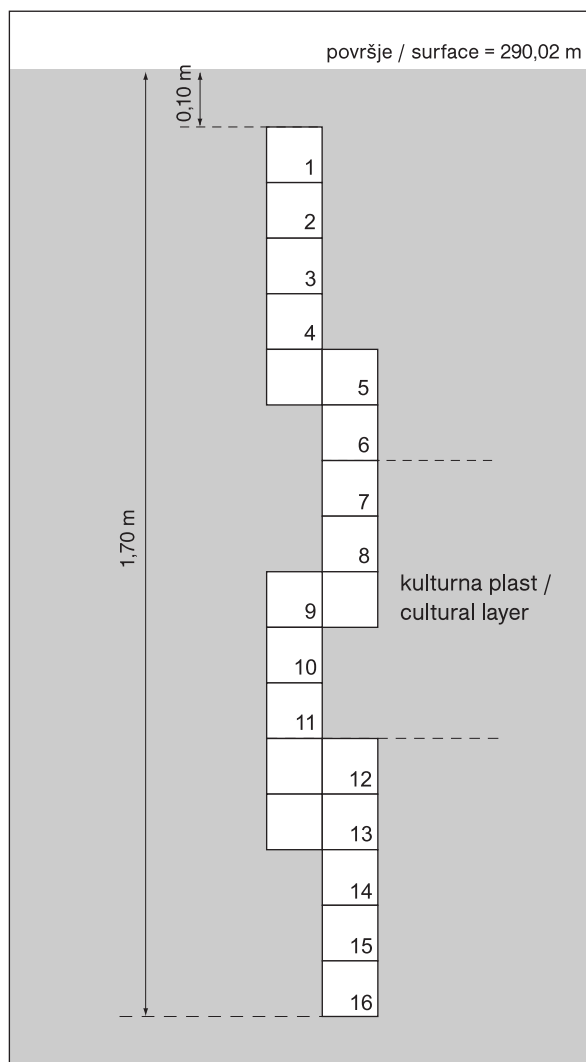
<sup>4</sup> Prestor, Janža 2002.

<sup>1</sup> Mencej 1989

<sup>2</sup> Pavšič 1989.

<sup>3</sup> Mencej 1989.

<sup>4</sup> Prestor, Janža 2002.



Sl. 2.2: Stare gmajne. Shematiziran prikaz vzorčenja v steni jarka 12 (SG-12). Risba: T. Korošec.

Fig. 2.2: Stare gmajne. Stylised model of sampling within profile in the drainage ditch no. 12 (SG-12). Drawn by: T. Korošec.

Na območjih, kjer se hudourniški potoki izlivajo s hribovij na Ljubljansko barje, so nastali vršaji, ki so sestavljeni iz peščene gline, glinastega melja ter slabo zaobljenih prodnikov peščenjaka in skrilavega glinovca. Prodni vršaji segajo celo daleč na barje, pod jezerske in močvirske plasti.<sup>5</sup>

Arheološko najdišče Stare gmajne leži na jugozahodnem delu Ljubljanskega barja, med Bistrom in Verdrom. V bližini najdišča tečeta reka Ljubljanica in njen manjši pritok Bistra. Koliščarska naselbina sega v čas bakrene dobe, v obdobje med 5500 in 5000 let pred sedanostjo.<sup>6</sup> V približno tem času so se odlagali najstarejši sedimenti, obravnavani v naši raziskavi. Sedimentacija je potekala vse do sedanosti. Geološko gledano so vsi ti sedimenti

<sup>5</sup> Mencej 1989.

<sup>6</sup> Poglavji 3 in 7 v tem zborniku.

In areas, where torrential streams flow from hills to the Barje, fans were formed, made of sandy clay, clayey siltstones, coarse sandstone pebbles and mudstone. Gravelly fans reach far into the Barje, under lake and marsh layers.<sup>5</sup>

The archaeological site Stare gmajne lies on south-western part of the Ljubljansko barje, between Bistra and Verd. The River Ljubljanica and its smaller tributary Bistra flow in the vicinity of the site. Pile-dwelling settlement dates to the Copper Age, to 5500 and 5000 cal BP.<sup>6</sup> At that time the oldest sediments, considered in our research, were deposited. Sedimentation has been taking place ever since. All these sediments are, from geological perspective, of the Holocene origin, dating from the end of the last Ice Age to present. In spite of comparatively short period, the environmental circumstances changed drastically. Lake slowly transformed to marsh, the Ljubljanica and especially its tributaries were occasionally discharging sand and gravel at flood conditions. The majority of environmental changes are recorded in sediments, if these were not eroded or removed in any other way. We took samples from adjoining profiles on the site due to this reason (Fig. 2.1). Sequences of sediments, considered in the article, encompass only the utmost top part of surface layers with lake and marsh sediments and occasional flood deposits of the Ljubljanica. These sediments on the Ljubljansko barje present over 30 m thick sedimentary deposits,<sup>7</sup> while we analysed a total of 1.6 m and 1.2 m thick sedimentary sequences (measured from surface downward). The first profile comprises sediments between absolute heights 288.32 and 289.92 m (profile SG-12, Fig. 2.2), and the second one between 288.29 and 289.49 m (profile SG-6, Fig. 2.3). Profiles lay approximately 100 m apart (Fig. 2.1). The sediment columns studied comprised former organic floor that, after Tancik,<sup>8</sup> developed at forming of lakes.

## 2.2 RESULTS AND INTERPRETATION

Sedimentary sequences were divided into several samples. In profiles sediments were sampled every 10 cm. We separated every sample in two fractions by wet sieving; same was done at samples from Resnikov prekop.<sup>9</sup>

All samples from thicker, 0.2–2 mm fraction were inspected with a stereo microscope. Texture of this fraction was then compared with fraction below 0.2 mm (examined under optical microscope) with an attempt to align and interpret the results. In addition, the small

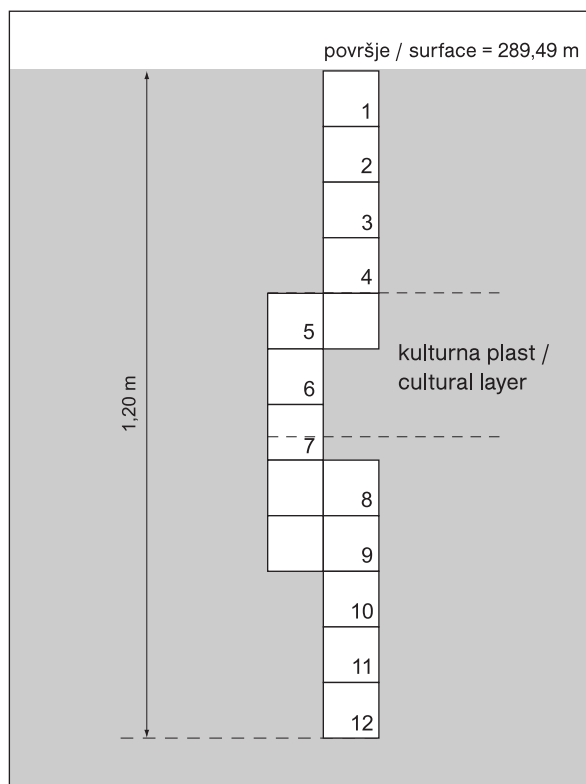
<sup>5</sup> Mencej 1989.

<sup>6</sup> See Chapters 3 and 7 in this monograph.

<sup>7</sup> Prestor, Janža 2002.

<sup>8</sup> 1965.

<sup>9</sup> Turk 2006.



Sl. 2.3: Stare gmajne. Shematiziran prikaz vzorčenja v steni jarka 6 (SG-6). Risba: T. Korošec.

Fig. 2.3: Stare gmajne. Stylised model of sampling within profile in the drainage ditch no. 6 (SG-6). Drawn by: T. Korošec.

holocenskega nastanka. Kljub razmeroma kratkemu obdobju so se okoljske razmere temeljito spremenile. Jezero je počasi prehajalo v barjansko okolje, Ljubljana in predvsem njeni pritoki pa so ob velikih nalivih občasno nanašali pesek in prod. Večina okoljskih sprememb je zapisana v sedimentih, v kolikor ti niso bili erodirani ali kako drugače odstranjeni. V ta namen smo na najdišču odvzeli vzorce iz dveh sosednjih profilov (sl. 2.1). Zaporedni sedimentov, ki so obravnavani v članku, obsegata le skrajni vrhni del površinskih plasti z jezerskimi in močvirskimi usedlinami ter občasnimi poplavnimi nanosi Ljubljane. Ti sedimenti predstavljajo na Ljubljanskem barju 30 m in več debel sedimentni nanos,<sup>7</sup> medtem ko smo mi analizirali skupno 1,6 m in 1,2 m debeli sedimentni zaporedji (merjeno od površine navzdol). Prvi profil obsega sedimente med absolutnima višinama 288,32 in 289,92 m (profil SG-12, sl. 2.2), drugi pa med višinama 288,29 in 289,49 m (profil SG-6, sl. 2.3). Razdalja med profiloma je znašala približno 100 m. Obravnavana sedimentna stolpca sta po Tanciku<sup>8</sup> del nekdanjih organskih tal, ki so se razvila ob ojezeritvah.

<sup>7</sup> Prestor, Janža 2002.

<sup>8</sup> 1965.

fraction was also analysed with granulometry. Methodology was the same as in 2006.<sup>10</sup>

Some sedimentological slides were also palaeontologically studied. We were interested in relative representation of diatom genera, as diatoms are good indicator of ecological conditions that were prevailing during the time of sedimentation.

## 2.2.1 THE 0.2–2 mm FRACTION

### 2.2.1.1 PROFILE SG-12

Samples 16, 15 and 14 are characteristic for carbonate, water environments.<sup>11</sup> Mineral grains are not apparent, instead, small white aggregates, that present c. 40 % of the entire sediment, are present. Organic remains of vegetal as well as animal origin form the rest. Ostracod valves and oogonia of Haracea are numerous and well preserved. Evident mineral grains are extremely rare.

Samples 13 and 12 are different, composed almost solely of organic substance of vegetal origin. Percent of mineral grains is extremely small, less than 1 %. However, the two samples elementarily differentiate in structure as well as appearance of organic substance.

In sample 13 individual, mostly ostracod valves and probably shells still occur, similarly as in underlying sediments, but not in the top layer. Structures in organic grains in sample 13 are evident, their colour is brighter (brown), similar as in underlying ("lake") samples. Organic grains are somewhat larger in the top layer sample 12.

Organic material (vegetal remains) in sample 12 is explicitly dark, black and fine. Structures in sample 12 are not apparent and it is hard to say whether organic substance were stalks, bark or other parts of plants. Sample probably belongs to the gyttia. Considering described features of sediments, we could place the upper margin of "lake sediments", i.e. the gyttia somewhere between sample 13 and 12.

Considerable difference is apparent in samples 11 to 9. Percent of mineral grains increases extremely in them. The percentage of them is approximately the same or slightly larger as the percent of organic grains. Enlarged proportion of mineral grains corresponds with some sort of prominent palaeoenvironmental change, which is also evident from the analysis of the fraction below 0.2 mm.

The rest of the samples (8 to 1), which lie high in the profile, have their characteristics similar to humus. Samples 4 and 3 are exceptions, due to the lack of data about their composition. Almost entire material from both samples was sifted through 0.2 mm sieve, so there was no material left for stereo microscope analysis.

<sup>10</sup> Turk 2006.

<sup>11</sup> Turk 2006.



## 2.2 REZULTATI IN RAZLAGA

Sedimentni zaporedji smo razdelili na več vzorcev. V profilih smo vzorčevali sedimente na vsakih 10 cm. Vsak vzorec smo ločili na dve frakciji s pomočjo mokrega sejanja, enako kot pri vzorcih z Resnikovega prekopa.<sup>9</sup>

Vsi vzorci debelejšje frakcije, tj. 0,2–2 mm, so bili pregledani pod lupo. Značilnosti te frakcije smo nato primerjali s frakcijo manjšo od 0,2 mm (pregledano pod optičnim mikroskopom), in ugotovitve poskušali uskladiti ter interpretirati. Nadalje smo drobno frakcijo podrobneje analizirali tudi z granulometrijsko metodo. Metodologija je bila enaka kot leta 2006.<sup>10</sup>

Nekateri sedimentološki preparati so bili pregledani tudi paleontološko. Zanimale so nas relativne zastopnosti rodov diatomej, saj so te dober kazalnik ekoloških razmer, ki so prevladovali v času sedimentacije.

### 2.2.1 FRAKCIJA DEBELINE 0,2 DO 2 mm

#### 2.2.1.1 PROFIL SG-12

Vzorci 16, 15 in 14 so po svojih lastnostih značilni za karbonatna, vodna okolja.<sup>11</sup> V njih namreč ni jasno izraženih mineralnih zrn marveč droben bel agregat, ki predstavlja okoli 40 % celotnega sedimenta. Ostalo so organski ostanki, tako rastlinskega kot živalskega izvora. Številne in lepo ohranjene so lupinice ostrakodov in oogoniji haracej. Jasno izražena mineralna zrna so izredno redka.

Sprememba se pojavi v vzorcih 13 in 12, ki ju sestavljajo skoraj izključno organske snovi rastlinskega izvora. Delež mineralnih zrn je izredno majhen in ne preseže 1 %. Vendar se vzorca med seboj bistveno razlikujeta v zgradbi in videzu organske snovi.

V vzorcu 13 se še pojavljajo posamezne lupinice predvsem ostrakodov in verjetno školjk, podobno kot v talninskih sedimentih, v krovnini pa ne več. V vzorcu 13 so strukture v organskih zrnih razpoznavne, njihova barva je svetlejša (rjava), podobna kot v talninskih ("jezerskih") vzorcih. Organska zrna so nekoliko večja kot v krovninskem vzorcu 12.

V vzorcu 12 je organska snov (rastlinski ostanki) izrazito temne, črne barve in zelo drobna. Strukture v vzorcu 12 niso razpoznavne, tako da je težko reči, ali organska snov pripada stebelom, lubju ali drugim delom rastlin. Vzorec verjetno pripada gytiji.

Glede na opisane značilnosti sedimentov bi zgornjo mejo "jezerskih sedimentov" oz. gytije uvrstili nekje med vzorca 13 in 12.

Izrazita sprememba glede na talnino se pojavi v vzorcih 11 do 9. V njih je delež mineralnih zrn izjemno

Samples 8 to 1 are almost entirely from organic substances. Namely, they are organic remains of plants, with noticeable remains of various stalks, bark, of seed etc. Mineral grains are extremely rare and they represent 1 % of material inside individual sample at most. Only sample 5 is slightly different, as it contains some more mineral grains, which reminds a particular sedimentary occasion in time of deposition of sediments inside the sample itself.

#### 2.2.1.2 PROFILE SG-6

Fine grain white aggregates prevail in basal layer samples 12 to 9, presumably from shallow-lake (to marshy?) sedimentation. Proportion of them is 40 to 60 %. Percentage of organic remains (mainly of vegetal origin) is high. Moreover, ostracod valves and oogonia of Haracea are numerous, representing approximately one third of all organic substances. Only sample 11 contains somewhat less. Mineral grains are very rare in these samples, as we can find only individual grains.

Difference is apparent in sample 8, where percentage of aggregate substance reduces to c. 20 %. Among numerous organic remains we can also find ostracod valves and perhaps shells.

Samples 7 to 1 are composed almost entirely of organic remains of vegetal origin. Percent of mineral grains is less than 1 %, with the exception of samples 5 and 4, where proportion of mineral grains reaches a few percents. Compositions of vegetal organic remains are apparent, with remains of stalks, bark and various seeds visible. Snail shells were present in samples 3 and 1. Moreover, individual fragments of animal shells/valves were found in samples 7, 6 and 5.

### 2.2.2 THE FRACTION BELOW 0.2 mm

#### 2.2.2.1 DESCRIPTION OF PROFILE SG-12

The main characteristic of basal samples (16 to 14) is a high proportion of carbonate (60–83 %) that strongly prevails over quartz and organic grains (*Fig. 2.4*). Proportion of carbonate clearly prevails in the lowest of the studied samples, while in the other two, higher-lying samples, the proportion of organic grains slowly approaches the proportion of carbonate, with the proportions equalizing in sample 13. Although carbonate grains strongly prevail, their proportion is considerably higher within pure lake marl (> 90 %). We therefore presume that the studied sediments present transitional sediment between lake marl and peat, perhaps gytia. Sedimentary environment would therefore be a shallow lake with rich aquatic or marsh flora.

Diatoms are present in all basal samples, with their percentage being comparatively low.

<sup>9</sup> Turk 2006.

<sup>10</sup> Turk 2006.

<sup>11</sup> Turk 2006.

poveča in je približno enak ali pa celo rahlo presega delež organskih zrn. Povečanje deleža mineralnih zrn se ujema z neko izrazitejšo paleoekološko spremembo, kar nakazuje tudi analiza frakcije, manjše od 0,2 mm.

Ostali višje ležeči vzorci (8 do 1) so po svojih značilnostih podobni humusu. Izjema sta vzorca 4 in 3, za katera nimamo podatkov o njihovi sestavi. Pri obeh vzorcih se je praktično ves material presejal skozi sito z odprtini 0,2 mm, tako da materiala za analizo pod lupo ni bilo na razpolago.

Vzorci 8 do 1 sestavljajo skoraj izključno organske snovi. In sicer gre za organske ostanke rastlin, med katerimi lahko opazimo razna stebila, lubje, semena itd. Mineralna zrna so izredno redka in predstavljajo največ 1 % materiala v posameznem vzorcu. Iztopa le vzorec 5, ki ima nekoliko več mineralnih zrn, kar nakazuje na neki značilen sedimentacijski dogodek v času odlaganja sedimentov v ta vzorec.

### 2.2.1.2 PROFIL SG-6

V talninskih vzorcih 12 do 9, ki jih pripisujemo plitvo jezerski (do močvirski?) sedimentaciji, prevladujejo drobnozrnati beli agregati. Njihov delež se giblje med 40 do 60 %. Visok je delež organskih ostankov (predvsem rastlinskega izvora). Prav tako so številne lupinice ostrakodov in oogonijev haracej, ki skupaj predstavljajo približno tretjino vse organske snovi. Nekoliko manj jih je le v vzorcu 11. Mineralna zrna v teh vzorcih so zelo redka, najdemo le posamezna.

Sprememba se pojavi v vzorcu 8, kjer se delež agregatne snovi zmanjša na okoli 20 %. Med številnimi organskimi ostanki so tudi lupinice ostrakodov in morda školjk.

Vzorci 7 do 1 sestavljajo skoraj izključno organski ostanke rastlinskega izvora. Mineralnih zrn je pod 1 %, izjema sta le vzorca 5 in 4, v katerih doseže njihov delež nekaj odstotkov. Strukture rastlinskih organskih ostankov so lepo vidne, in sicer gre za ostanke stebel, lubja in razna semena. V vzorcu 3 in 1 so bile najdene polžje hišice. Prav tako so bili posamezni fragmenti živalskih lupinic najdeni v vzorcih 7, 6 in 5.

## 2.2.2 FRAKCIJA DEBELINE MANJŠE OD 0,2 mm

### 2.2.2.1 OPIS PROFILA SG-12

Poglavitna značilnost talninskih vzorcev (16 do 14) je visok delež karbonata (60–83 %), ki močno prevladuje nad kremenom in organskimi zrnji (sl. 2.4). Delež karbonata je izrazito prevladujoč v najnižjem izmed obravnavanih vzorcev, v sosednjih dveh višje ležečih vzorcih pa se delež organskih zrn počasi približuje deležu

The middle part of profile is composed of transitional samples 12 to 7, which, according to their characteristics, most probably belong to peat. The proportion of organic grains gradually decreases upwards (Fig. 2.4). Proportion of organic grains is highest, as much as c. 90 %, in the lower sample of peaty part of profile. However, the top sample of peat contains very low proportion of organic substance (12 %). Proportion of quartz is in reverse proportion with proportion of organic substance and increases upwards from a few ‰ to 76 % within uppermost sample of the middle part of profile. Proportion of carbonate grains is low, but characteristic. Carbonate grains combined with organic substance, indicate marshy environment at the time of deposition of sediments. Another indicator of aquatic or marshy environment is also decreasing proportion of diatoms, that are present up to sample 10, but not within samples higher up. The top sample 7 is the most different of all peat samples, as the proportion of quartz grains prevails above the proportion of organic substances. A flood could explain this, when the Ljubljanica discharged large amounts of fine-grained (quartz) flood sediments. Samples 8 and 7 were, according to their characteristics, categorised as the middle/transitional layer, that we characterised as peat, in contrast with the fraction above 0.2 mm that is comparable with the humus top layer.

Humus represents the uppermost layer of the profile. Typical humus composition is present in samples 6 to 1. High, dominant proportions of organic substance are characteristic for them. Quartz is prevailing among minerals, while carbonate grains are very rare. Sample 5 differs again, as mineral grains, mostly quartz, prevail over organic grains, which indicates overflowing of the Ljubljanica.

### 2.2.2.2 DESCRIPTION OF PROFILE SG-6

Samples 12 to 7 indicate sedimentation in shallow lake-marsh environment. Proportion of carbonate is comparatively high, c. 60 % (Fig. 2.5). Diatoms are more frequent as in profile SG-12. Sample 6 is a transitional one, inside which we could place the margin between lake-marsh sediments and the top layer. Transition in sample 6 can be assumed due to dominance of organic grains above mineral ones and comparatively low percent of carbonate grains in comparison to the basal layer.

Microscopic analysis of the fraction below 0.2 mm proves that samples 7 and 6 signify transition from lake-marsh sediments (gyttia?) to humus, while, based on the analysis of fraction above 0.2 mm, we can place the samples to the humus top layer. Diatoms are fairly often in both samples.

With their characteristics, samples 5 to 1 are identical to humus in profile SG-6. As before, organic grains typically prevail above mineral ones. Percent of organic

karbonata, dokler se deleža ne izenačita v vzorcu št. 13. Čeprav karbonatna zrna močno prevladujejo, je njihov delež v čisti jezerski kredi znatno višji (> 90 %). Torej sklepamo, da obravnavani sedimenti predstavljajo neki prehodni sediment med jezersko kredo in šoto, morda gre za gyttjo. Sedimentacijsko okolje bi potemtakem bilo plitvo jezero z bujno vodno oz. močvirsko vegetacijo.

V vseh talninskih vzorcih se pojavljajo diatomeje, katerih delež pa je razmeroma nizek.

Srednji del profila sestavljajo prehodni vzorci 12 do 7, ki po svojih lastnostih po vsej verjetnosti že pripadajo šoti. Delež organskih zrn navzgor po profilu postopoma upada (sl. 2.4). Najvišji delež organskih zrn je v spodnjem vzorcu šotnega dela profila, kjer znaša kar okoli 90 %. Najbolj odstopa vrhni vzorec šote z zelo nizkim deležem organske snovi (12 %). Delež kremenja je v obratnem sorazmerju z deležem organske snovi in od spodaj narašča od nekaj promilov do 76 % v vrhnjem vzorcu srednjega dela profila. Nizek, vendar značilen je delež karbonatnih zrn. Prav ta skupaj z organsko snovjo nakazujejo zamočvirjenost okolja, kjer so se odlagali obravnavani sedimenti. Na vodnato oz. močvirsko okolje kažejo tudi sicer vedno bolj redke diatomeje, ki se pojavljajo vse do vzorca 10, v višje ležečih vzorcih pa ne več. Med vsemi šotnimi vzorci, kot rečeno, najbolj odstopa vrhni vzorec 7, kjer delež kremenovih zrn značilno prevladuje nad organskimi. To lahko razložimo s poplavnim dogodkom, ko je Ljubljana nanosila velik delež drobnozrnatih (kremenovih) poplavnih sedimentov. Vzorca 8 in 7 smo po njunih značilnostih umestili med srednjo oz. prehodno plast, ki jo razlagamo kot šoto, v nasprotju s frakcijo, večjo od 0,2 mm, kjer njune značilnosti bolj kažejo na krovninsko humusno plast.

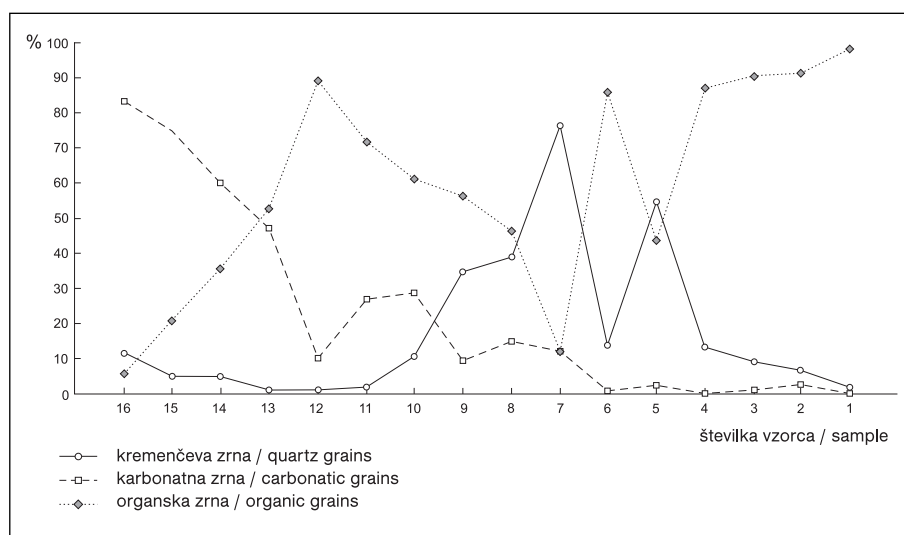
Krovninski del profila sestavlja humusni horizont. Tipično humusno sestavo najdemo v vzorcih 6 do 1.

grains exceeds 70 %. Percentage of carbonate in these samples is low. Somewhat higher is percentage of quartz grains, the amount of which reduces upwards. Increasing trend of percentage of organic grains and decreasing trend of percentage of mineral grains is also noticeable in the same direction. Diatoms are extremely rare in all these samples. Their presence could be ascribed to mixing of sediments, due to probable decay of peat layer, which is not present in profile SG-6.

Based on the microscopic analysis of fraction below 0.2 mm we can undoubtedly separate lake-marsh sediments (gyttia?) from the humus layer. There is also an intermediate layer of peat in samples from the profile SG-12. The boundary between these layers cannot be clearly defined.

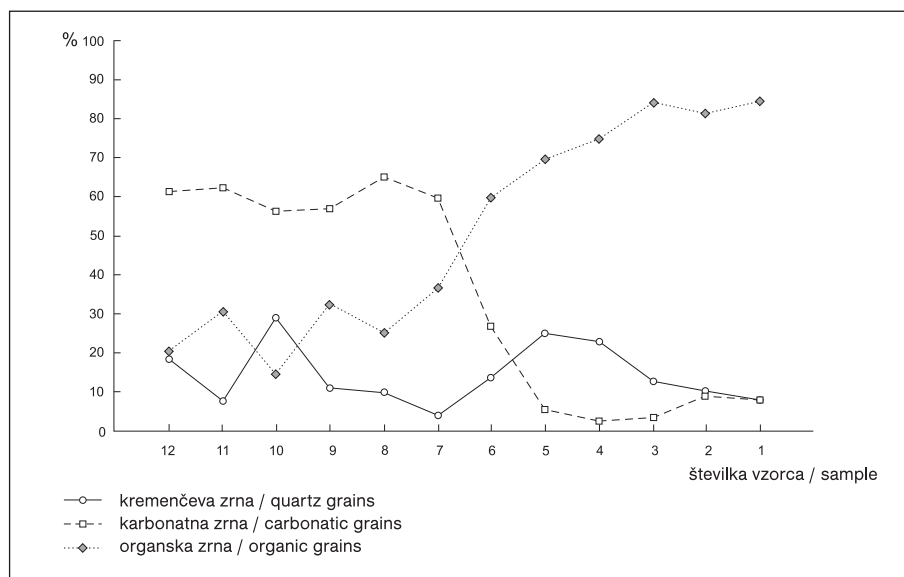
Based on comparatively high percentage of carbonate we can presume shallow-lake to marsh environment. High percentage of carbonate is characteristic for such environments. Sample 12 contains different characteristics as the other sediments in profile SG-12. Occurrence of peat sediments in the middle part of the profile indicates a change of environment. The lake was reducing gradually, with its shallow-water shoreline transforming to swamp and later to marsh. Top layer of profile SG-12 is a humus deposit. These sediments are relatively late. Sedimentation was taking place when marsh was already dried out and transformed to grassy or agricultural surfaces. Sedimentation was occurring mostly with dying and disposal of vegetation (grassland). There is no indication of larger flood events that would influence change in sedimentation, with the only exception perhaps being sample 5.

The adjoining profile SG-6 cannot be completely correlated with the profile SG-12. Lake-marsh sedi-



Sl. 2.4: Stare gmajne. Kvalitativna mineraloška sestava vzorcev iz profila SG-12.

Fig. 2.4: Stare gmajne. Qualitative mineralogical composition of samples from profile SG-12.



Sl. 2.5: Stare gmajne. Kvalitativna mineraloška sestava vzorcev iz profila SG-6.

Fig. 2.5: Stare gmajne. Qualitative mineralogical composition of samples from profile SG-6.

Zanje so značilni visoki, prevladujoči deleži organske snovi. Med minerali prevladuje kremen, karbonatna zrna so izredno redka. Ponovno izstopa le vzorec 5, v katerem mineralna zrna, ki v veliki večini pripadajo kremenu, prevladujejo nad organskimi zrni, kar nakazuje na možnost poplavljanja Ljubljaniice.

#### 2.2.2.2 OPIS PROFILA SG-6

Sedimentacijo v plitvem jezersko-močvirskem okolju nakazujejo vzorci 12 do 7. Delež karbonata je razmeroma visok in znaša okoli 60 % (sl. 2.5). Diatomeje so nekoliko bolj številne kot v profilu SG-12. Prehoden je vzorec št. 6, v okvir katerega bi lahko umestili mejo med jezersko-močvirskimi sedimenti in krovnino. Na prehodnost vzorca 6 kaže značilna prevlada organskih zrn nad mineralnimi in razmeroma nizke odstotke karbonatnih zrn v primerjavi s talnino.

Mikroskopska analiza frakcije pod 0,2 mm dokazuje, da predstavljata vzorca 7 in 6 nekakšen prehod iz jezersko-močvirskih sedimentov (gyttje?) v humus, medtem ko lahko vzorca na podlagi analize frakcije večje od 0,2 mm, uvrstimo že v krovninsko humusno plast. V obeh vzorcih se relativno pogosto pojavljajo diatomeje.

Humusu v profilu SG-6 glede na svoje značilnosti ustrezajo vzorci 5 do 1. Tudi tu organska zrna značilno prevladujejo nad mineralnimi. Odstotek organskih zrn je večji od 70 %. Odstotki karbonata v teh vzorcih so nizki. Nekoliko višji so odstotki kremenovih zrn, katerih delež se navzgor po profilu zmanjšuje. V isti smeri je zaznaven tudi trend naraščanja deleža organskih in upadanja mineralnih zrn. V vseh teh vzorcih se pojavljajo izredno redke diatomeje. Njihovo prisotnost bi morda lahko pripisali

ments are present higher up in the profile SG-6. Humus sediments lie directly on top of these sediments, while peat layer is missing. Peat could be anthropogenically removed, but this is unlikely, as also cultural layer would be removed in this case. However, it could be naturally decomposed.<sup>12</sup> It is possible that it did not exist in this area. Comparing the location of profile SG-12, location of the profile SG-6 is set c. 100 m towards the prehistoric centre of the lake (see Fig. 2.1). The lake was present here for longer and that is why peat started deposit later, if ever. Occurrence of individual (infrequent) diatoms in top layer sediments with else typically humus characteristics is interesting. It may indicate that peat layer truly was decomposed, with humus top layer sediments progressing downwards in profile as a result. The profile SG-6 is, instead of a starting point of interpretation of palaeoenvironmental conditions, more suitable for comparison with the adjoining profile SG-12.

#### 2.2.3 DIATOM ANALYSIS

Four samples were examined in profiles SG-6 and SG-12. Only sample 12 from the profile SG-6 contained sufficient amount of diatoms. The other samples were not suitable for palaeoecological analyses as only fragments of diatoms or individual valves were present within.

In the analysed sample *Gomphonema* (25 %) and *Cymbella* (21.7 %) prevail, with analogous percentage represented by *Fragilaria* (14.2 %), *Cocconeis* (11.7 %) and *Eunotia* (10.5 %). Percentages of other genera are not greater than 3 % (Figs. 2.6 and 2.7).

<sup>12</sup> Tancik 1965.



mešanju sedimentov zaradi morebitnega razkroja šotne plasti, ki je v profilu SG-6 ni.

Na osnovi mikroskopske analize frakcije, manjše od 0,2 mm, jasno ločimo jezersko-močvirske sedimente (gyttjo?) od humusne plasti, med njima se v vzorcih v profilu SG-12 pojavlja še vmesna plast šote. Mejo med temi plastmi je možno določiti le približno.

Na plitvo jezersko-močvirsko okolje sklepamo na podlagi razmeroma visokega deleža karbonata, značilnega za takšna okolja. Večjo spremembo v značilnosti sedimentov v profilu SG-12 opazimo v vzorcu 12. Pojav šotnih sedimentov v srednjem delu profila nakazuje spremembo okolja. Jezero se je postopoma krčilo, njegovo plitvo vodno obrežje je prehajalo v močvirje in pozneje v barje. Krovnino profila SG-12 predstavlja humusni nanos. Ti sedimenti so relativno mladi. Sedimentacija je potekala, ko je bilo barje že izsušeno in spremenjeno v travnate ali obdelovalne površine. Povzročila sta jo predvsem odmiranje in odlaganje rastja (travinja). Kakšnih večjih poplavnih dogodkov, ki bi vplivali na spremembo v sedimentaciji, ni zaznati, morda je izjema le vzorec 5.

Sosednjega profila SG-6 ni mogoče popolnoma korelirati s profilom SG-12. Jezersko-močvirski sedimenti se v profilu SG-6 pojavljajo v višji nadmorski višini. Neposredno na teh sedimentih leži humusni paket sedimentov, medtem ko šotna plast manjka. Šota bi bila lahko antropogeno odstranjena, kar pa ni verjetno, saj bi bila v tem primeru odstranjena tudi kulturna plast. Lahko pa je bila razkrojena po naravni poti.<sup>12</sup> Možno je, da v tem delu sploh ni nastajala. Lokacija profila SG-6 je pomaknjena za približno 100 m proti središču nekdanjega jezera v primerjavi z lokacijo profila SG-12 (glej sl. 2.1). Jezero je bilo tu prisotno dalj časa, zato se je šota tu začela odlagati pozneje, kolikor je do njenega odlaganja sploh prišlo. Zanimivo je pojavljanje posameznih (redkih) diatomej v krovninskih sedimentih s sicer tipično humusnimi značilnostmi, kar nakazuje možnost, da je bila šotna plast res razkrojena, zaradi česar so se krovninski humusni sedimenti posedli navzdol po profilu. Profil SG-6 je bolj kot izhodišče za interpretacijo paleoekoloških razmer primeren za primerjavo s sosednjim profilom SG-12.

### 2.2.3 ANALIZA DIATOMEJ

V profilih SG-6 in SG-12 so bili pregledani štirje vzorci. Diatomeje je v zadostni količini vseboval le vzorec 12 v profilu SG-6. Preostali vzorci niso bili primerni za paleoekološke analize, saj so v njih prisotni zgolj odlomki diatomej ali posamezne valve.

V analiziranem vzorcu prevladujeta rodova *Gomphonema* (25 %) in *Cymbella* (21,7 %), s podobnimi deleži

Dominant genera *Gomphonema*, *Cymbella* and *Cocconeis* belong to periphyton and indicate sedimentation in stagnant, freshwater, shallow-water environment with prevailing oligotrophic and alkaline conditions.<sup>13</sup> Abundance of plankton genera (*Aulacoseira*, *Melosira*), which are characteristic for lake environments with well-developed profundal zone, is small.

*Eunotia* is characteristic for slightly different water environment. *Eunotia* is an epiphyte genus usually lives in acidic oligotrophic waters, where carbonate usually does not deposit.<sup>14</sup> Considering the fact that the living genus is frequent in higher latitudes,<sup>15</sup> we presume that the climate during the sedimentation was a bit colder from present-day one. The presence of *Eunotia* is in disagreement with the dominant abundance of the alkalophilic genera. Considering the dominance of alkalophilic genera we can conclude, that the marginal parts of water body was more or less marshy from where the acidophilic species were redeposited in more central and deeper part of the sedimentary basin. This is additionally confirmed with the presence of *Cymbella* and *Gomphonema*, which are also frequent in running waters.<sup>16</sup>

Direct comparison of sample from the profile at Stare gmajne with the "Na mahu 1" borehole<sup>17</sup> is not possible, mostly due to large percent of *Cymbella* and *Cocconeis* in the Stare gmajne sample, which are not present in the "Na mahu 1" borehole. Moreover, genera *Gomphonema* and *Fragilaria* exclude one another by frequency in the samples from the "Na mahu 1" borehole, while they are represented more evenly in the sample from Stare gmajne (Fig. 2.6).

Based on the diatom analysis we assume that the studied area of Stare gmajne was a stagnant shallow-water body in some marginal parts probably overgrown by marsh vegetation.

### 2.2.4 GRANULOMETRIC ANALYSIS OF THE FRACTION BELOW 0.2 mm

Granulometric data, gained from both studied profiles, were statistically evaluated. There is not enough data for reliable statistical analysis. Error in statistical results can therefore be considerable, that is why it serves only for a comparison with earlier results. Based on granulometric method, percentage of three grain sizes, i.e. clay (< 0.002 mm), mudstone (0.002 to 0.063 mm) and sand (0.063 to 2 mm) was calculated in every sample of the fraction below 0.2 mm.

<sup>13</sup> Krammer, Lange-Bertalot 1986; 1991; Round, Crawford, Mann 1992.

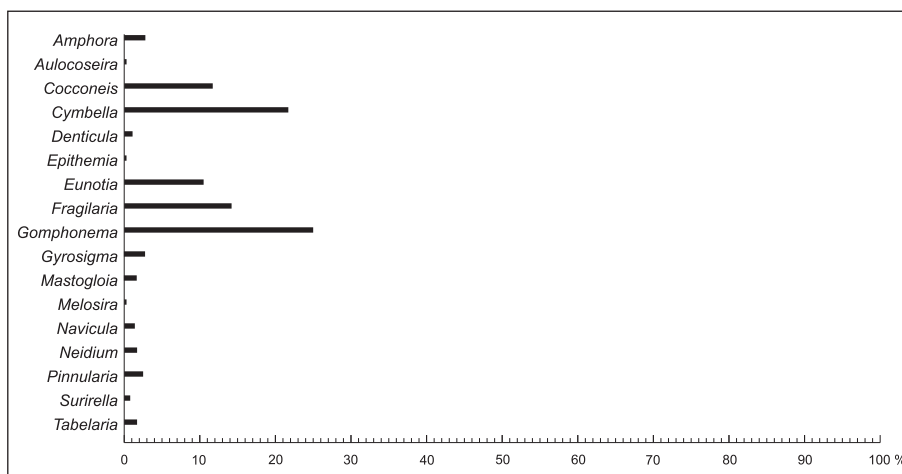
<sup>14</sup> Round, Crawford, Mann 1992.

<sup>15</sup> Krammer, Lange-Bertalot 1991.

<sup>16</sup> Krammer, Lange-Bertalot 1986.

<sup>17</sup> Andrič et al. 2008.

<sup>12</sup> Tancik 1965.



Sl. 2.6: Stare gmajne. Relativna pogostnost diatomskih rodov v vzorcu 12 iz profila SG-6.

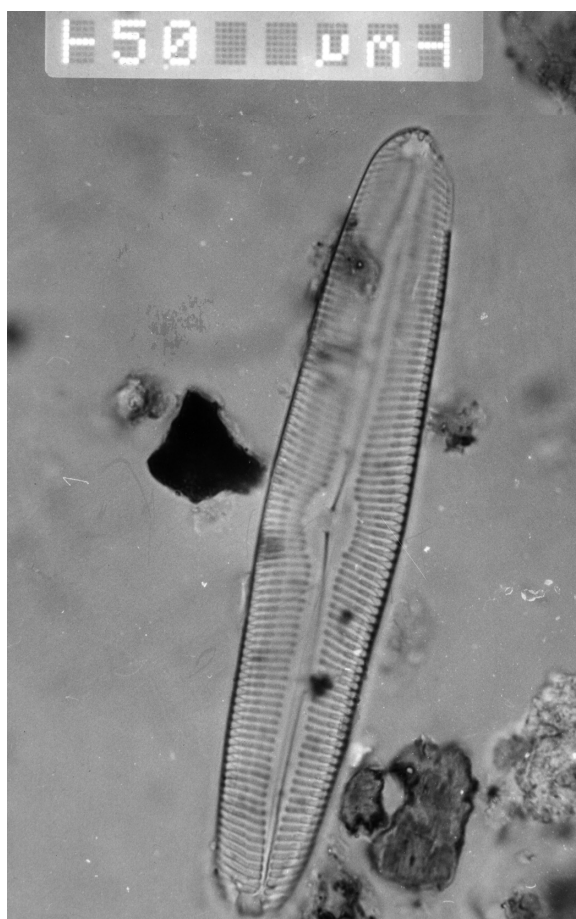
Fig. 2.6: Stare gmajne. Relative frequency of diatom genera in sample 12, profile SG-6.

pa so zastopani rodovi *Fragilaria* (14,2 %), *Cocconeis* (11,7 %) in *Eunotia* (10,5 %). Deleži drugih rodov ne presegajo 3 % (sl. 2.6 in 2.7).

Prevladujoči rodovi *Gomphonema*, *Cymbella* in *Cocconeis* pripadajo perifitonu in kažejo na sedimentacijo v sladkovodnem stoječem plitvo vodnem okolju, kjer prevladujejo oligotrofne in alkalne razmere.<sup>13</sup> Delež planktonskih oblik (*Aulacoseira*, *Melosira*), ki so značilne za jezerska okolja z dobro razvitim profundalom, je majhen.

Za nekoliko drugačna vodna okolja je značilna *Eunotia*. Ta rod diatomej je epifitski in naseljuje izrazito kisle, oligotrofne vode, kjer se karbonat navadno ne odlaga.<sup>14</sup> Glede na dejstvo, da je rod danes pogost na višjih geografskih širinah,<sup>15</sup> sklepamo da je bila klima za časa takratne sedimentacije nekoliko hladnejša od današnje. Pojav rodu *Eunotia* ni najbolj skladen z ostalimi prevladujočimi rodovi, saj v združbi prevladujejo alkalofitski. Glede na prevlado alkalofitskih rodov lahko sklepamo, da je bilo takratno vodno telo vsaj v obrobni delih bolj zamočvirjeno, odkoder bi lahko bile te oblike presedimentirane v osrednejši in nekoliko globljevodni del sedimentacijskega bazena. Na to kažejo tudi rodovi *Cymbella* in *Gomphonema*, katerih predstavniki so prav tako pogosti v tekočih vodah.<sup>16</sup>

Neposredna primerjava vzorca iz profila Stare gmajne z vrtino "Na mahu 1"<sup>17</sup> ni mogoča, predvsem zaradi velikega deleža rodov *Cymbella* in *Cocconeis* v vzorcu Stare gmajne, ki jih v vrtini "Na mahu 1" ne zasledimo. Prav tako se v vrtini "Na mahu 1" vsebnosti rodov *Gomphonema* in *Fragilaria* v vzorcih izključujejo,



Sl. 2.7: Stare gmajne. Diatomeja iz rodu *Pinnularia*. Foto: J. Turk.

Fig. 2.7: Genus *Pinnularia* from Stare gmajne. Photo: J. Turk.

<sup>13</sup> Krammer, Lange-Bertalot 1986; 1991; Round, Crawford, Mann 1992.

<sup>14</sup> Round, Crawford, Mann 1992.

<sup>15</sup> Krammer, Lange-Bertalot 1991.

<sup>16</sup> Krammer, Lange-Bertalot 1986.

<sup>17</sup> Andrič et al. 2008.

Statistical analysis of mentioned fractions in the profile SG-12 revealed that percentage of clay increases upwards (Fig. 2.8). One-way regression confirms the increasing trend of abundance of clay fraction upwards

medtem ko sta rodova v vzorcu Stare gmajne zastopana v enakomernejšem razmerju (sl. 2.6).

Na podlagi analize prevladujočih rodov diatomej domnevamo, da je bilo obravnavano območje Starih gmajn zalito z jezerom, ki je bilo sicer plitvovodno in verjetno že deloma poraščeno z močvirskim rastlinstvom.

#### 2.2.4 GRANULOMETRIČNA ANALIZA FRAKCIJE DEBELINE POD 0,2 mm

Granulometrične podatke, pridobljene iz obeh obravnavanih profilov, smo statistično obdelali. Za zanesljivo statistično analizo je podatkov sicer premalo. Napaka statističnih rezultatov je zaradi tega lahko precejšnja, zato naj nam služi le kot primerjava s prejšnjimi rezultati. Na podlagi granulometrične metode so bili v vsakem vzorcu frakcije pod 0,2 mm določeni trije velikostni redi zrn, in sicer glina (< 0,002 mm), melj (0,002 do 0,063 mm) ter pesek (0,063 do 2 mm).

Statistična analiza omenjenih frakcij v profilu SG-12 je pokazala, da delež gline navzgor narašča (sl. 2.8). Linearna regresija potrjuje trend naraščanja glinene frakcije navzgor po profilu, koeficient korelacije znaša: 0,77. Delež glinene frakcije je deloma povezan z deležem peska.

Negativna korelacija med peskom in glino je v najglobljih treh vzorcih ( $r = -0,99$ ). V srednjem delu postane naraščanje deleža glinene frakcije neodvisno od razmerja peščene (in tudi meljaste) frakcije. Med krovninskimi vzorci 6 (oz. 5) in 1 je delež gline ponovno v obratnem sorazmerju z deležem peska. Korelacija znaša:  $-0,98$ .

Podobna korelacija je tudi med peskom in meljem. Deleža peska in melja med vzorcema 16 in 6 sta v medsebojni korelaciji ( $r = -0,97$ ). Deleža peščene in meljaste

in profile, with the ratio of correlation being: 0.77. Percentage of clay fraction is partly depended on the percentage of sand.

Negative correlation between sands and clays occurs in the deepest three samples ( $r = -0,99$ ). In the middle part, increasing percentage of clay becomes independent from sand (and also silt) fraction. In top layer samples from 6 (5 respectively) to 1, percentage of clay is again present in inverse proportion with percentage of sand, with the ratio of correlation being:  $-0,98$ .

Correlation is similar also between sand and silt. Percents of sands and silts between samples 16 and 6 are in mutual correlation ( $r = -0,97$ ). Percents of sandy and silty fractions do not possess any prominent trend in sedimentary sequence.

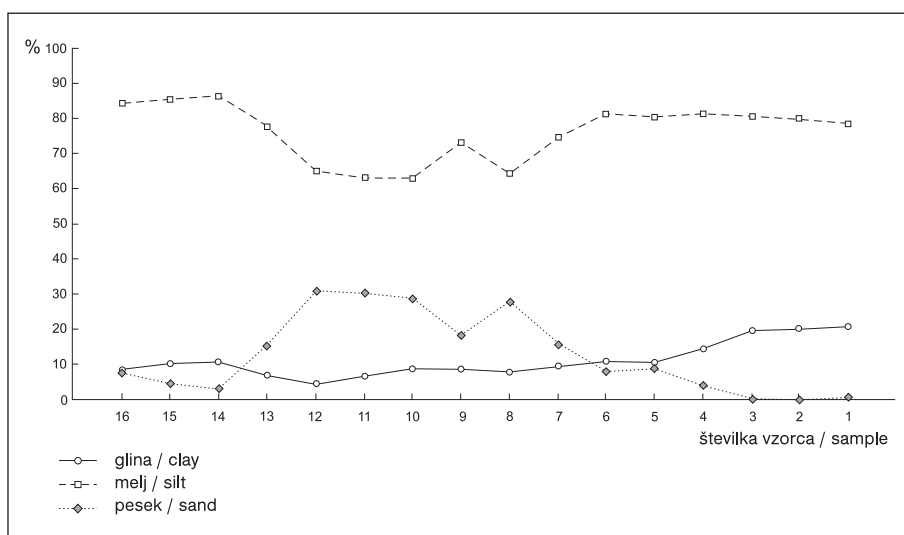
Considering correlations of three fractions, we could prove division of sedimentary sequence from profile SG-12 to three parts, which was discussed in previous chapters;

- lower part with samples 16, 15 and 14
- middle part with samples 13 to 7
- top part with samples 6 to 1.

Only small variation in percentage of the three studied fractions is characteristic for the lower part of profile SG-12.

Increasing trend of percentage of clay fraction is characteristic in the middle part. Percentages of sand and silt fractions are, as noticed before, in strong correlation. At the time of deposition of sample 7, flood episode could occur based on results of microscopy. However, granulometric method does not confirm this, similarly as it does not confirm the episode in sample 5. Percent of sand is relatively low in both samples.

There is practically no diversity in percent of silt in top part. Silt is prevailing strongly, as it presents c.



Sl. 2.8: Stare gmajne. Granulometrična razporeditev zrn v vzorcih iz profila SG-12.

Fig. 2.8: Stare gmajne. Granulometric distribution of grains in samples from the profile SG-12.

frakcije ne kaže izrazitega trenda v sedimentacijskem zaporedju.

Glede na omenjene korelacije med tremi frakcijami bi lahko sedimentni profil SG-12 ponovno razdelili na tri dele, ki se skoraj povsem ujemajo s prej opisanimi:

- a. spodnji del z vzorci 16, 15 in 14
- b. srednji del z vzorci 13 do 7
- c. vrhnji del z vzorci 6 do 1.

Za spodnji del profila SG-12 so značilne le majhne spremembe v deležih treh obravnavanih frakcij.

V srednjem delu je trend naraščanja deleža glinene frakcije značilen. Deleža peščene in meljaste frakcije sta, kot rečeno, v močni korelaciji. Prav v času odlaganja sedimentov vzorca 7 naj bi prišlo do poplavnega sunka, na kar smo sklepali na podlagi mikroskopije. Vendar pa granulometrična metoda tega dogodka ne potrjuje, podobno kot ne dogodka v vzorcu 5. V obeh vzorcih je delež peska relativno nizek.

V vrhnjem delu se delež melja praktično ne spreminja. Melj močno prevladuje, saj znaša kar okoli 80 % vseh frakcij. Delež peska navzgor po profilu počasi upada od 10 % proti zanemarljivi vrednosti, hkrati pa na njegov račun narašča delež gline.

Podobno statistično analizo kot za profil SG-12 smo izvedli tudi za profil SG-6. Glede na absolutne višine predstavlja profil SG-6 približen ekvivalent vzorcem 16 do 5 profila SG-12. Vendar na podlagi mikroskopske analize ugotavljamo, da se srednja šotna plast v tem profilu ne pojavlja oz. ni ohranjena. Potemtakem lahko primerjamo vzorce 12 do 6 iz profila SG-6 s spodnjimi "jezerskimi" vzorci profila SG-12. Vzorce 5 do 1 iz profila SG-6 pa z zgornjimi humusnimi vzorci profila SG-12.

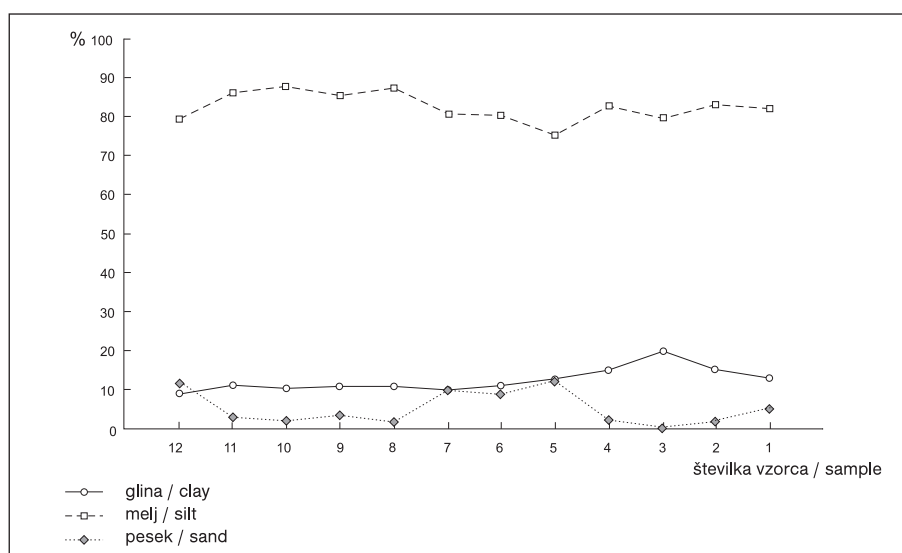
80 % of all fractions. Percent of sand slowly declines upwards, from 10 % to a negligible value, while the amount of clay is increasing. Similar statistical analysis as the one in profile SG-12, was also carried out in profile SG-6. Considering absolute heights, profile SG-6 is an approximate equivalent of samples 16 to 5 within the profile SG-12. However, based on microscopic analysis we assume that the middle peat layer is not present or is not preserved in this profile. Accordingly, we can then compare samples 12 to 6 from profile SG-6 with the lower "lake" samples of profile SG-12. Samples 5 to 1 from profile SG-6 can be compared with upper humus samples of profile SG-12.

General trend of clay fraction from profile of SG-6 is rising, similarly as in profile SG-12. Percent of silt fraction in profile SG-6 is over 75 % (Fig. 2.9). Smaller amounts occur only in the middle peat layer in profile SG-12, which we assume was absent in profile SG-6. Absence of peat layer enriched with sandy fraction in profile SG-6 is also evident from triangular diagrams (Fig. 2.10).

## 2.3 CONCLUSION

### 2.3.1 INTERPRETATION OF PALAEO-ENVIRONMENTAL CONDITIONS IN TIME OF DEPOSITION OF SEDIMENTS

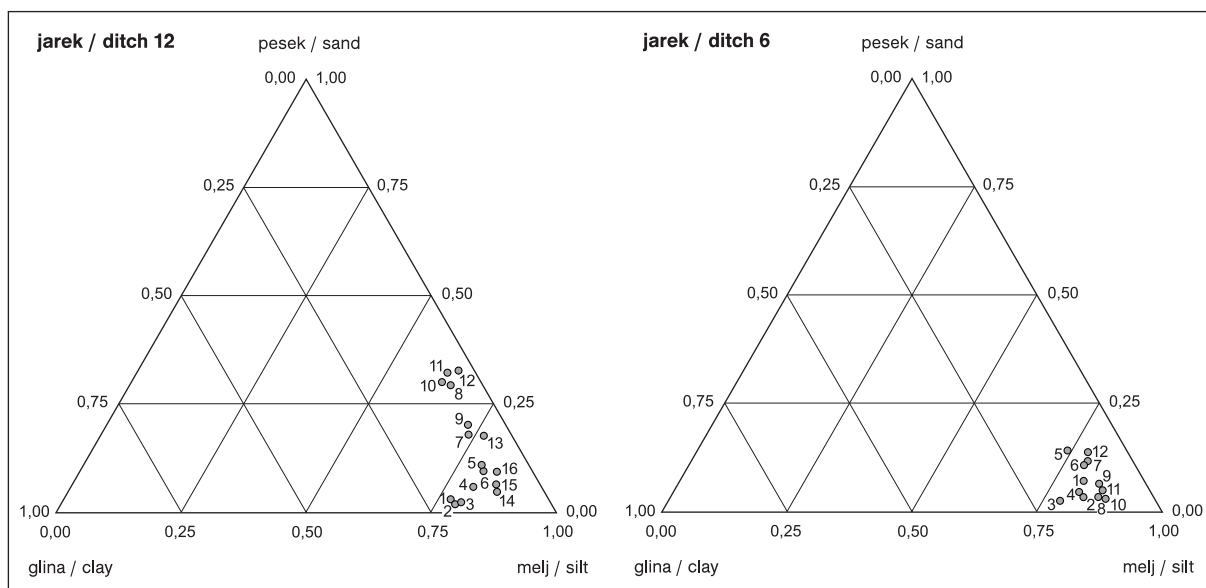
Deposition of all sediments studied was carried out within relatively calm sedimentary environments. Torrential streams from surrounding hills did not have any impact on sedimentation of the location examined,



Sl. 2.9: Stare gmajne. Granulometrična razporeditev zrn v vzorcih iz profila SG-6.

Fig. 2.9: Stare gmajne. Granulometric distribution of grains in samples from the profile SG-6.





Sl. 2.10: Stare gmajne. Trikotni diagram.

Fig. 2.10: Stare gmajne. Triangular diagram.

Splošen trend glinene frakcije iz profila SG-6 je naraščajoč, podobno kot v profilu SG-12. Deleži meljaste frakcije v profilu SG-6 ne padejo pod 75 % (sl. 2.9). V profilu SG-12 se nižji deleži pojavljajo le v srednji šotni plasti, ki naj bi po naših predvidevanjih v profilu SG-6 manjkala. Tudi trikotna diagrama (sl. 2.10) nakazujeta odsotnost šotne plasti, bogate s peščeno frakcijo, v profilu SG-6.

## 2.3 SKLEP

### 2.3.1 INTERPRETACIJA PALEOOKOLJSKIH RAZMER V ČASU ODLAGANJA SEDIMENTOV

Odlaganje vseh obravnavanih sedimentov je potekalo v razmeroma mirnih sedimentacijskih razmerah. Hudourniški potoki z okoliških hribov niso imeli vpliva na sedimentacijo na obravnavani lokaciji, poplavne vode Ljubljanice pa so prinašale v okolje večinoma le drobnozrnate sedimente.<sup>18</sup>

Spodnji del profilov SG-12 in SG-6 pripisujemo sedimentom, ki so se odlagali v plitvovodnem jezeru, ki je počasi že prehajalo v močvirje. Pomemben indikator okolja so fosili, ki so ohranjeni v sedimentu, v našem primeru so to predvsem fosilni ostanki diatomej in tudi drugih jezerskih organizmov.

Plitvovodni jezerski sedimenti razmeroma hitro preidejo v prehodne sedimente, ki jih pripisujemo šoti. Ta se je tvorila v močvirskem in barjanskem okolju. Za takšna okolja je značilno bujno rastje, v močvirjih se

while floodwaters of the Ljubljanica discharged mostly fine-grained sediments.<sup>18</sup>

Lower part of profiles SG-12 and SG-6 was ascribed to sediments that were deposited in shallow-water lake, which was slowly transforming to swamp. Fossils, kept in sediment are important indicator of environment; in this case these are mostly fossil remains of diatoms and of other lake organisms.

Shallow-water lake sediments comparatively quickly transformed to transitional sediments, which we ascribe to peat. Peat was composed in marsh and moor environment. Lush vegetation is characteristic for such environments; carbonate can still deposit in marsh. The Ljubljanica was depositing quartz grains and sand to the contracting lake. The outflow of the Ljubljanica to the lake was probably in the vicinity of Stare gmajne. Discharged material spread in a fan-shaped form from the outflow of the river towards the centre of the lake and alongside its shore. Shore/fringe of lake was probably mostly marsh. Marsh environment is rich in aquatic vegetation, among which the discharged material was caught and sedimented in situ. On the contrary, in parts with no aquatic vegetation, fine sediment deposit broke deeper into the lake, where sedimentation was scattered. to longer area

Peat sediments are absent in profile SG-6, either because they decomposed or they were not forming at all. Lake-marsh sediments are present up to higher absolute altitude, as in adjoining profile SG-12. Location of profile SG-6 is placed further towards the centre of the Ljubljansko barje, and that is why we presume that the lake was existing here for longer as

<sup>18</sup> Buser 1965.<sup>18</sup> Buser 1965.

lahko še vedno odlaga karbonat. Kremenova zrna in pesek je v umikajoče se jezero prinašala Ljubljana, ki se je v jezero verjetno izlivala v bližini Starih gmajn. Prineseni material se je pahljjačasto širil od izliti reke proti notranjosti jezera in vzdolž njegove obale. Obala oz. obrobje jezera je bilo verjetno v veliki meri zamočvirjeno. Močvirnato okolje je bogato z vodnim rastlinjem, med katerega se je ujemal prineseni material in se odlagal na mestu. Nasprotno pa je v predelih brez vodnega rastlinja drobni sedimentni nanos prodril globlje v notranjost jezera, kjer se je odlagal bolj razpršeno in postopoma.

Šotni sedimenti se ne pojavljajo v profilu SG-6, bodisi ker se so razkrojili ali niso nastajali. Jezersko-močvirski sedimenti se pojavljajo do višje absolutne višine kot v sosednjem profilu SG-12. Lokacija profila SG-6 je pomaknjena bolj proti središču Ljubljanskega barja, zato sklepamo, da je jezero na tem mestu obstajalo dalj časa kot v sosednjem profilu. V kolikor je prišlo do razkroja šotne plasti, bi se lahko talninske plasti ob razbremenitvi dvignile za nekaj decimetrov,<sup>19</sup> kar bi bila ena izmed možnih razlag, zakaj se tu jezersko-močvirski sedimenti pojavljajo do absolutno višje nadmorske višine.

Tudi sedimentacija humusa kaže na enakomerno usedanje v mirnem okolju. Takšno mirno usedanje predvsem organskih usedlin sta morda prekinila večja poplavna nanosa (vzorca št. 7 in 5 iz profila SG-12). Vendar pa granulometrična analiza teh dogodkov ne potrjuje. O drugih podobnih dogodkih v vrhnjem delu profila nimamo dokazov, niso pa izključeni. Nič namreč ne vemo o točni starosti vseh obravnavanih sedimentnih vzorcev, saj ti niso bili datirani. Neznane so morebitne sedimentacijske ali celo erozijske vrzeli.

### Zahvala

Prvo podpisani avtor se za nemoteno delo z optičnim mikroskopom zahvaljujem prof. dr. Jerneju Pavšiču in g. Marjanu Grmu za pomoč pri fotografiranju. Oba sta z Oddelka za geologijo.

at the adjoining profile SG-12. If decay of peat layer occurred, basal layers could rise for a few decimetres at disburdening,<sup>19</sup> which would also be a possible explanation of why lake-marsh sediments are present up to higher absolute altitude.

Sedimentation of humus also indicates uniform deposition in stable environment. Such steady deposition of mostly organic sediments was perhaps interrupted by two larger flood deposits (sample 7 and 5 from profile SG-12). However, the granulometric analysis does not confirm these events. We do not have any evidence of analogous events in the top part of profile, but they cannot be ruled out. The exact age of all examined sedimental samples is not known, as these were not dated. Furthermore, eventual sedimental or even erosion gaps can not be excluded.

<sup>19</sup> Šercelj 1965.

<sup>19</sup> Šercelj 1965.

### 3. KOLIŠČARSKA NASELBINA STARE GMAJNE PRI VERDU

Anton VELUŠČEK

### 3. STARE GMAJNE PILE-DWELLING SETTLEMENT NEAR VERD

Anton VELUŠČEK

#### Izvleček

V prispevku so predstavljeni rezultati arheoloških raziskav na koliščarski naselbini Stare gmajne, ki jih je med letoma 1995 in 2007 izvedel Inštitut za arheologijo ZRC SAZU.

Predstavljeni so horizontalna in vertikalna stratigrafija, arheološke najdbe in tipološka opredelitev keramike.

**Ključne besede:** stratigrafija, arheološke najdbe, tipologija keramike, Stare gmajne, Ljubljansko barje, eneolitik.

#### Abstract

This chapter introduces results of archaeological research on the pile-dwelling settlement Stare gmajne, carried out by the Institute of Archaeology of the Scientific Research Centre of the Slovenian Academy of Sciences and Arts (ZRC SAZU) between 1995 and 2007.

We present horizontal and vertical stratigraphy, archaeological finds and a typological definition of pottery.

**Keywords:** stratigraphy, archaeological finds, typology of pottery, Stare gmajne, the Ljubljansko barje, Eneolithic.

#### 3.1 LEGA NAJDIŠČA

**Koda najdišča:** 084303.06, 084303.17<sup>1</sup>

**Lega:** Koliščarska naselbina leži na Ljubljanskem barju vzhodno od Verda, južno od Ljubljanice na ledini Stare gmajne.

**Koordinate po karti 1 : 5000:** E 448 560, N 90 864, nadmorska višina = približno 289 m.

#### 3.1 LOCATION OF THE SITE

**Site code:** 084303.06, 084303.17<sup>1</sup>

**Location:** The pile-dwelling settlement stood at the Ljubljansko barje, eastwards from Verd, southwards from the River Ljubljanica, at the Stare gmajne fallow.

**Coordinate on a map to a scale of 1 : 5000:** E 448 560, N 90 864, c. 289 m a.s.l.

##### 3.1.1 TOPOGRAFSKI PODATKI IN ZGODOVINA RAZISKOVANJ

###### 3.1.1.1 ODKRITJE LETA 1992 IN RAZISKOVANJE LETA 1995

Arheološko najdišče Stare gmajne leži na jugozahodnem delu Ljubljanskega barja na istoimenski ledini južno od Ljubljanice in približno 750 m severovzhodno od zaselka Podgora pri Verdu.

Leta 1992 je J. Dirjec z Inštituta za arheologijo ZRC SAZU pri terenskem obhodu jarka Hočevarica v mejnem jarku med parcelama št. 1276 in 1277 k. o. Verd približno 70 m severno od kolovozne poti opazil navpično zabite kole in koliščarsko keramiko.

##### 3.1.1 TOPOGRAPHIC DATA AND HISTORY OF RESEARCHES

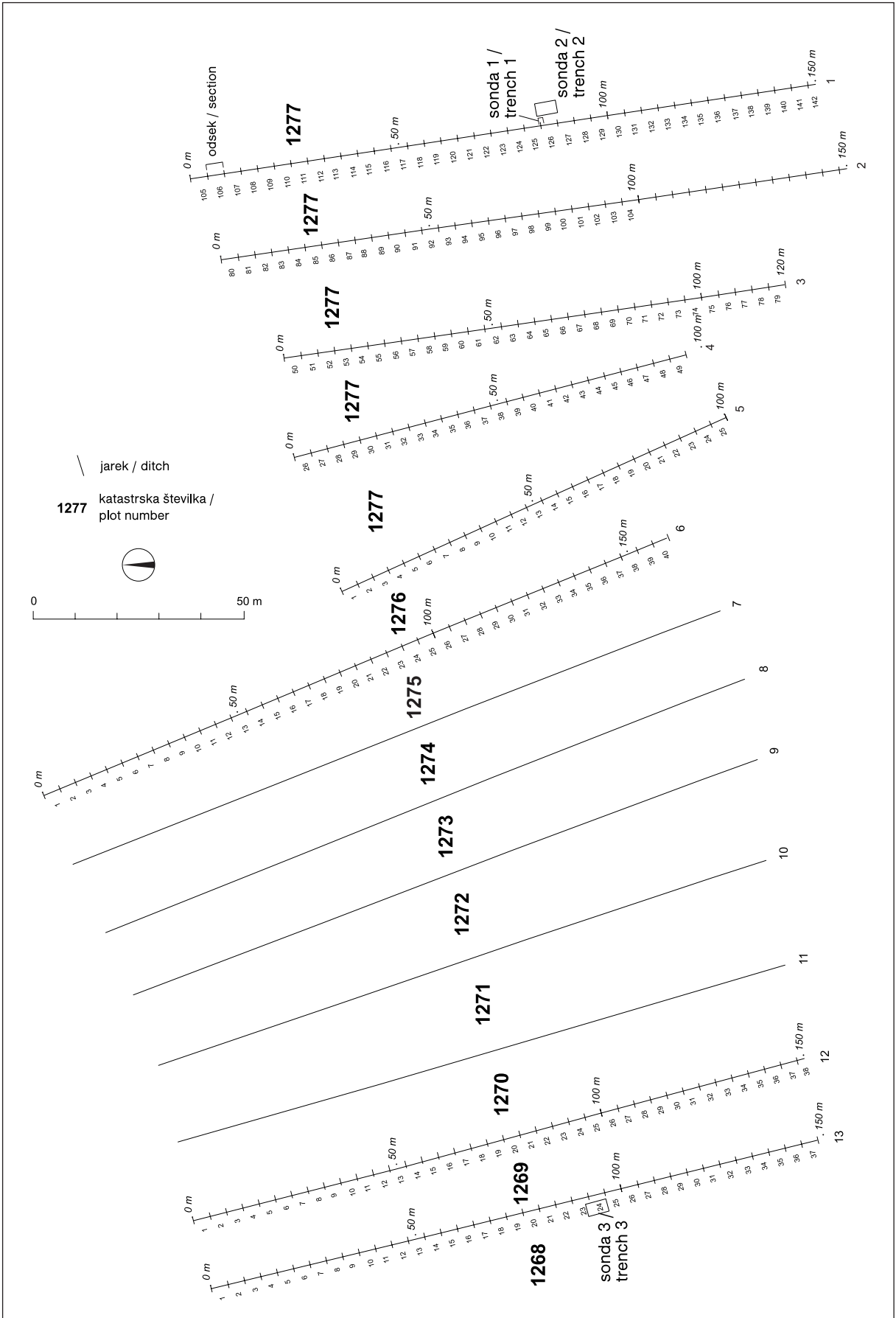
###### 3.1.1.1 DISCOVERY IN 1992 AND RESEARCH IN 1995

The archaeological site Stare gmajne lies on the southwestern part of the Ljubljansko barje, on eponymous fallows southward from the Ljubljanica and approximately 750 m to the northeast from the hamlet Podgora near Verd.

In 1992, J. Dirjec from the Institute of Archaeology ZRC SAZU noticed vertical piles and a pile-dwelling pottery at field walking of the ditch Hočevarica, in boundary ditch between plots nos. 1276 and 1277 in the Verd cadastral registry, c. 70 m northwards from a rut.

<sup>1</sup> Najdiščna koda je povzeta po bazi ARKAS (glej Tecco Hvala 1992; Modrijan 1994).

<sup>1</sup> After ARKAS (see Tecco Hvala 1992; Modrijan 1994).







*Sl. 3.1:* Načrt raziskanega območja na najdišču Stare gmajne z označenimi jarki, odseki in sondami. Najdbe so bile v odvodnih jarkih 1–6, 12 in 13 ter v vseh treh sondah, pri tem pa opozarjamo, da odvodna jarka 14 in 15, ki ležita zahodno od jarka 13, na načrtu nista označena. V njiju najdb iz arheoloških obdobij ni bilo. Risba: T. Korošec.

*Fig. 3.1:* Plan of investigated area at the excavation site Stare gmajne with marked ditches, sections (or sectors) and trenches. Finds yielded from drainage ditches 1–6, 12 and 13 and all three trenches. Note that drainage ditches 14 and 15, which lie to the west from ditch 13, are not marked on a plan, as they were archaeologically negative. Drawn by: T. Korošec.

V maju 1995 je ekipa Inštituta za arheologijo ZRC SAZU v sveže očiščenih jarkih zamejila obseg v letu 1992 odkritega najdišča na parcelah št. 1275 do 1277 k. o. Verd. Sočasno smo na območju, ki leži približno 100 m zahodno, na parcelah št. 1270, 1269 in 1268 k. o. Verd, odkrili ostanke domnevno še ene koliščarske naselbine, ki smo jo označili z delovnim imenom Stare gmajne 2, medtem ko je prvoodkrito kolišče dobilo delovno oznako Stare gmajne 1 (*sl. 3.1*). Pozneje, z nadaljevanjem raziskav, se je pokazalo, da gre za enovito naselbinsko območje, za katerega v tem zborniku uporabljamo ime Stare gmajne.

### 3.1.1.2 RAZISKOVANJE LETA 2002 (*sl. 3.1*)

Dokumentiranje in vzorčenje je potekalo v marcu in aprilu leta 2002. Ekipa Inštituta za arheologijo ZRC SAZU je raziskovala odvodne jarke na parcelah št. 1276 in 1277 k. o. Verd.

Tako je bilo na metodološko podoben način kot v primeru Založnice pri Kamniku pod Krimom<sup>2</sup> očiščenih 5 jarkov. Pred vzorčenjem so bile vertikalnim kolom izmerjene koordinate. Arheološke najdbe so bile dokumentirane po odsekih. Posamezni odsek je v dolžino meril 4 m.

**Odvodni jarek 1:** leži na osrednjem delu parcele št. 1277 k. o. Verd. Raziskano in dokumentirano je bilo 38 odsekov (št. 105–142), tj. 152 m. Meterski trak je potekal vzporedno ob jarku na njegovem vzhodnem robu. Vrednosti  $x$  so naraščale proti jugovzhodu, vrednosti  $y$  proti jugozahodu. Na nivoju hodne površine vrednosti širine jarka nihajo med približno 1,3 in 1,5 m. Proti dnu se jarek zoži.

**Sonda 1** (*sl. 3.1, 3.2*): sondiranje je potekalo 3. in 4. aprila 2002. Ker je bilo na parceli št. 1277 k. o. Verd v vzhodnem profilu jarka 1 na meji med odsekoma 125 in 126 odkrito leseno kolo z osjo, smo na tem mestu zastavili manjšo sondo, pozneje označeno kot sonda 1. Merski sistem je bil postavljen tako, da je izhodiščna točka sonde ( $x_1 = 0 - E 448 653$ ,  $y_1 = 0 - N 90 858$ ) glede na jarek 1 stala v odseku 125, na  $x = 83,65$  in  $y = 0$  m.

<sup>2</sup> Glej Velušček, Čufar 2003.

In May 1995, a team of the Institute of Archaeology ZRC SAZU, located the site, discovered in 1992, in freshly cleaned ditches in plots nos. 1275 to 1277 in the Verd cadastral registry. Remains of supposedly another pile-dwelling settlement were discovered at the same time. It was located c. 100 m to the west, on plots nos. 1270, 1269 and 1268 in the Verd cadastral registry. We acknowledged it with working name Stare gmajne 2, while the first pile-dwelling was identified as Stare gmajne 1 (*Fig. 3.1*). It turned out during research that this was a single settlement area, known as Stare gmajne in this publication.

### 3.1.1.2 RESEARCH IN 2002 (*Fig. 3.1*)

Documenting and sampling were conducted in March and April 2002. A team including members of the Institute of Archaeology examined drainage ditches on plots nos. 1276 and 1277 in the Verd cadastral registry.

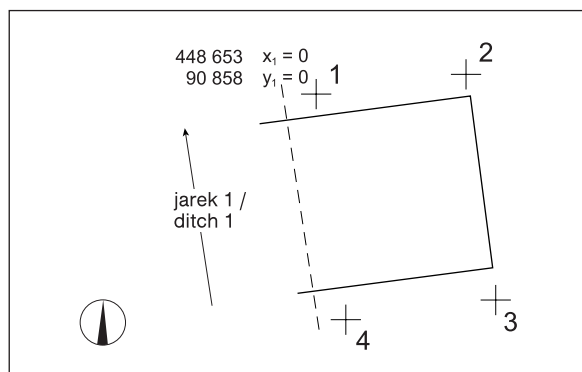
Five ditches were cleaned using a similar method as at Založnica near Kamnik pod Krimom.<sup>2</sup> Coordinates of vertical piles were determined before sampling. Archaeological finds were documented by sections/sectors. An individual section measured 4 m in length.

**Drainage ditch 1:** is located in the central part of plot no. 1277 in the Verd cadastral registry. 38 sections were examined and documented (nos. 105–142), i.e. 152 m. Measuring tape was placed parallel to the ditch along its eastern edge. The  $x$  values increased towards the southeast and the  $y$  values towards the southwest. Width of the ditch on the current walking surface varies between c. 1.3 and 1.5 m. The ditch narrows downwards.

**Trench 1** (*Figs. 3.1, 3.2*): sample trenching was carried out on the 3<sup>rd</sup> and 4<sup>th</sup> April 2002. As a wooden wheel with an axle was found on plot no. 1277 in the Verd cadastral registry in eastern section of ditch 1 on boundary between sections 125 and 126, we opened a smaller trench in this area. We later identified it as trench 1. The zero-point marker ( $x_1 = 0 - E 448 653$ ,  $y_1 = 0 - N 90 858$ ) was placed in section 125,  $x = 83.65$  m and  $y = 0$  m, with respect to ditch 1. The  $x_1$  values increased towards the southeast and  $y_1$  values towards the southwest. All elevations in the trench were measured from the same spot with an absolute height of 289.39 m (*Fig. 3.2*).

**Drainage ditch 2:** is located to the west from ditch 1 on plot no. 1277 in the Verd cadastral registry. 36 and a half sections were examined, i.e. 146 m. Considering the distribution of finds and piles, detailed documentation was done only for 25 sections (nos. 80–104). Measuring tape was placed parallel to the ditch along its eastern edge. The  $x$  values increased towards the southeast and the  $y$  values towards the southwest. Width of the ditch on the current walking surface varies between c. 1.3 and 1.5 m. The ditch narrows downwards.

<sup>2</sup> See Velušček, Čufar 2003.



Sl. 3.2: Sonda 1. Risba: T. Korošec. M = 1 : 50.

Fig. 3.2: Trench 1. Drawn by: T. Korošec. Scale = 1 : 50.

Vrednosti  $x_1$  so naraščale proti jugovzhodu, vrednosti  $y_1$  proti jugozahodu. Vse višine na sondi so bile merjene od iste osnove, ki je imela izmerjeno absolutno višino 289,39 m (sl. 3.2).

**Odvodni jarek 2:** leži zahodno od jarka 1 na parceli št. 1277 k. o. Verd. Raziskano je bilo 36 in pol odsekov, tj. 146 m. Glede na razporeditev najdb in kolov se je vodila natančnejša dokumentacija samo za prvih 25 odsekov (št. 80–104). Metrski trak je potekal vzporedno ob jarku na njegovem vzhodnem robu. Vrednosti  $x$  so naraščale proti jugovzhodu, vrednosti  $y$  proti jugozahodu. Na nivoju hodne površine vrednosti širine jarka nihajo med približno 1,3 in 1,5 m. Proti dnu se jarek zoži.

**Odvodni jarek 3:** leži zahodno od jarka 2 na parceli št. 1277 k. o. Verd. Raziskano je bilo 30 odsekov in tričetrt, tj. 123 m. Glede na razporeditev najdb in kolov se je vodila natančnejša dokumentacija samo za 30 odsekov (št. 50–79). Metrski trak je potekal vzporedno ob jarku na njegovem vzhodnem robu. Vrednosti  $x$  so naraščale proti jugovzhodu, vrednosti  $y$  proti jugozahodu. Na nivoju hodne površine vrednosti širine jarka nihajo med približno 1,3 in 1,5 m. Proti dnu se jarek zoži.

**Odvodni jarek 4:** leži zahodno od jarka 3 na parceli št. 1277 k. o. Verd. Raziskano je bilo 24 odsekov in četrt, tj. 97 m. Glede na razporeditev najdb in kolov se je vodila natančnejša dokumentacija samo za 24 odsekov (št. 26–49). Metrski trak je potekal vzporedno ob jarku na njegovem vzhodnem robu. Vrednosti  $x$  so naraščale proti jugovzhodu, vrednosti  $y$  proti jugozahodu. Na nivoju hodne površine vrednosti širine jarka nihajo med približno 1,3 in 1,5 m. Proti dnu se jarek zoži.

**Odvodni jarek 5:** je mejni jarek med parcelama št. 1276 in 1277 k. o. Verd. Raziskan je bil južni del jarka skoraj do kolovozne poti, tj. 25 odsekov (št. 1–25) oz. 100 m. Metrski trak je potekal vzporedno ob jarku na njegovem vzhodnem robu. Vrednosti  $x$  so naraščale proti jugovzhodu, vrednosti  $y$  proti jugozahodu. Na nivoju hodne površine vrednosti širine jarka nihajo med približno 1,3 in 1,5 m. Proti dnu se jarek zoži.

**Drainage ditch 3:** is located to the west from ditch 2 on plot no. 1277 in the Verd cadastral registry. 30 sections and  $\frac{3}{4}$  were examined, i.e. 123 m. Considering the distribution of finds and piles, detailed documentation was done only for 30 sections (nos. 50–79). Measuring tape was placed parallel to the ditch along its eastern edge. The  $x$  values increased towards the southeast and the  $y$  values towards the southwest. Width of the ditch on the current walking surface varies between c. 1.3 and 1.5 m. The ditch narrows downwards.

**Drainage ditch 4:** is located to the west from ditch 3 on plot no. 1277 in the Verd cadastral registry. 24 sections and  $\frac{1}{4}$  were examined, i.e. 97 m. Considering the distribution of finds and piles, detailed documentation was done only for 24 sections (nos. 26–49). Measuring tape was placed parallel to the ditch along its eastern edge. The  $x$  values increased towards the southeast and the  $y$  values towards the southwest. Width of the ditch on the current walking surface varies between c. 1.3 and 1.5 m. The ditch narrows downwards.

**Drainage ditch 5:** is a boundary ditch between plots nos. 1276 and 1277 in the Verd cadastral registry. Southern part of the ditch was examined in the direction towards the rut, i.e. 25 sections (nos. 1–25) or 100 m. Measuring tape was placed parallel to the ditch along its eastern edge. The  $x$  values increased towards the southeast and the  $y$  values towards the southwest. Width of the ditch on the current walking surface varies between c. 1.3 and 1.5 m. The ditch narrows downwards.

### 3.1.1.3 RESEARCH IN 2004 (Fig. 3.1)

Documenting and sampling was done in April in 2004. We examined drainage ditches between plots no. 1268 and 1276 in the Verd cadastral registry. We used the same methodology as in 2002. We determined coordinates of vertical piles prior to sampling. Archaeological finds were documented by sections. An individual section was 4 m long.

**Drainage ditch 6:** is located to the west from ditch 5 and represents a boundary ditch between plots no. 1275 and 1276 in the Verd cadastral registry. 40 sections were examined and documented (nos. 1–40), i.e. 160 m. Considering the distribution of finds and piles, detailed documentation was only done for 8 sections (nos. 27–30 and 34–37). Measuring tape was placed parallel to the ditch along its western edge. The  $x$  values increased towards the southeast and the  $y$  values towards the northeast. Width of the ditch on the current walking surface varies between c. 1.3 and 1.5 m. The ditch narrows downwards.

Sediment samples for natural history researches were extracted from two areas:

3.1.1.3 RAZSIKOVANJE LETA 2004 (*sl. 3.1*)

Dokumentiranje in vzorčenje je potekalo v aprilu leta 2004. Raziskovali smo odvodne jarke med parcelama št. 1268 in 1276 k. o. Verd. Pri raziskovanju smo sledili podobni metodologiji kot pri posegu v letu 2002. Pred vzorčenjem smo vertikalnim kolom izmerili koordinate. Arheološke najdbe smo dokumentirali po odsekih. Posamezni odsek je v dolžino meril 4 m.

**Odvodni jarek 6:** leži zahodno od jarka 5 in je mejni jarek med parcelama št. 1275 in 1276 k. o. Verd. Raziskano in dokumentirano je bilo 40 odsekov (št. 1–40), tj. 160 m. Glede na razporeditev najdb in kolov smo vodili natančnejšo dokumentacijo samo za 8 odsekov (št. 27–30 in 34–37). Metrski trak je potekal vzporedno ob jarku na njegovem zahodnem robu. Vrednosti x so naraščale proti jugovzhodu, vrednosti y proti severovzhodu. Na nivoju hodne površine vrednosti širine jarka nihajo med približno 1,3 in 1,5 m. Proti dnu se jarek zoži.

Vzorci sedimenta za naravoslovne raziskave so bili odvzeti na dveh mestih:

- 180 litrov sedimenta iz kulturne plasti v vzhodnem profilu jarka, odsek 29: x = 114–116 m, y = 1,80–2,00 m;
- vzorci za sedimentološko analizo v vzhodnem profilu jarka, odsek 29: x = 113,80–114 m, y = 2,00–2,10 m.<sup>3</sup>

**Odvodni jarek 7:** leži zahodno od jarka 6 in je mejni jarek med parcelama št. 1274 in 1275 k. o. Verd. Raziskano in dokumentirano je bilo 37 odsekov in pol (št. 1–38), tj. 150 m. Glede na razporeditev najdb in kolov smo vodili natančnejšo dokumentacijo samo za 12 odsekov (št. 24–35). Metrski trak je potekal vzporedno ob jarku na njegovem vzhodnem robu. Vrednosti x so naraščale proti jugovzhodu, vrednosti y proti jugozahodu. Na nivoju hodne površine vrednosti širine jarka nihajo med približno 1 in 1,5 m. Proti dnu se jarek zoži.

**Odvodni jarki 8–11:** ležijo zahodno od jarka 7 na parcelah od št. 1270 do 1274 k. o. Verd in so arheološko negativni.

**Odvodni jarek 12:** leži zahodno od jarka 11 in je mejni jarek med parcelama št. 1269 in 1270 k. o. Verd. Raziskano in dokumentirano je bilo 37 odsekov in pol (št. 1–38), tj. 150 m. Glede na razporeditev najdb in kolov smo vodili natančnejšo dokumentacijo samo za 12 odsekov (št. 24–35). Metrski trak je potekal vzporedno ob jarku na njegovem vzhodnem robu. Vrednosti x so naraščale proti jugovzhodu, vrednosti y proti jugozahodu. Na nivoju hodne površine vrednosti širine jarka nihajo med približno 1 in 1,5 m. Proti dnu se jarek zoži.

Vzorci sedimenta za naravoslovne raziskave so bili odvzeti na dveh mestih:

- 230 litrov sedimenta kulturne plasti v vzhodnem profilu jarka, odsek 28: x = 110–112 m, y = 0,30–0,50 m;
- vzorci za sedimentološko analizo v vzhodnem profilu jarka, odsek 32: x = 126,90–127,10 m, y = 0,40–0,50 m.<sup>4</sup>

**Odvodni jarek 13:** leži zahodno od jarka 12 in je mejni jarek med parcelama št. 1268 in 1269 k. o. Verd. Raziskano in dokumentirano je bilo 37 odsekov (št.

- 180 litrov sedimenta iz kulturne plasti v vzhodnem profilu jarka, odsek 29: x = 114–116 m, y = 1,80–2,00 m;

- vzorci za sedimentološko analizo v vzhodnem profilu jarka, odsek 29: x = 113,80–114 m, y = 2,00–2,10 m.<sup>3</sup>

**Drainage ditch 7:** is located to the west from ditch 6 and is a boundary ditch between plots no. 1274 and 1275 in the Verd cadastral registry. We examined a total of 165 m. We came across individual archaeological finds on a field eastwards of the ditch. Considering the vicinity, they perhaps originate from the ditch. The ditch was otherwise archaeologically negative and did not contain any piles.

**Drainage ditches 8–11:** are located to the west from ditch 7 on plots from no. 1270 to no. 1274 in the Verd cadastral registry. They were archaeologically negative.

**Drainage ditch 12:** is located to the west from ditch 11 and is a boundary ditch between plots no. 1269 and 1270 in the Verd cadastral registry. 37 and a half sections were examined and documented (nos. 1–38), i.e. 150 m. Considering the distribution of finds and piles, detailed documentation was only done for 12 sections (nos. 24–35). Measuring tape was placed parallel to the ditch along its eastern edge. The x values increased towards the southeast and the y values towards the southwest. Width of the ditch on the current walking surface varies between c. 1 and 1.5 m. The ditch narrows downwards.

Sediment samples for natural history researches were extracted from two areas:

- 230 litres of sediment from the cultural layer in the eastern section of ditch, section 28: x = 110–112 m, y = 0,30–0,50 m;

- samples for sedimentological analysis from eastern section of ditch, section 32: x = 126,90–127,10 m, y = 0,40–0,50 m.<sup>4</sup>

**Drainage ditch 13:** is located to the west from ditch 12 and is a boundary ditch between plots no. 1268 and 1269 in the Verd cadastral registry. 37 sections were examined and documented (nos. 1–37), i.e. 148 m. Considering the distribution of finds and piles, more detailed documentation was done only for 15 sections (nos. 21–24 and 27–37). Measuring tape was placed parallel to the ditch along its eastern edge. The x values increased towards the southeast and the y values towards the southwest. Width of the ditch on the current walking surface varies between c. 1 and 1.4 m. The ditch narrows downwards.

Sediment samples for natural history researches were extracted from two areas:

- 50 litres from the western section of the ditch, section 24: x = 92–94 m, y = 1.30–1.50 m;

- 120 litres from the eastern section of the ditch, section 30: x = 116–118 m, y = 0.30–0.50 m.

<sup>3</sup> Poglavje 2 v tem zborniku.

<sup>4</sup> Poglavje 2 v tem zborniku.

<sup>3</sup> See Chapter 2 in this monograph.

<sup>4</sup> See Chapter 2 in this monograph.

1–37), tj. 148 m. Glede na razporeditev najdb in kolov se je vodila natančnejša dokumentacija samo za 15 odsekov (št. 21–24 in 27–37). Meterski trak je potekal vzporedno ob jarku na njegovem vzhodnem robu. Vrednosti  $x$  so naraščale proti jugovzhodu, vrednosti  $y$  proti jugozahodu. Na nivoju hodne površine vrednosti širine jarka nihajo med približno 1 in 1,4 m. Proti dnu se jarek zoži.

Vzorci sedimenta za naravoslovne raziskave so bili odvzeti na dveh mestih:

– 50 litrov v zahodnem profilu jarka, odsek 24:  $x = 92\text{--}94$  m,  $y = 1,30\text{--}1,50$  m;

– 120 litrov v vzhodnem profilu jarka, odsek 30:  $x = 116\text{--}118$  m,  $y = 0,30\text{--}0,50$  m.

**Odvodna jarka 14 in 15:** ležita zahodno od jarka 13 med parcelama št. 1266 in 1268 k. o. Verd in sta arheološko negativna.

### 3.1.1.3.1 Palinološko vrtanje

Dne 8. septembra 2004 je ekipa Inštituta za arheologijo ZRC SAZU na parceli št. 1277 k. o. Verd zastavila palinološko vrtino in sicer na travniku približno 8 metrov vzhodno od jarka 5, približno na  $x = 36$  m oz. v bližini odsekov 9 in 10 (glej sl. 3.1).<sup>5</sup>

#### 3.1.1.4 RAZISKOVANJE LETA 2006

Sondiranje je potekalo od 19. junija do 14. julija 2006. Raziskana je bila sonda 2 na parceli št. 1277 k. o. Verd ( $y_2 = 0$  – E 448 655,  $x_2 = 0$  – N 90 853).

**Sonda 2** (sl. 3.1 in 3.3): je bila zastavljena v bližini sonde 1 in vzporedno na jarek 1. V dolžino je merila 5 m in v širino 3 m, razdeljena je bila na 15 kvadrantov ( $1 \times 1$  m).

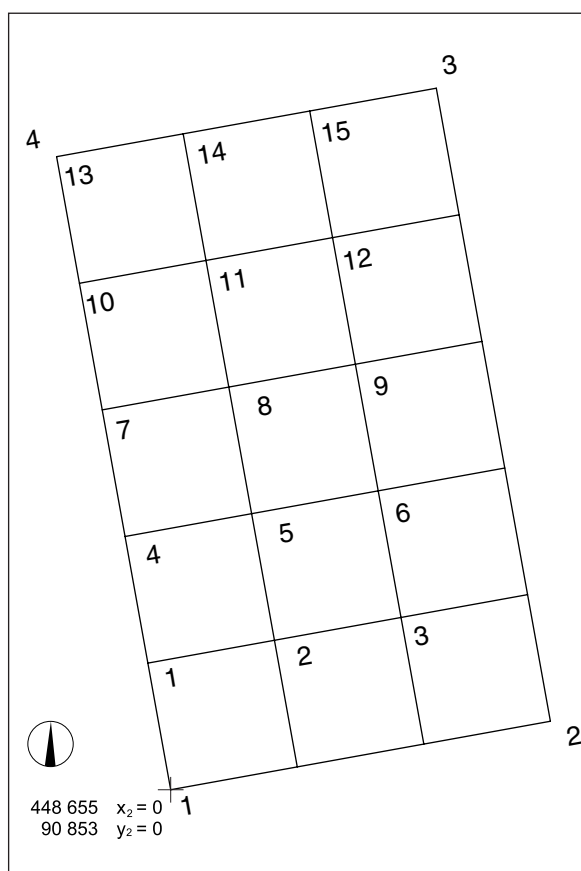
Merski sistem je bil postavljen tako, da je stala izhodiščna točka  $x_2 = 0$ ,  $y_2 = 0$  na jugozahodu sonde v smeri proti jarku 1. Vrednost  $x_2$  je naraščala proti severozahodu, vrednost  $y_2$  proti severovzhodu. Na zahodnem delu sonde pri vrednosti  $y_2 = 0$  so bili razporejeni kvadranti 1, 4, 7, 10 in 13, na vzhodnem delu pri vrednosti  $y_2 = 3$  kvadranti 3, 6, 9, 12 in 15, vmes pa kvadranti 2, 5, 8, 11 in 14.

Vse višine na sondi so bile merjene od iste osnove, ki je imela izmerjeno absolutno višino 289,62 m.

#### 3.1.1.5 RAZISKOVANJE LETA 2007

Sondiranje je potekalo od 26. junija do 19. julija 2007. Raziskana je bila sonda 3 na parceli št. 1268 k. o. Verd ( $y_3 = 0$  – E 448 395),  $x_3 = 0$  – N 90 841).

**Sonda 3** (sl. 3.1 in 3.4): je bila zastavljena zahodno od jarka 13 v bližini mesta, kjer smo leta 2004 odvzeli



Sl. 3.3: Mreža kvadrantov na sondi 2. Risba: T. Korošec.  
Fig. 3.3: Grid in trench 2. Drawn by: T. Korošec.

**Drainage ditches 14 and 15:** are located to the west from ditch 13 between plots no. 1266 and 1268 in the Verd cadastral registry and are archaeologically negative.

### 3.1.1.3.1 Palynological drilling

On 8<sup>th</sup> September 2004, a team of the Institute of Archaeology drilled a palynological borehole on plot no. 1277 in the Verd cadastral registry, on a meadow c. 8 m eastwards from ditch 5, approximately on  $x = 36$  m, i.e. near sections 9 and 10 (see Fig. 3.1).<sup>5</sup>

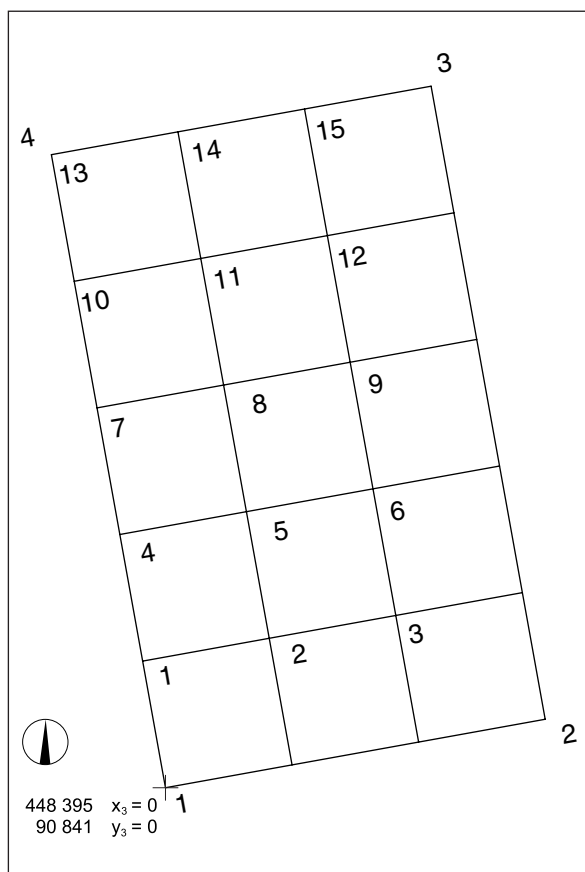
#### 3.1.1.4 RESEARCH IN 2006

Sample trenching was carried out between 19<sup>th</sup> June and 14<sup>th</sup> July 2006. Trench 2 on plot no. 1277 in the Verd cadastral registry ( $y_2 = 0$  – E 448 655,  $x_2 = 0$  – N 90 853) was examined.

<sup>5</sup> Prispevek o analizi palinološkega profila je v pripravi.

<sup>5</sup> Publication of analysis of palynological profile in preparation.





Sl. 3.4: Mreža kvadrantov na sondi 3. Risba: T. Korošec.  
Fig. 3.4: Grid in trench 3. Drawn by: T. Korošec.

50-litrski vzorec sedimenta iz kulturne plasti in kjer smo našli ostanke metalurških pripomočkov.

Zastavljena je bila vzporedno na jarek 13. V dolžino je merila 5 m in v širino 3 m, razdeljena je bila na 15 kvadrantov ( $1 \times 1$  m).

Merski sistem je bil postavljen tako, da je stala izhodiščna točka  $x_3 = 0$ ,  $y_3 = 0$  na jugozahodu sonde proč od jarka 13. Vrednost  $x_3$  je naraščala proti severozahodu, vrednost  $y_3$  proti severovzhodu. Na zahodnem delu sonde pri vrednosti  $y_3 = 0$  so bili razporejeni kvadranti 1, 4, 7, 10 in 13, na vzhodnem delu pri vrednosti  $y_3 = 3$  kvadranti 3, 6, 9, 12 in 15, vmes pa kvadranti 2, 5, 8, 11 in 14.

Vse višine na sondi so bile merjene od iste osnove, ki je imela izmerjeno absolutno višino 290,28 m.

### 3.1.1.6 KOMENTAR

Na podlagi topografskih podatkov ugotavljamo, da se najdiščno območje razprostira najmanj od jarka 1 na vzhodu do jarka 6 ter na njihah vzdolž jarkov 12 in 13 na zahodu (sl. 3.5).

**Trench 2** (Figs. 3.1 and 3.3): was opened close to trench 1, parallel to ditch 1. It was 5 m long, 3 m wide and was divided into 15 quadrants ( $1 \times 1$  m).

The zero-point marker ( $x_2 = 0$ ,  $y_2 = 0$ ) was placed to the southwestern side of the trench in the direction towards ditch 1. The  $x_2$  value increased towards the northwest and  $y_2$  values towards the northeast. At value  $y_2 = 0$ , on the western part of the trench, quadrants 1, 4, 7, 10 and 13 were placed, at  $y_2 = 3$ , on the eastern part of the trench, quadrants 3, 6, 9, 12 and 15, with quadrants 2, 5, 8, 11 and 14 in between.

All elevations in the trench were measured from the same spot with absolute height 289.62 m.

### 3.1.1.5 RESEARCH IN 2007

Sample trenching was carried out between 26<sup>th</sup> June and 19<sup>th</sup> July 2007. Trench 3 on plot no. 1268 in the Verd cadastral registry ( $y_3 = 0$  - E 448 395,  $x_3 = 0$  - N 90 841) was examined.

**Trench 3** (Figs. 3.1 and 3.4): was opened to the west from ditch 13, close to the area where a 50 litre sample of sediment from cultural layer was extracted and where the remains of metallurgical accessories were discovered in 2004.

Trench 3 was opened parallel to ditch 13. It was 5 m long, 3 m wide and was divided into 15 quadrants ( $1 \times 1$  m).

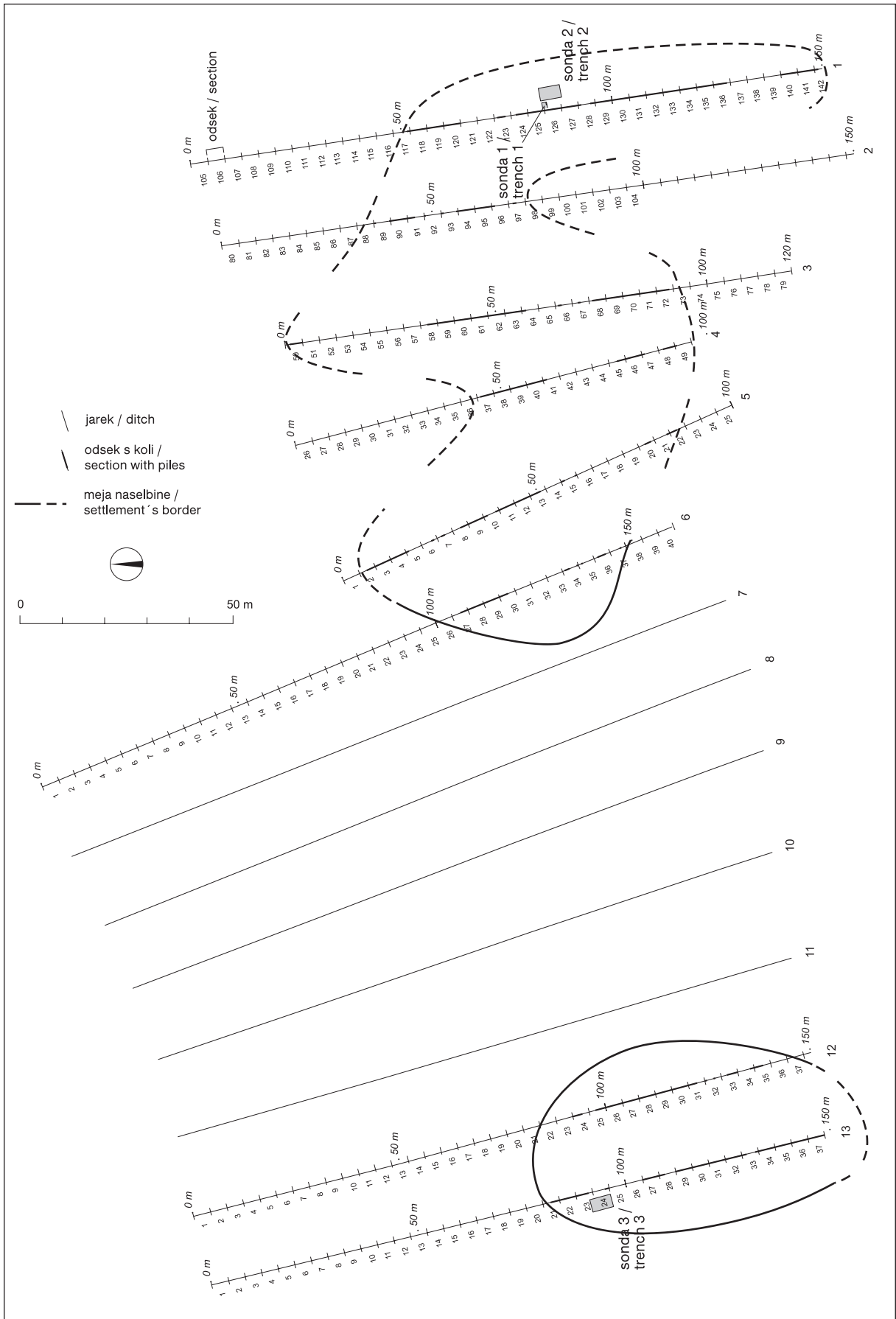
The zero-point marker ( $x_3 = 0$ ,  $y_3 = 0$ ) was placed to the southwestern side of the trench away from ditch 13. The  $x_3$  value increased towards the northwest and  $y_3$  values towards the northeast. On western part of trench, at value  $y_3 = 0$ , quadrants 1, 4, 7, 10 and 13 were placed, while at value  $y_3 = 3$ , on the eastern part of the trench, quadrants 3, 6, 9, 12 and 15 were placed, with quadrants 2, 5, 8, 11 and 14 in between.

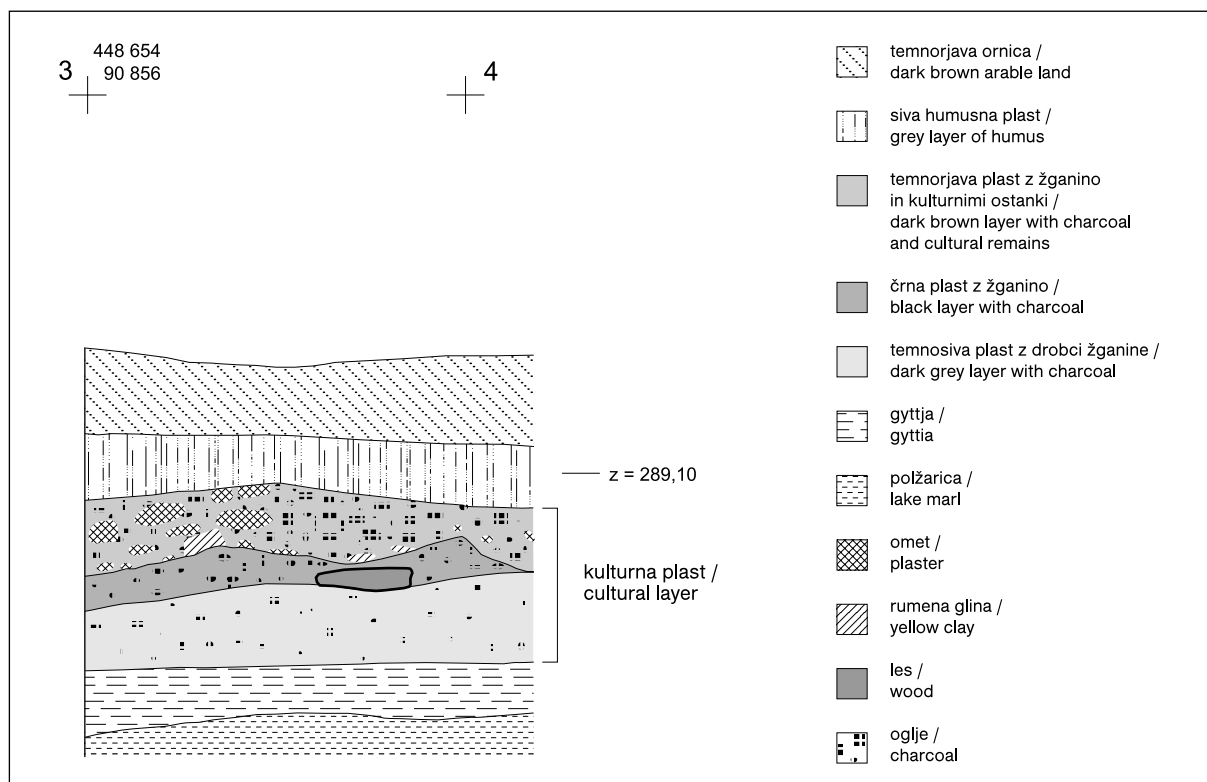
All elevations in the trench were measured from the same spot with absolute height 290.28 m.

### 3.1.1.6 COMMENTARY

Based on topographic data, we assume that the site spreads at least from ditch 1 to ditch 6 in the east, and over fields alongside ditches 12 and 13 in the west (Fig. 3.5).

The western edge of the eastern side of the site has been determined, while the edges in the remaining directions have not been confirmed. We perhaps found the edge of the pile-dwelling also on its western side, where we can approximately establish it in the west, east and north, while the southern edge, predominantly in the direction of ditch 13, has not been recognized.





Sl. 3.6: Sonda 1. Južni profil. Risba: T. Korošec. M = 1 : 20.

Fig. 3.6: Trench 1. Southern section. Drawn by: T. Korošec. Scale = 1 : 20.

Na vzhodnem delu smo najdišče zamejili v smeri proti zahodu, v druge smeri pa meja ni dokončno potrjena. Na rob kolišča domnevamo tudi na njegovem zahodnem delu, kjer lahko približno začrtamo mejo na zahodu, vzhodu in severu, medtem ko nam južne meje, predvsem v smeri jarka 13, še ni uspelo določiti.

### 3.1.2 VERTIKALNA STRATIGRAFIJA

#### 3.1.2.1 SONDA 1 (sl. 3.6)

Spodnjo plast 5 predstavlja svetlosivo blato oz. polžarica.

Na njej leži temnosiva plast 4, t. i. gyttja, gre za sladkovodni mulj z organsko snovjo, ki je nastal v anaerobnih pogojih.<sup>6</sup> V gyttji je najti lise z organskim materialom; verjetno gre za mah.<sup>7</sup>

Plast 4 prekriva t. i. kulturna plast 3 temnorjave do črne barve: v spodnjem delu gre za detritus z malo najdbami, z ostanki lesa, koščki žganine. Večja količina najdb, gre za artefakte, ostanke lesa in večje kose žganine,

<sup>6</sup> Pavšič 2006, 99.

<sup>7</sup> Prim. z Jeraj 2004.

### 3.1.2 VERTICAL STRATIGRAPHY

#### 3.1.2.1 TRENCH 1 (Fig. 3.6)

The basal layer 5 is composed of light grey mud or lake marl.

It is covered by a dark grey layer 4, i.e. gyttia. It is a freshwater sludge with organic substance, created in anaerobic conditions.<sup>6</sup> Lenses, containing organic material, probably moss, are present in gyttia.<sup>7</sup>

Layer 4 is overlapped by a so-called cultural layer 3, dark brown to black in colour: its lower part is a detritus with few finds, with remains of wood and charcoal. Larger number of finds, i.e. artefacts, remains of wood and larger pieces of charcoal, are to be found in the upmost upper part of the layer. Larger pieces of yellowy orange fired clay are also present, mostly in its eastern part. These are most probably remains of a kiln.

Grey humus layer 2 overlaps the cultural layer, with vertical piles present at the bottom of which.

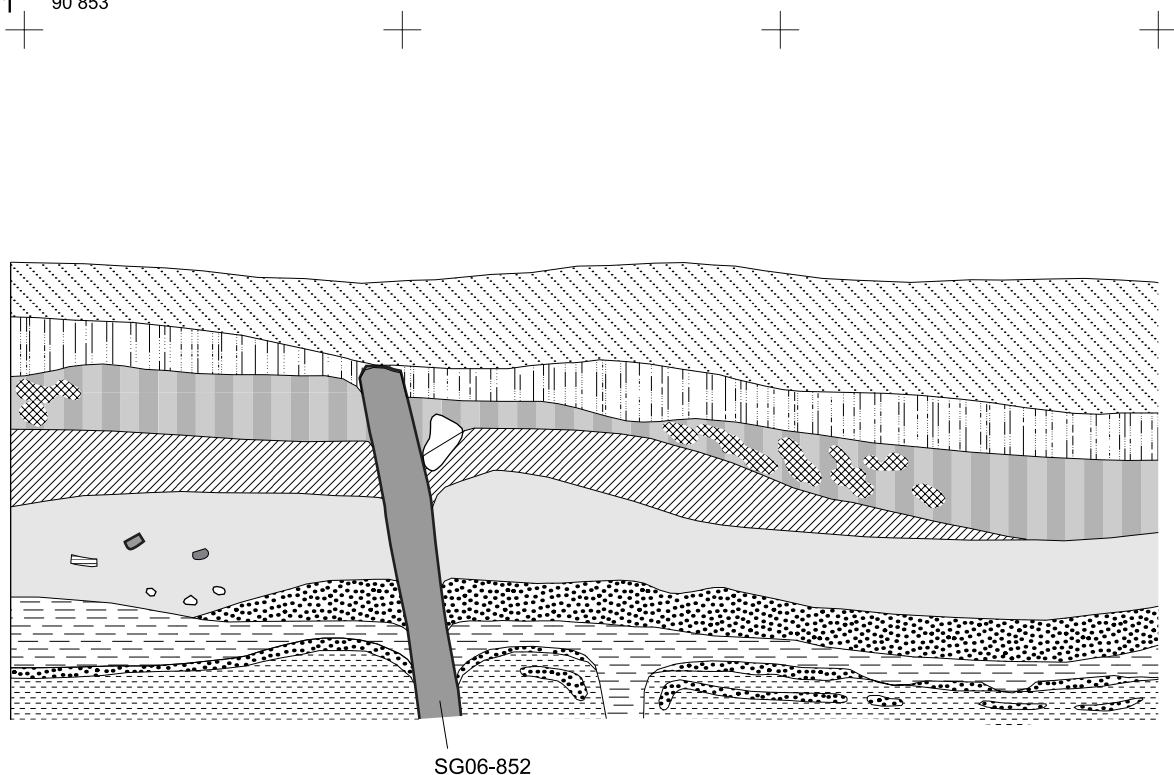
<sup>6</sup> Pavšič 2006, 99.

<sup>7</sup> Compare with Jeraj 2004.

Sl. 3.5: Ugotovljeni in domnevni obseg arheološkega najdišča Stare gmajne. Risba: T. Korošec.

Fig. 3.5: Discovered and presumed area of the archaeological site Stare gmajne. Drawn by: T. Korošec.

1 448 655  
90 853

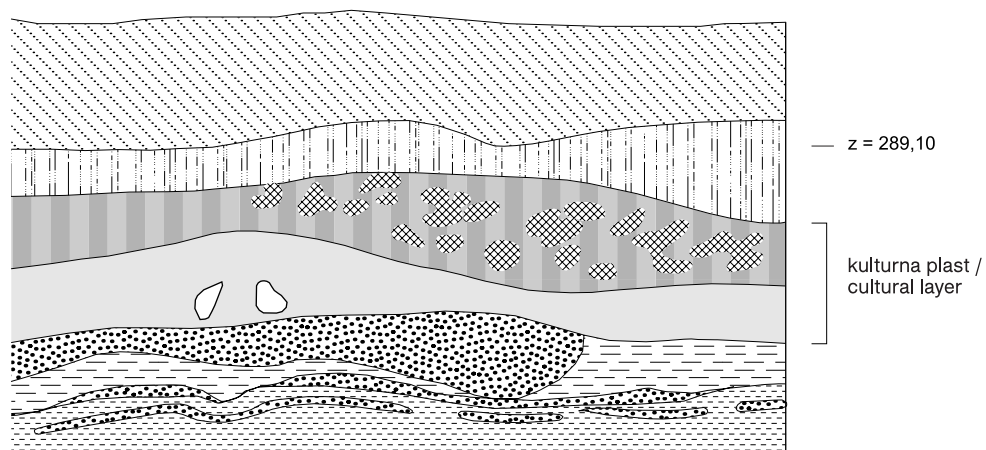


+

+

+

4



se nahaja višje v zgornjem delu plasti, kjer je predvsem na vzhodnem delu najti tudi večje kose prežgane gline rumenooranžne barve, verjetno ostanke peči.

Humus layer 1: dark brown arable land is present on the eastern part, and dark brown humus on the western part of the trench.





Sl. 3.7: Sonda 2. Zahodni profil. Risba: T. Korošec. M = 1 : 20. Spodnja in zgornja višinska točka v metrih nad morjem po posameznih režnjih pri  $x_2 = 5$ ,  $y_2 = 0$  (kol št. 4): reženj 8 (288,39–288,49 m), reženj 7 (288,49–288,59 m), reženj 6 (288,59–288,73 m), reženj 5 (288,73–288,87 m), reženj 4 (288,87–288,92 m) in reženj 3 (288,92–289,10 m).

Fig. 3.7: Trench 2. Western section. Drawn by: T. Korošec. Scale = 1 : 20. Top and bottom altitude points of individual deepening at  $x_2 = 5$ ,  $y_2 = 0$  (pile no. 4) in metres a.s.l.: deepening 8 (288.39–288.49 m), deepening 7 (288.49–288.59 m), deepening 6 (288.59–288.73 m), deepening 5 (288.73–288.87 m), deepening 4 (288.87–288.92 m) and deepening 3 (288.92–289.10 m).

Kulturno plast prekriva humusna plast 2 sive barve, na dnu katere se začno pojavljati vertikalni koli.

Humusna plast 1: v vzhodnem delu sonde gre za temnorjavo ornico, na zahodnem pa za temnorjavi humus.

### 3.1.2.2 SONDA 2 (sl. 3.7)

S sondo 2 smo podobno kot pri sondi 1 dosegli svetlo sivo blato oz. polžarico, ki smo jo poimenovali plast 5.

Mejo z višje ležečo temnosivo plastjo 4, t. i. gyttjo, predstavljajo lise organskega izvora, verjetno gre za mah.<sup>8</sup> V zgornjem delu plasti 4 oz. na meji s plastjo 3, t. i. kulturno plastjo, med  $x_2 = 0,50$  m in  $x_2 = 4,50$  m, je bilo najti do 0,20 m debelo skoraj črno plast iz rastlin-

<sup>8</sup> Glej npr. Jeraj 2004.

### 3.1.2.2 TRENCH 2 (Fig. 3.7)

Similarly as in trench 1, trench 2 revealed light grey mud or lake marl basal layer, which was identified as layer 5.

Contact with the overlapping dark grey layer 4, i.e. gyttia, can be seen as lenses of organic origin, probably moss.<sup>8</sup> At the top of layer 4, at the contact with layer 3, i.e. cultural layer, between  $x_2 = 0.50$  m and  $x_2 = 4.50$  m, a 0.20 m thick, almost black layer of vegetal remains, reminiscent of peat was present. At  $x_2 = 3.50$  m,  $y_2 = 0.80$  m and on  $x_2 = 2.25$  m,  $y_2 = 1.40$  m, two stumps with roots and burnt upper parts, between heights 288.51 and 288.65 (no. SG06-936) or 288.53 and 288.63 m (no. SG06-923), were discovered. Stump SG06-923 (Fig. 3.4I) was determined as alder (*Alnus*).

Cultural layer 3 overlaps layer 4. It is mainly dark brown to black in colour, interlaced with yellowish streaks. A great number of pieces of wood and archaeological finds yielded from this layer. In the middle part of the layer 3, between  $x_2 = 0$  m and  $x_2 = 2.60$  m, there is a 0.20 m thick patch of yellowish clay, which was overlaid by a thick layer of charcoal (Fig. 3.9). Numerous pieces of clay were found within, mostly at  $x_2 = 0$  m,  $x_2 = 2$  m and between  $x_2 = 3.60$  m and  $x_2 = 5$  m; these are probably remains of a kiln, orange yellow in colour.

Cultural layer is overlapped by a grey layer of humus 2, with vertical piles starting to occur at the bottom of it.

Humus layer 1: dark brown arable land.

### 3.1.2.3 TRENCH 3 (Fig. 3.10)

At the base of the trench 3 we barely achieved the upper level of a light grey mud or lake marl, which imperceptibly transforms to dark grey layer 5, so-called gyttia, that presents a transition between lake and marsh environment. Layer 5 is interrupted with darker lenses of vegetal origin; probably moss.<sup>9</sup> Some archaeological artefacts were found in this layer.

Layer 5 is overlaid by a so-called cultural layer 4, mainly dark brown to black in colour with yellowish lenses. Analysis of the core sample from ditch 12 (SG-12) showed that peat layer occurs on this level and that the environment around the area of sampling was marshy or boggy at the time when this layer was created.<sup>10</sup>

Nonetheless, numerous archaeological artefacts and other cultural remains can be found in layer 4. The cultural layer is not homogeneous; on the contrary, it shows extreme layering, which is clearly visible in the eastern section, between  $x_3 = 2.80$  m and  $x_3 = 5$  m, where we can notice alternation compact yellowish clay layers.

<sup>8</sup> See e.g. Jeraj 2004.

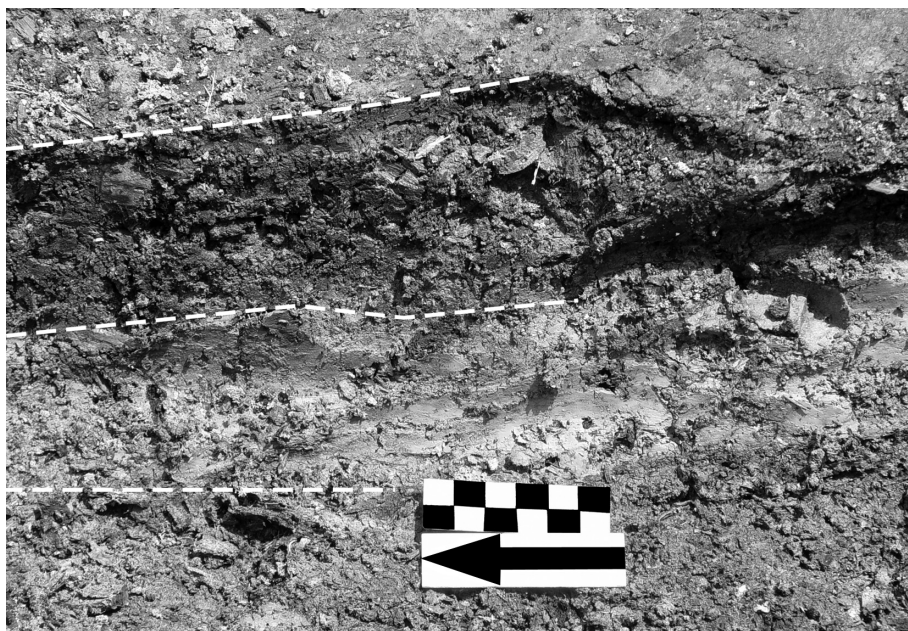
<sup>9</sup> See Jeraj 2004.

<sup>10</sup> See Chapter 2 in this monograph.



Sl. 3.8: Sonda 2. Zahodni profil, detajl v kv. 1 in 4. Foto: M. Turk.

Fig. 3.8: Trench 2. Western section, details of quadrants 1 and 4. Photo: M. Turk.



Sl. 3.9: Sonda 2. Pogled na plast rumenkaste glin in nad njo ležečo plast žganine v 4. režnju kv. 5 med izkopavanjem. Foto: M. Turk.

Fig. 3.9: Trench 2. View on layer of yellowish clay and overlapping charcoal layer in deepening 4, quadrant 5, during excavation. Photo: M. Turk.

skih ostankov, ki spominja na šoto. Na  $x_2 = 3,50$  m,  $y_2 = 0,80$  m in na  $x_2 = 2,25$  m,  $y_2 = 1,40$  m smo naleteli tudi na dva v zgornjem delu ožgana štora s koreninama med višinama 288,51 in 288,65 (št. SG06-936) oz. 288,53 in 288,63 m (št. SG06-923). Štor SG06-923 (sl. 3.41) je bil determiniran in kaže, da gre za jelšo (*Alnus*).

On top of layer 4 lies humus layer 3, brown in colour, containing some archaeological finds.

Layer 3 is overlaid by humus layer 2, with its lower part light grey in colour.

Layer 1: dark brown humus.



Na plasti 4 leži kulturna plast 3, ki je v glavnem temnorjave do črne barve z rumenkastimi progami. V njej je najti veliko koščkov lesa in arheološke najdbe. V srednjem delu plasti 3 je med  $x_2 = 0$  m in  $x_2 = 2,60$  m do 0,20 m debela zaplata zbite rumenkaste gline, nad njo pa debela plast žganine (*sl.* 3.9), v kateri je predvsem okoli  $x_2 = 0$  m,  $x_2 = 2$  m ter med  $x_2 = 3,60$  m in  $x_2 = 5$  m tudi veliko kosov prežgane gline, verjetno ostankov peči, oranžnorumene barve.

Kulturno plast prekriva humusna plast 2 sive barve, na dnu katere se začno pojavljati vertikalni koli.

Humusna plast 1: temnorjava ornica.

### 3.1.2.3 SONDA 3 (*sl.* 3.10)

Na dnu izkopa v sondi 3 smo komaj dosegli zgornji nivo svetlosivega blata oz. polžarice, ki neopazno prehaja v temnosivo plast 5, t. i. gytjto, ki predstavlja prehod med jezerskim in močvirskim okoljem. Plast 5 prekinjajo temnejše lise rastlinskega izvora; verjetno gre za mah.<sup>9</sup> V tej plasti je že bilo najti posamezne arheološke artefakte.

Na plasti 5 leži t. i. kulturna plast 4, ki je v glavnem temnorjave do črne barve z rumenkastimi lisami. Analiza sedimentnega stolpca iz jarka 12 (SG-12) je pokazala, da se na tej višini pojavlja šotna plast in da je bilo v času nastajanja plasti okolje na mestu vzorčenja zamočvirjeno oz. barjansko.<sup>10</sup>

Kakor koli že, v plasti 4 je najti številne arheološke artefakte in druge kulturne ostanke. Kulturna plast ni homogena, nasprotno, izkazuje izredno plastovitost, kar je razvidno predvsem v vzhodnem profilu na odseku med  $x_3 = 2,80$  m in  $x_3 = 5$  m, kjer je opaziti alternacijo plasti zbite rumenkaste gline.

Na plasti 4 leži humusna plast 3 rjave barve, kjer je bilo še vedno najti nekaj arheoloških najdb.

Na plasti 3 leži humusna plast 2, ki je v spodnjem delu nekoliko bolj svetlosiva.

Plast 1: temnorjavi humus.

<sup>9</sup> Glej Jeraj 2004.

<sup>10</sup> Glej poglavje 2 v tem zborniku.



*Sl.* 3.11: Sonda 3. Vzhodni profil. Foto: D. Veranič.

*Fig.* 3.11: Trench 3. Eastern section. Photo: D. Veranič.

## 3.2 FINDS

### 3.2.1 POTTERY AND CLAY ARTEFACTS

Pottery is dominant among the archaeological finds. The following starting points were followed by the evaluation:

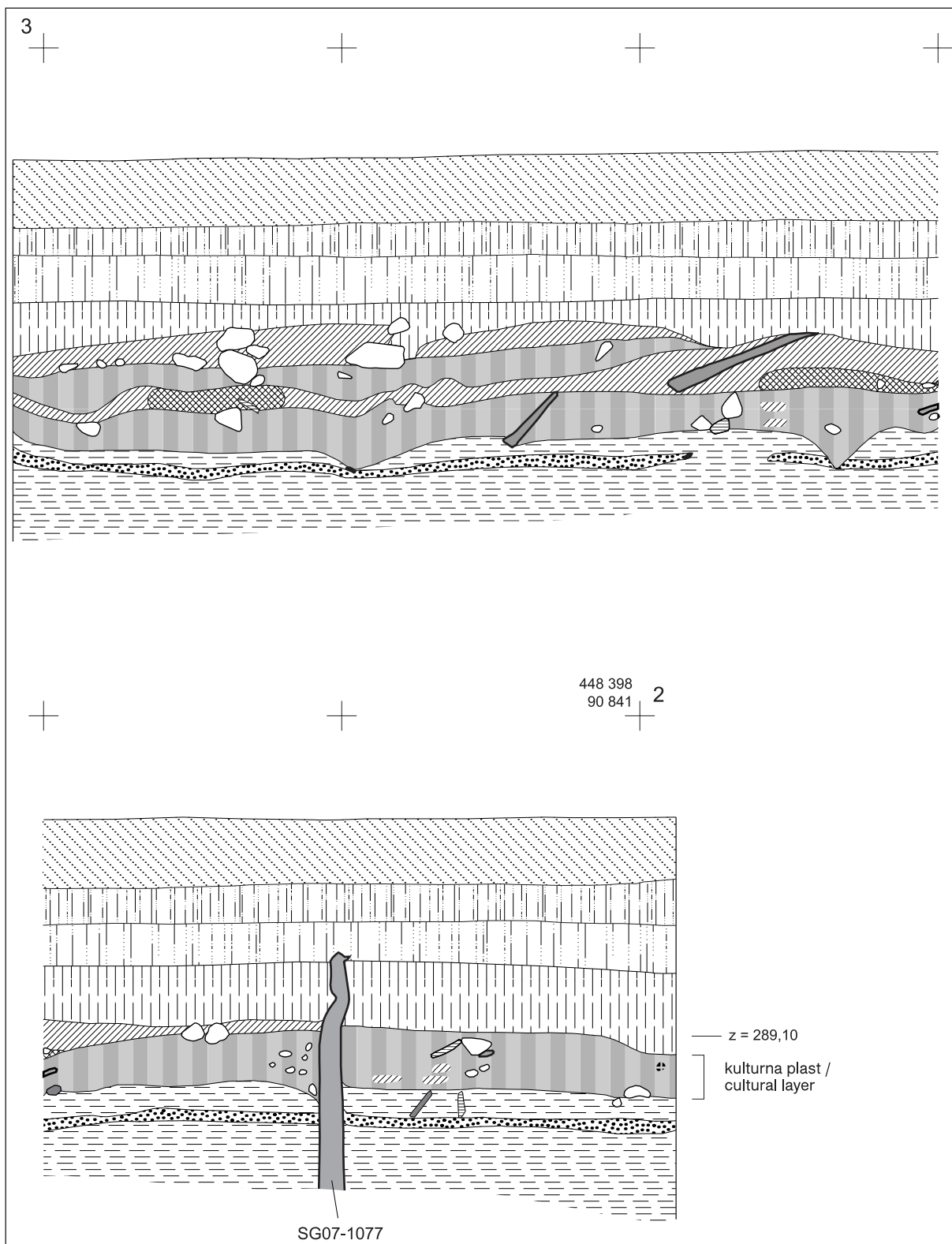
1. Macroscopic analysis was performed on pottery.
2. Because of spatial restraints and specific method of discovering the finds (see above), we did not try to re-assemble the fragments; the latter occurred when fresh fractures were visible (as e.g. *Pl.* 3.6: 6) and at finds from trenches 2 and 3.
3. All finds that were subjectively marked as diagnostic were prepared for publication: rims with walls,<sup>11</sup> ornamented fragments<sup>12</sup> etc.
4. Shapes of pots were determined based on drawing reconstructions – we mostly used larger fragments, usually rims with walls.
5. Quantity of published specimens of an individual type of vessels is not reflecting the real percentage vessels of such type, found at Stare gmajne. However, we can expect that the percentage of specific types of vessels is at least partly reflected in the publication.
6. Quantity of published specimens with a certain type of ornament reflects at least approximately realistic percentage of ware, ornamented in such way.
7. Analysis of quantitative occurrence of pottery according to sections was not done, as it would be methodologically controversial due to differences in collecting of finds.<sup>13</sup>

<sup>11</sup> All types of vessels are included.

<sup>12</sup> All types of decoration are included.

<sup>13</sup> The first factor is a relative depth of the cultural layer in respect to the surface. The cultural layer lies deeper on northern part, as on southern part of the investigated area. On places, where the cultural layer lies relatively shallow, it was subjected to destroying with machine cleaning for a long time and is entirely destroyed. We assume that there were more and more finds dislocated and distributed across the field/ditch through time.

Southern part of the investigated area, alongside macadam road, where the cultural layer lies relatively deep and is barely touched with machine treatment, is somewhat different. Relocation of finds was probably less intense.



Sl. 3.10: Sonda 3. Vzhodni profil. Risba: T. Korošec. M = 1 : 20. Spodnja in zgornja višinska točka v metrih nad morjem po posameznih režnjah pri  $x_3 = 0$ ,  $y_3 = 3$  (kol št. 2): reženj 8 (288,73–288,87 m), reženj 7 (288,87–288,98 m), reženj 6 (288,98–289,06 m), reženj 5 (289,06–289,19 m), reženj 4 (289,19–289,27 m) in reženj 3 (289,27–289,45 m).

Fig. 3.10: Trench 3. Eastern section. Drawn by: T. Korošec. Scale = 1 : 20. Top and bottom altitude points of individual deepenings at  $x_3 = 0$ ,  $y_3 = 3$  (pile no. 2) in metres a.s.l.: deepening 8 (288.73–288.87 m), deepening 7 (288.87–288.98 m), deepening 6 (288.98–289.06 m), deepening 5 (289.06–289.19 m), deepening 4 (289.19–289.27 m) and deepening 3 (289.27–289.45 m).





## 3.2 NAJDBE

### 3.2.1 KERAMIČNI IN GLINASTI ARTEFAKTI

Med arheološkimi najdbami oz. artefakti je največ keramike. Pri njenem vrednotenju smo se opirali na naslednja metodološka izhodišča:

1. Keramiko smo preučevali makroskopsko.
2. Zaradi prostorskih omejitev in specifične metode pridobivanja najdb (glej zgoraj) fragmentov nismo poskušali sestavljati, razen v redkih primerih, ko je bil razviden svež prelom (kot npr. *t. 3.6: 6*) in pri najdbah iz sond 2 in 3.
3. Za objavo so bile pripravljene vse najdbe, ki smo jih subjektivno označili za izpovedne in za katere se zdi, da so reprezentativne: ustja z ostenjem,<sup>11</sup> ornamentirani fragmenti<sup>12</sup> ...
4. Oblike posod so določene na podlagi risarske rekonstrukcije – v poštev so prišli predvsem večji fragmenti, v glavnem ustja z ostenjem.
5. Število objavljenih primerkov posameznega tipa posode ne odseva dejanskega deleža teh posod na Starih gmajnah, čeprav je umestno pričakovati, da je zastopanost pogostejših posod vsaj delno vidna tudi v objavi.
6. Število objavljenih primerkov določenega tipa ornamenta odseva vsaj približno realen delež tako ornamentiranih posod.

<sup>11</sup> Zajeti so vsi diagnosticirani tipi posodja.

<sup>12</sup> Zajeti so vsi diagnosticirani tipi ornamenta.

8. Typological determination of ware, handles, lugs and ornaments is based upon somewhat modified typology of pottery from pile-dwelling settlements of Hočevarica and Maharski prekop.<sup>14</sup>

Dark grey pottery prevails at Stare gmajne. There is only a small amount of light grey and light-coloured pottery. Pottery is fragile and breaks easily. There were hardly any entirely preserved vessels; sherds with old fractures prevail.

Pottery was divided into vessels (pots, pitchers/amphora, goblets, dishes, bowls and hanging vessels) and special shapes (ladle, spindle whorls).

In addition, products made of unfired clay occur, such as a weight and crucibles.

#### 3.2.1.1 FORMS

##### 3.2.1.1.1 Pots

The following types of pots were recognised: L1, L3, L4, L5, L6, L8, L9 (*Fig. 3.12*), L12, L13, L15, L17, L18, L19 (*Fig. 3.13*), L20, L21, L24 and L26 (*Fig. 3.14: L20–L26*).

##### 3.2.1.1.2 Pitchers or amphorae

Only a few handled vessels were discovered in ditches at Stare gmajne. Only a fragment shown on *Pl. 3.19: 11* (see also *Fig. 3.14: V/A*) can be definitely classified as a pitcher/amphora.

##### 3.2.1.1.3 Goblets

Two types of goblets occur: K1 and K4 (*Fig. 3.15*).

##### 3.2.1.1.4 Dishes

The following dishes occur: S1, S2, S4, S5, S6, S7, S9 (*Fig. 3.16*), S11, S14, S15, S16 and S21 (*Fig. 3.17*).

##### 3.2.1.1.5 Bowls

Fragment of a bowl (*Pl. 3.19: 9* and *Fig. 3.18: Sk*) was found in a field next to ditch 13, close to section 24 (see *Fig. 3.1*).

##### 3.2.1.1.6 Hanging vessels

Fragment of a handle (*Pl. 3.13: 3* and *Fig. 3.18: VP*) can doubtlessly be categorised as a fragment of a hang-

<sup>14</sup> See Velušček 2001, 37–72; 2004c, 184–212.

7. Analiza količinskega pojavljanja keramike po odsekih zaradi razlik v pridobivanju najdb ni bila opravljena, metodološko bi bila namreč sporna.<sup>13</sup>

8. Tipološko označevanje posodja, ročajev, držajev in ornamenta temelji na rahlo modificirani tipologiji keramičnega gradiva s koliščarskih naselbin Hočevarica in Maharski prekop.<sup>14</sup>

Na Starih gmajnah prevladuje keramika temnosivih barvnih tonov, svetlosive ali barvno svetlejšje keramike je malo. Keramika je krhka, ob dotiku se rada lomi. Celih posod je bilo malo, prevladujejo fragmenti s starimi prelomi.

Po obliki smo keramiko razdelili na posodje (lonci, vrči/amfore, kupe, sklede, skodele in viseče posode) in na posebne oblike (zajemalke, vretenca).

Polega keramike se pojavljajo tudi izdelki iz nežgane gline, kamor lahko uvrstimo utež in talilne posode.

### 3.2.1.1 OBLIKE

#### 3.2.1.1.1 Lonci

Med lonci smo diagnosticirali naslednje tipe: L1, L3, L4, L5, L6, L8, L9 (sl. 3.12), L12, L13, L15, L17, L18, L19 (sl. 3.13), L20, L21, L24 in L26 (sl. 3.14: L20-L26).

#### 3.2.1.1.2 Vrči ali amfore

V jarkih na Starih gmajnah smo odkrili malo ročajastih posod. Med vrče ali amfore lahko zanesljivo uvrstimo samo fragment na t. 3.19: 11 (glej še sl. 3.14: V/A).

#### 3.2.1.1.3 Kupe

Pojavljata se dva tipa kup: K1 in K4 (vse sl. 3.15).

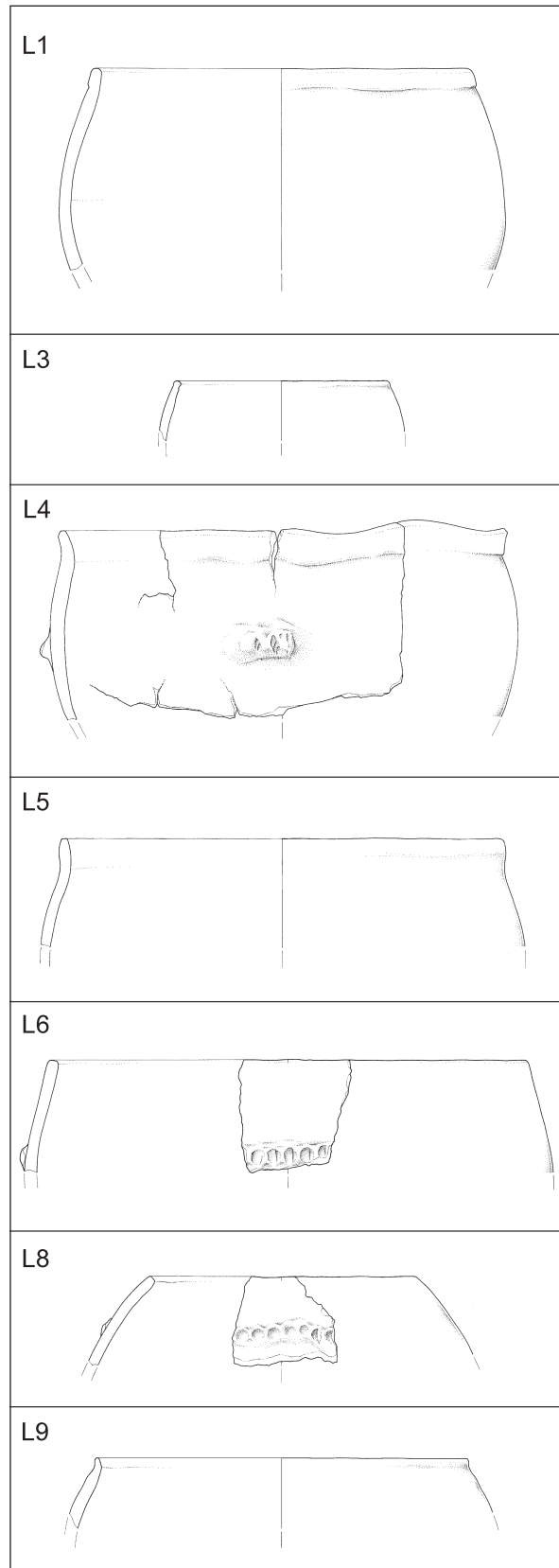
#### 3.2.1.1.4 Sklede

Pojavljajo se naslednje sklede: S1, S2, S4, S5, S6, S7, S9 (sl. 3.16), S11, S14, S15, S16 in S21 (sl. 3.17).

<sup>13</sup> Prvi dejavnik je relativna globina kulturne plasti glede na površje. Na severnem delu raziskovanega območja leži kulturna plast globlje kot na južnem. Na mestih, kjer je kulturna plast relativno plitva, je bila že dalj časa podvržena uničevanju s strojnim čiščenjem in je zato v celoti uničena. Sklepamo, da so skozi čas na njivo izmetane najdbe postajale številčnejše in da so se tudi bolj razpršile po njivi oz. po jarku.

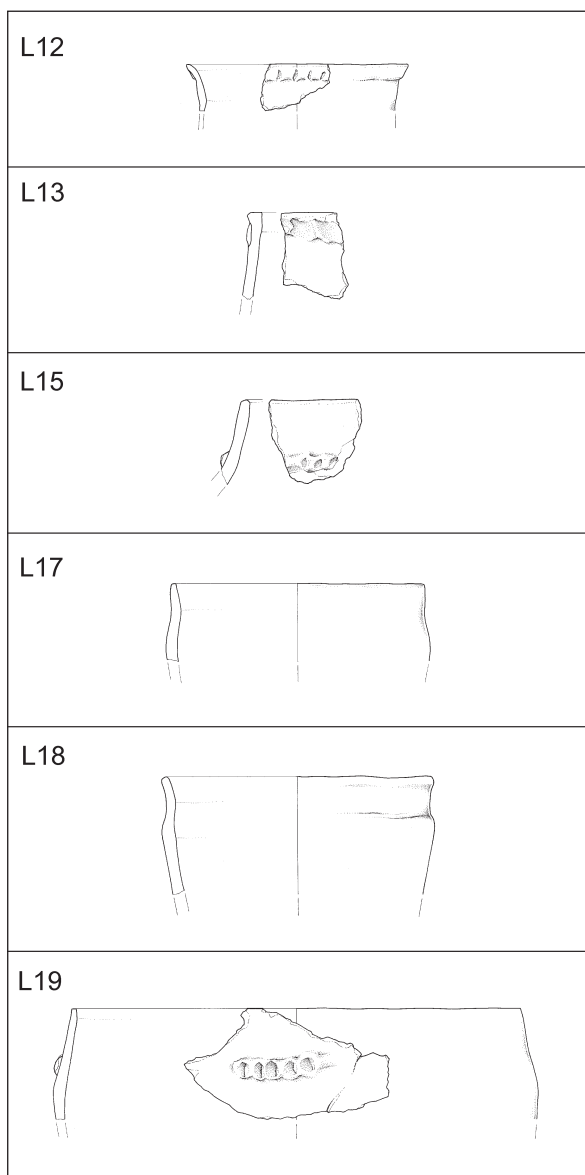
Nekoliko drugače pa je na južnem delu raziskovanega območja, vzdolž makadamske ceste, kjer leži kulturna plast relativno globoko in je na nekaterih mestih s strojnim obdelovanjem komaj dotaknjena. Relokacija najdb je bila verjetno manj intenzivna.

<sup>14</sup> Glej Velušček 2001, 37-72; 2004c, 184-212.



Sl. 3.12: Stare gmajne. Lonci po tipih. Risbe: T. Korošec. M = 1 : 5.

Fig. 3.12: Stare gmajne. Types of pots. Drawn by: T. Korošec. Scale = 1 : 5.



Sl. 3.13: Stare gmajne. Lonci po tipih. Risbe: T. Korošec. M = 1 : 5.

Fig. 3.13: Stare gmajne. Types of pots. Drawn by: T. Korošec. Scale = 1 : 5.

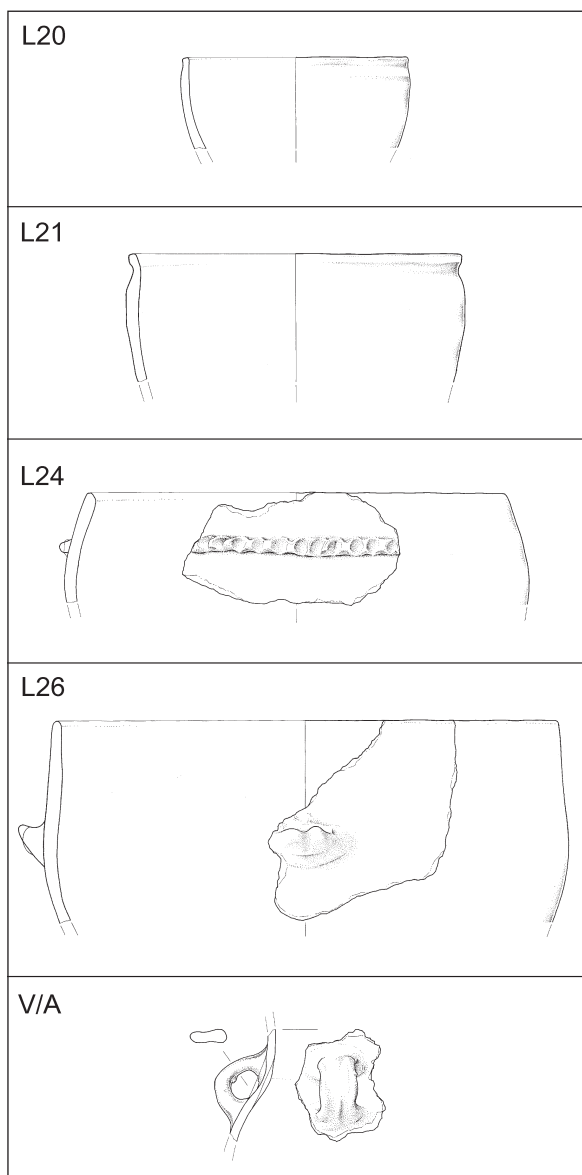


Sl. 3.15: Stare gmajne. Kupe po tipih. Risbi: T. Korošec. M = 1 : 5.

Fig. 3.15: Stare gmajne. Types of goblets. Drawn by: T. Korošec. Scale = 1 : 5.

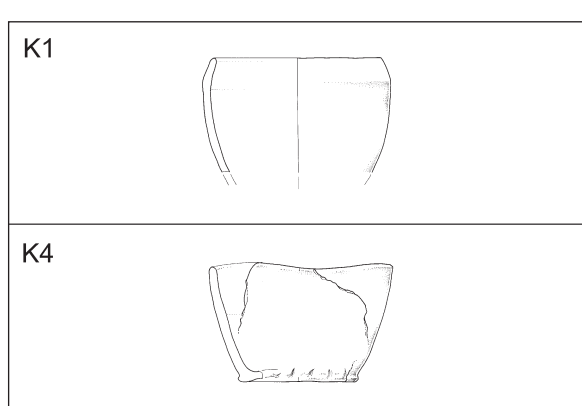
### 3.2.1.1.5 Skodele

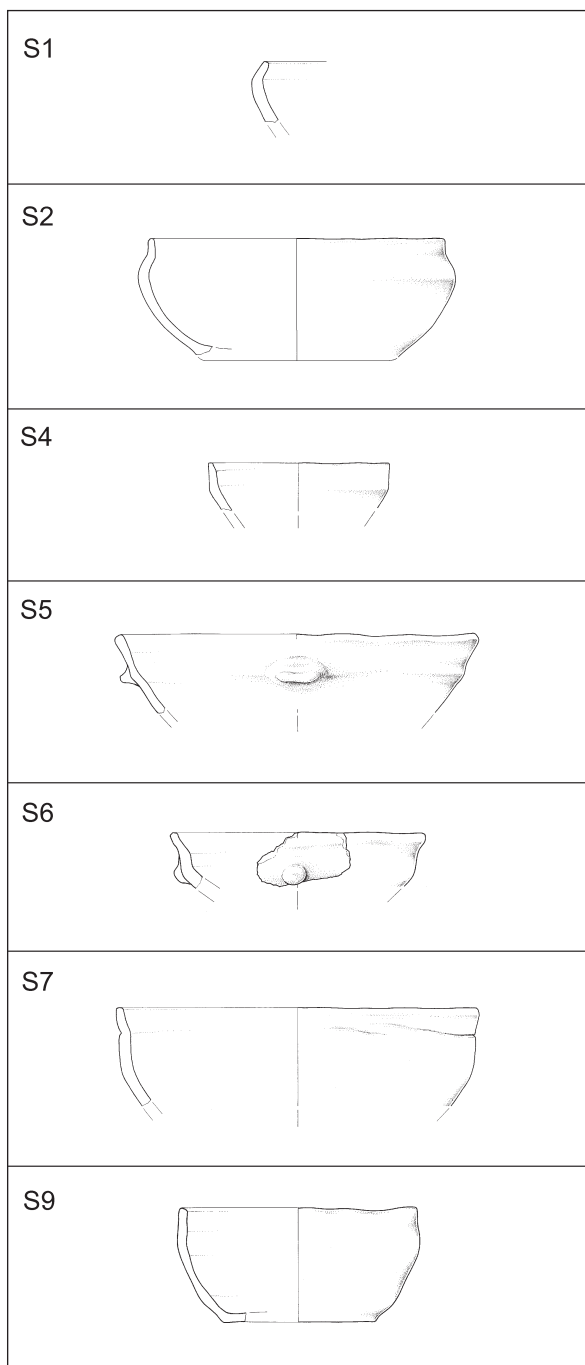
Odlomek skodele (t. 3.19: 9 in sl. 3.18: Sk) je bil odkrit na njivi ob jarku 13 v bližini odseka 24 (glej sl. 3.1).



Sl. 3.14: Stare gmajne. Lonci po tipih, vrči in amfore. Risbe: T. Korošec. M = 1 : 5.

Fig. 3.14: Stare gmajne. Types of pots, pitchers and amphorae. Drawn by: T. Korošec. Scale = 1 : 5.



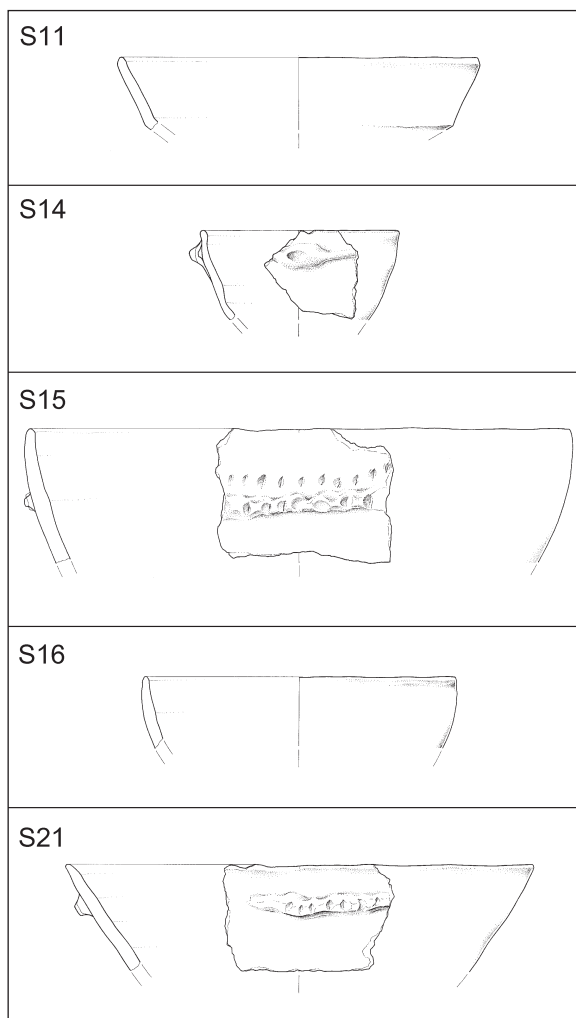


Sl. 3.16: Stare gmajne. Sklede po tipih. Risbe: T. Korošec. M = 1 : 5.

Fig. 3.16: Stare gmajne. Types of dishes. Drawn by: T. Korošec. Scale = 1 : 5.

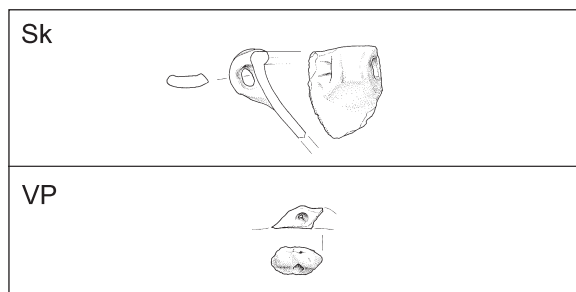
### 3.2.1.1.6 Viseče posode

V to skupino posodja nedvomno sodi fragment ročaja (t. 3.13: 3 in sl. 3.18: VP), morda pa tudi z odtisi in vrezi ornamentirano ostenje z ročajem (t. 3.5: 10 in sl. 3.24: R2).



Sl. 3.17: Stare gmajne. Sklede po tipih. Risbe: T. Korošec. M = 1 : 5.

Fig. 3.17: Stare gmajne. Types of dishes. Drawn by: T. Korošec. Scale = 1 : 5.



Sl. 3.18: Stare gmajne. Skodele in viseče posode. Risbi: T. Korošec. M = 1 : 5.

Fig. 3.18: Stare gmajne. Bowls and hanging vessels. Drawn by: T. Korošec. Scale = 1 : 5.

ing vessel. Fragment of a wall with a handle, decorated with prints and incisions, perhaps fit into this category as well (Pl. 3.5: 10 and Fig. 3.24: R2).



### 3.2.1.1.7 Miniaturne posode

Majhnih posod (*sl. 3.19: MP*) ni veliko. Najmanjša med njimi ima ustje s premerom 4,8 cm (*t. 3.3: 3*).

### 3.2.1.1.8 Posebne oblike

#### 3.2.1.1.8.1 Zajemalke

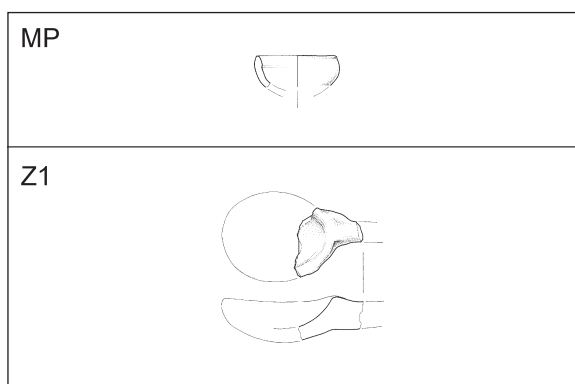
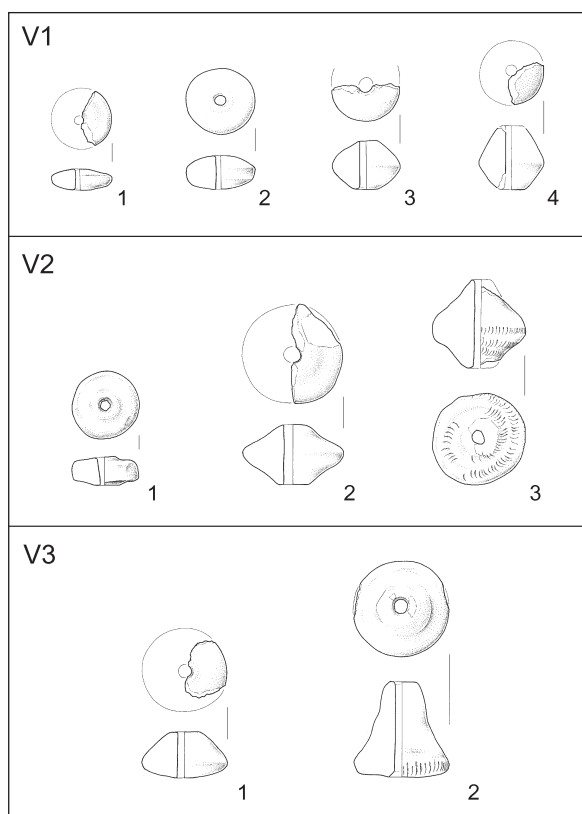
Na Starih gmajnah se pojavljajo izključno zajemalke s polnim držajem, ki jih uvrščamo v tip Z1 (*sl. 3.19: Z1*).

#### 3.2.1.1.8.2 Vretenca

Vretenca so številčno dobro zastopana. Pojavljajo se v več tipih: V1–V3.

K tipu V1 prištevamo enostavna bikonična vretenca (*sl. 3.20: V1*). Znotraj tipa pa lahko prepoznamo variante, ki se razlikujejo po višini. Tako imamo celoten spekter od ploščatega (*sl. 3.20: V1/1*) do visokega izrazito bikoničnega vretenca (*sl. 3.20: V1/4*).

K tipu 2 prištevamo bikonična vretenca z močno poudarjenim sredinskim delom (*sl. 3.20: V2*). Tudi znotraj tega tipa vretenc je opaziti različne variante, ki se razlikujejo po višini. Imamo nizko oz. ploščato (do 3 cm; *sl. 3.20: V2/1*), srednje visoko (od 3 do 5 cm; *sl. 3.20: V2/2*) in visoko vretenca (nad 5 cm; *sl. 3.20: V2/3*).



*Sl. 3.19: Stare gmajne. Miniaturne posode in zajemalke. Risbi: T. Korošec. M = 1 : 5.*

*Fig. 3.19: Stare gmajne. Miniature vessels and ladles. Drawn by: T. Korošec. Scale = 1 : 5.*

### 3.2.1.1.7 Miniature vessels

Only a few miniature vessels occur (*Fig. 3.19: MP*). The smallest one has a rim with 4.8 cm in diameter (*Pl. 3.3: 3*).

### 3.2.1.1.8 Special forms

#### 3.2.1.1.8.1 Ladles

Only ladles with solid handles, representing type Z1, were discovered at Stare gmajne (*Fig. 3.19: Z1*).

#### 3.2.1.1.8.2 Spindle whorls

Spindle whorls are well represented. Several types were found: V1–V3.

Simple biconical spindle whorls represent type V1 (*Fig. 3.20: V1*). We can recognize several versions of this type, which were categorised according to height. The entire spectrum from flat (*Fig. 3.20: V1/1*) to tall and extremely biconical (*Fig. 3.20: V1/4*) spindle whorls occur.

Biconical spindle whorls with strongly accentuated central part (*Fig. 3.20: V2*) represent type 2. We can recognize several versions of this type, which were categorised according to height. Low or flat (up to 3 cm; *Fig. 3.20: V2/1*), medium (from 3 to 5 cm; *Fig. 3.20: V2/2*) and tall-neck spindle whorls (above 5 cm; *Fig. 3.20: V2/3*) are present.

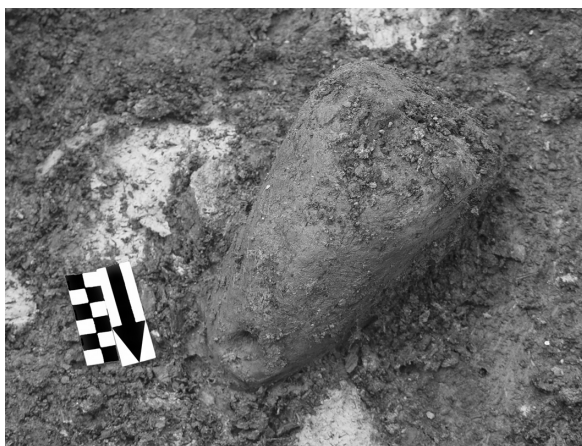
*Sl. 3.20: Stare gmajne. Vretenca po tipih. Risbe: T. Korošec. M = 1 : 5.*

*Fig. 3.20: Stare gmajne. Types of spindle whorls. Drawn by: T. Korošec. Scale = 1 : 5.*

K tipu V3 prištevamo vretenca s poudarjeno koničnostjo. Razlikujemo nizko (sl. 3.20: V3/1) in visoko varianto, ki ima obliko stožca (sl. 3.20: V3/2).

### 3.2.1.1.8.3 Uteži

Med najdbami iz nežgane gline posebno pozornost zasluži utež iz sonde 2, kv. 13, reženj 5 (sl. 3.1, 3.3). Gre za 22,2 cm visoko in do 14,4 cm široko piramidarno utež, katere posebnost je, da je votla (t. 3.28: 1; sl. 3.21, 3.22). Ob odkritju je bila napolnjena z blatom in zelo težka. Pri čiščenju in pripravi za risanje pa se je pokazalo, da je votla. Iz uteži smo pridobili vzorce za paleo- in arheobotanično analizo. Skoraj v celoti ohranjena prazna utež tehta 1410 g.



Sl. 3.21: Stare gmajne, sonda 2. Glinasta utež *in situ*. Foto: M. Turk.

Fig. 3.21: Stare gmajne, trench 2. Clay weight *in situ*. Photo: M. Turk.



Sl. 3.22: Pri čiščenju se je pokazalo, da je utež votla (glej še t. 3.28: 1). Foto: T. Tolar.

Fig. 3.22: We discovered at cleaning that the weight is hollow (see also Pl. 3.28: 1). Photo: T. Tolar.

Spindle whorls of accentuated conical form are categorised as type V3. We distinguish low (Fig. 3.20: V3/1) and tall versions. The latter one is cone-shaped (Fig. 3.20: V3/2).

### 3.2.1.1.8.3 Weights

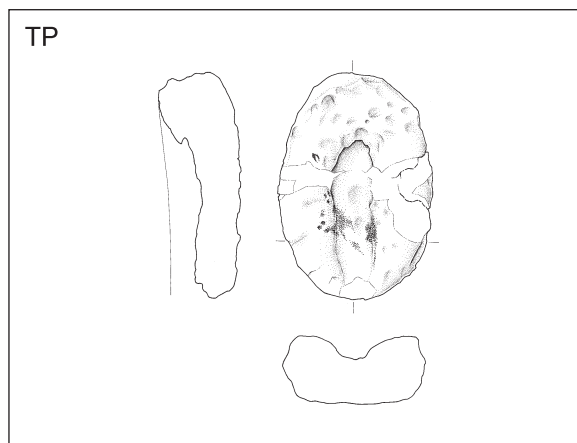
Weight earns special attention among the finds made of unfired clay. It was found in trench 2, quadrant 13, deepening 5 (Figs. 3.1, 3.3). It is 22.2 cm high and to 14.4 cm wide pyramid-shaped hollow weight (Pl. 3.28: 1; Figs. 3.21, 3.22). It was filled with mud and it was very heavy at discovery. While cleaning it and getting it ready for drawing it turned out, that it is hollow. We gained samples for palaeo- and archaeobotanical analysis from the weight. Almost entirely preserved empty weight weighs 1410 g.

### 3.2.1.1.8.4 Crucibles

Crucibles also fit into the group of clay artefacts.<sup>15</sup> Almost entirely preserved pot (Pl. 3.19: 15; Fig. 3.23) and fragments of at least another pot (e.g. Pl. 3.19: 13,14) were discovered in ditch 13, section 24 and in trench 3 (Fig. 3.1). Content that was preserved on the internal wall of the better-preserved pot from ditch 13 was analysed. It turned out, that this is copper; the pot was thus used in a metallurgical process.<sup>16</sup>

<sup>15</sup> Is it not certain whether these are crucibles or moulds (e.g. Velušček 2008a; 2008b). Determination is not easy. The clay crucible from Stare gmajne can be compared with a pot from the the Boleráz group site Lánycsók in Hungary. The pot from the latter site is categorised as a crucible (Ecsedy 1977, 163, Pls. 11: 4; 12: 1; 1990, Fig. 6) and as a mould (Durman 2000, 95).

<sup>16</sup> See Chapter 11 in this monograph.



Sl. 3.23: Stare gmajne. Talilna posoda. Risba: T. Korošec. M = 1 : 5.

Fig. 3.23: Stare gmajne. Crucible. Drawn by: T. Korošec. Scale = 1 : 5.

## 3.2.1.1.8.4 Talilne posode

V skupino artefaktov iz gline sodijo tudi talilne posode.<sup>15</sup> Skoraj v celoti ohranjeno posodo (*t. 3.19: 15; sl. 3.23*) in fragmente vsaj še ene ali celo več posod podobne namembnosti (npr. *t. 3.19: 13,14*) smo odkrili v jarku 13 na odseku 24 in v sondi 3 (*sl. 3.1*). Analizirana je bila vsebina na notranji steni bolj ohranjene posode iz jarka 13, kjer se je pokazalo, da gre za baker, torej je bila posoda uporabljena v metalurškem procesu.<sup>16</sup>

## 3.2.1.2 ROČAJI IN DRŽAJI

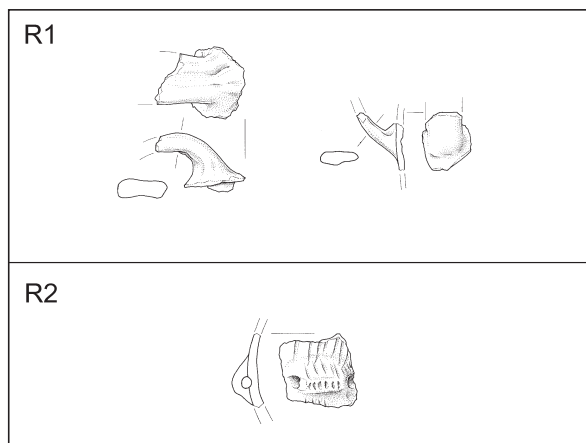
Ročaje smo razvrstili v dve skupini: R1 in R2. Za prvo so značilni trakasti ročaji (*sl. 3.24: R1*). Najdemo jih na trebuhu ročajastih posod (*t. 3.19: 10*), lahko povezujejo trebuh z vratom (*t. 3.19: 11*) ali pa so na ustju skodel (*t. 3.19: 9*). V drugi skupini (*sl. 3.24: R2*) najdemo samo en držaju podoben tunelast ročaj (*t. 3.5: 10*).

Na Starih gmajnah so v nasprotju z ročaji držaji pogostejši. Pojavljajo se v štirih osnovnih oblikah: D1, D2, D4 in D6. Pogosti so tako imenovani razčlenjeni držaji (*sl. 3.25: D2, 3.26: D2*). Lahko so zelo dolgi in podobni razčlenjenim rebrom (npr. *t. 3.9: 4*).

Nekoliko manj je jezičastih držajev (*sl. 3.25: D1*), še manj pa vertikalnih masivnih držajev tipa D4 (*sl. 3.26: D4*) in držajev z eno ali dvema ušescema (*sl. 3.26: D6; t. 3.13: 3*).

<sup>15</sup> Ali gre za talilne posode ali kalupe, še ni povsem ugotovljeno (npr. Velušček 2008a; 2008b). Opredelitev očitno ni tako enostavna. Dobro analogijo za glinasto talilno posodo s Starih gmajn poznamo z najdišča boleraške skupine Lánycsók na Madžarskem, ki se npr. interpretira kot talilna posoda (Ecsedy 1977, 163, t. 11: 4; 12: 1; 1990, sl. 6) ali kot kalup (Durman 2000, 95).

<sup>16</sup> Glej poglavje 11 v tem zborniku.



Sl. 3.24: Stare gmajne. Ročaji po tipih. Risbe: T. Korošec. M = 1 : 5.

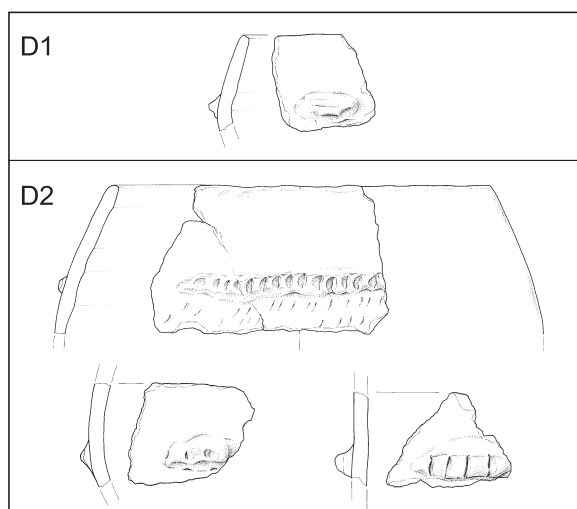
Fig. 3.24: Stare gmajne. Types of handles. Drawn by: T. Korošec. Scale = 1 : 5.

## 3.2.1.2 HANDLES AND LUGS

Handles were categorised in two groups: R1 and R2. Strap handles are characteristic for the first group (*Fig. 3.24: R1*). We can see them on lower bodies of handled vessels (*Pl. 3.19: 10*), they sometimes connect the lower body with the neck (*Pl. 3.19: 11*) or are present on rims of bowls (*Pl. 3.19: 9*). Only one lug-like pierced handle (*Pl. 3.5: 10*) forms the second group (*Fig. 3.24: R2*).

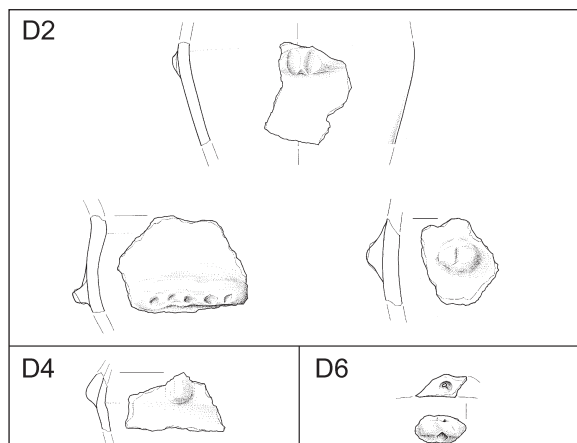
Lugs are more frequent. They form four basic shapes: D1, D2, D4 and D6. So-called lugs with slashed decoration are frequent (*Figs. 3.25: D2, 3.26: D2*). They can be very long and similar to slashed cordons (e.g. *Pl. 3.9: 4*).

Tongue-shaped lugs (*Fig. 3.25: D1*) are less frequent. Vertical massive lugs of type D4 (*Fig. 3.26: D4*) and pierced lugs (*Fig. 3.26: D6; Pl. 3.13: 3*) are even fewer.



Sl. 3.25: Stare gmajne. Držaji po tipih. Risbe: T. Korošec. M = 1 : 5.

Fig. 3.25: Stare gmajne. Types of lugs. Drawn by: T. Korošec. Scale = 1 : 5.



Sl. 3.26: Stare gmajne. Držaji po tipih. Risbe: T. Korošec. M = 1 : 5.

Fig. 3.26: Stare gmajne. Types of lugs. Drawn by: T. Korošec. Scale = 1 : 5.

## 3.2.1.3 ORNAMENT

Keramika s Starih gmajn je razmeroma skromno ornamentirana. Kljub temu je na njej zastopanih več vrst ornamenta, ki ga glede na ornamentalne tehnike lahko ločimo na vrezovanje, vtiskovanje in plastično apliciranje.

Na Starih gmajnah so s tehniko vrezovanja v stene keramike vrezane linije v obliki navadnega vreza (sl. 3.27: O1). Pojavlja se tudi metličenje (sl. 3.27: O1; t. 3.19: 7).

Z vrezovanjem ornamentiranih posod oz. keramičnih oblik ni veliko. Vrezane linije je najti na ostenju (t. 3.2: 4; 3.5: 8,9,10; 3.II: 3 itd.) in ročaju posod (t. 3.5: 10) ter tudi na stožčastem vretencu (t. 3.II: 11).

Zdi se, da je na Starih gmajnah vtiskovanje pogostokrat uporabljena ornamentalna tehnika. Rezultati omenjene tehnike so: vbodi (sl. 3.27: O10), odtisi prsta (sl. 3.27: O11), odtisi topega predmeta (sl. 3.27: O12), odtisi nohta (sl. 3.27: O13), odtisi noža oz. podolgovatega ostrega predmeta (sl. 3.28: O14) in odtis pletenine (sl. 3.28: O15).

Značilno je, da se različne vrste odtisov pojavljajo v kombinaciji z drugimi ornamentami. Pogosta je predvsem kombinacija odtisov in plastičnih reber, držajev (npr. t. 3.1: 3,9; 3.2: 1,6,8; 3.3: 1,2,7; 3.4: 4,5,7,8 itd.). Odtisi se pojavljajo tudi na vratu tik pod ustjem (t. 3.19: 4–6) in na ustju (t. 3.1: 6). Zanimiv je tudi odtis pletenine, ki ga je najti na dnu večjih posod (sl. 3.28: O15).

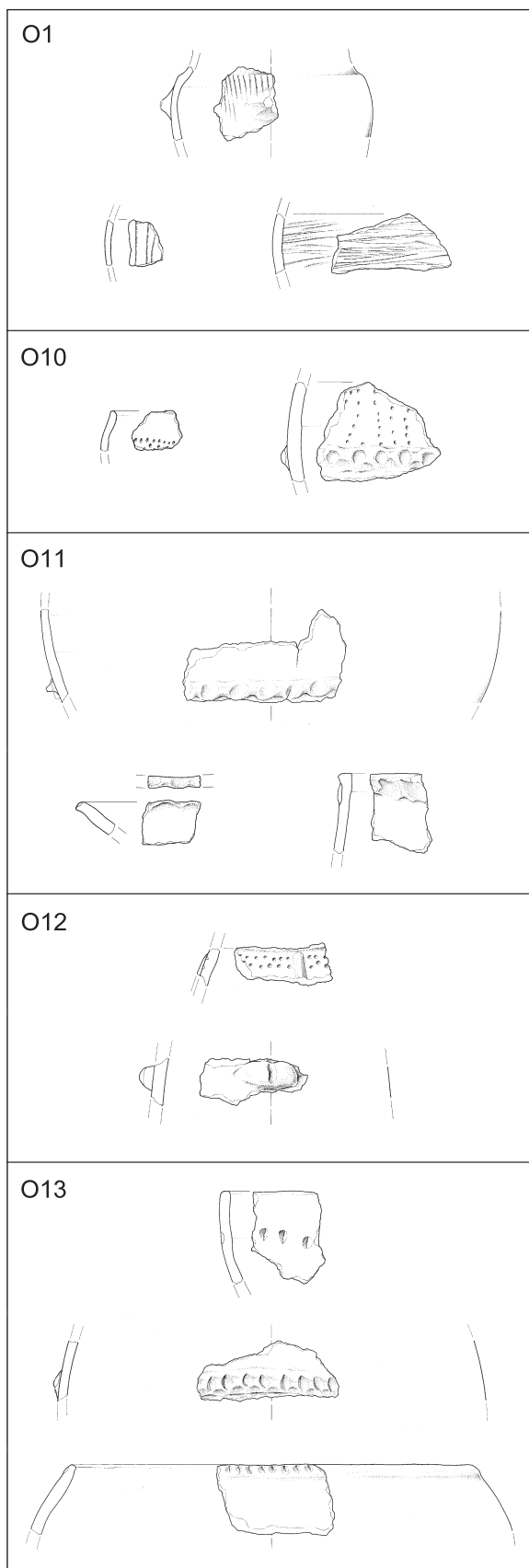
Na keramiki s Starih gmajn je najpogosteje uporabljena ornamentalna tehnika plastično apliciranje (sl. 3.27: O10–O13, 3.28: O14–O19).

Pojavljajo se aplicirana nerazčlenjena rebra, ki so lahko vertikalna, običajno v paru (t. 3.15: 14,15), ali horizontalna (t. 3.24: 14–17). Aplicirano nerazčlenjeno rebro je najti tudi v kombinaciji z vbodi oz. odtisi topega predmeta in vrezom (t. 3.24: 7).

Zdi se, da se na keramiki aplicirana razčlenjena rebra pojavljajo pogosto (sl. 3.28: O18; t. 3.3: 2; 3.4: 8; 3.5: 1,6; 3.6: 1,5; 3.9: 6 itd.). Opozoriti pa je treba, da se zato, ker so posode ohranjene samo v fragmentih, med apliciranimi razčlenjenimi rebri lahko skrivajo tudi izredno dolgi razčlenjeni držaji. Velikokrat pri tako ohranjeni keramiki ni mogoče razlikovati med rebrom in rebro podobnim držajem (prim. npr. t. 3.9: 4 in 3.10: 6). Pri fragmentu na t. 3.9: 4 gre za dolg razčlenjeni držaj. Pri fragmentu na t. 3.10: 6 pa smo v dilemi, ali gre za razčlenjeno rebro ali držaj.

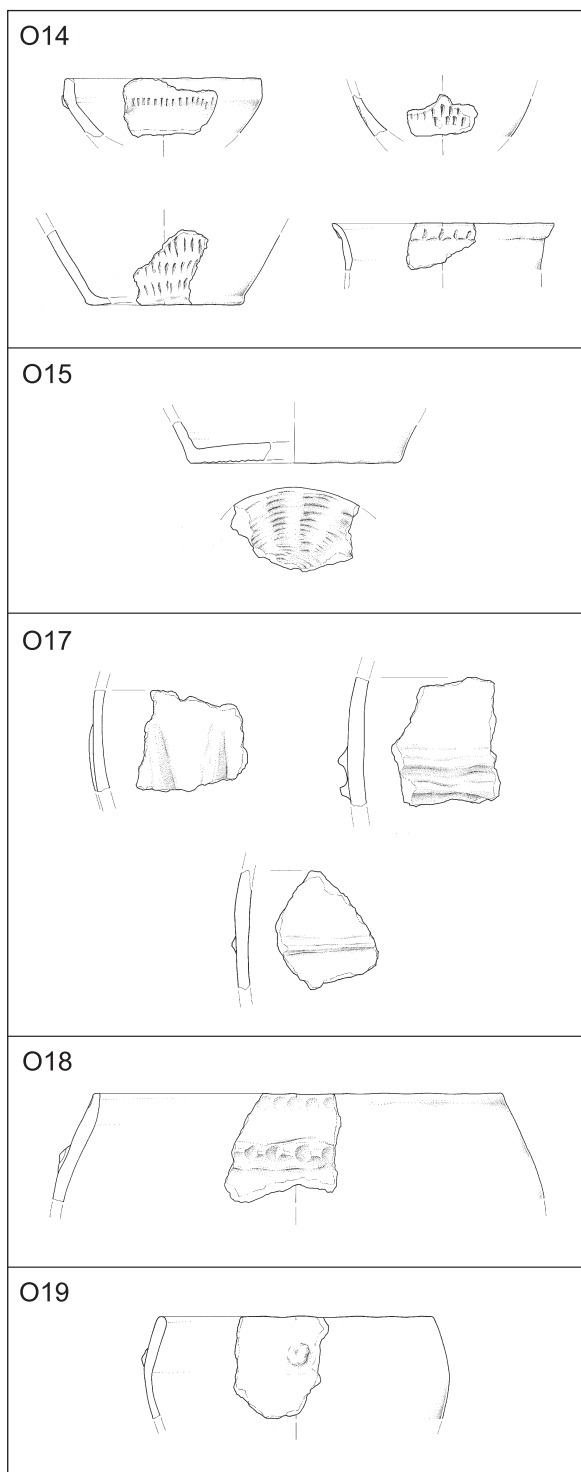
Kakor koli že, aplicirana razčlenjena rebra je najti na zgornji polovici ostenja posod (npr. t. 3.5: 1; 3.10: 6,7), redkeje na spodnjem delu (npr. t. 3.12: 7).

Bradavice (sl. 3.28: O19) najdemo v dveh variantah: enostavne (t. 3.20: 5) in z odtisom na sredi (t. 3.2: 5).



Sl. 3.27: Stare gmajne. Ornament po tipih. Risbe: T. Korošec. M = 1 : 5.  
Fig. 3.27: Stare gmajne. Types of pottery decoration. Drawn by: T. Korošec. Scale = 1 : 5.





Sl. 3.28: Stare gmajne. Ornament po tipih. Risbe: T. Korošec. M = 1 : 5.

Fig. 3.28: Stare gmajne. Types of pottery decoration. Drawn by: T. Korošec. Scale = 1 : 5.

### 3.2.1.3 ORNAMENTATION

Pottery from Stare gmajne is not richly ornamented. Still, several types of decoration occur; incision, impressing and applied decoration are present.

Incision technique is seen at Stare gmajne as etched lines in shape of an incised decoration on the pottery walls (Fig. 3.27: O1). In addition, decoration with brush-like implements occurs (Fig. 3.27: O1; Pl. 3.19: 7).

Only a few vessels are decorated with incisions. Etched lines are seen on walls (Pls. 3.2: 4; 3.5: 8,9,10; 3.11: 3 etc.), handles (Pl. 3.5: 10) and also on conical spindle whorl (Pl. 3.11: 11).

Impressing is frequently used decoration technique at Stare gmajne. It can be seen as: furrowed incisions (Fig. 3.27: O10), fingertip impressions (Fig. 3.27: O11), impressions of blunt objects (Fig. 3.27: O12), fingernail impressions (Fig. 3.27: O13), impressions of a knife or an oblong sharp object (Fig. 3.28: O14) and impressions of fabric (Fig. 3.28: O15).

It is characteristic that different types of impressed decoration occur in combination with other ornaments. Combination of impressing and plastic cordons or lugs is frequent (e.g. Pls. 3.1: 3,9; 3.2: 1,6,8; 3.3: 1,2,7; 3.4: 4,5,7,8 etc.). Impressions also occur on necks, just under the rim (Pl. 3.19: 4–6) and on rims (Pl. 3.1: 6). Fabric impression is also interesting and can be found on bases of larger vessels (Fig. 3.28: O15).

Applied decoration is the most frequently used ornamentation technique at Stare gmajne (Figs. 3.27: O10–O13; 3.28: O14–O19).

Applied cordons occur. They can be vertical and usually occur in pairs (Pl. 3.15: 14,15), or horizontal (Pl. 3.24: 14–17). Applied cordons are present also in combination with furrowed incisions or impressions of blunt objects and incised decoration (Pl. 3.24: 7).

Applied slashed cordons are frequent (Fig. 3.28: O18; Pls. 3.3: 2; 3.4: 8; 3.5: 1,6; 3.6: 1,5; 3.9: 6 etc.). However, vessels are fragmented and it is possible that these applied cordons are sometimes actually extraordinarily long lugs with slashed decoration. It is often not possible to differentiate between cordons and cordon-like lugs in fragmented pottery (e.g. Pls. 3.9: 4 and 3.10: 6). Fragment shown on Pl. 3.9: 4 is a long lug with slashed decoration. Moreover, we are not sure whether the fragment shown on Pl. 3.10: 6 is a slashed cordon or a lug.

Nonetheless, applied slashed cordons (e.g. Pls. 3.5: 1; 3.10: 6,7) are frequently applied to upper half of the vessel's walls and rarely on the lower half (e.g. Pl. 3.12: 7).

Only two types of appliqués (Fig. 3.28: O19) occur: simple (Pl. 3.20: 5) and with an impression in the middle (Pl. 3.2: 5).

### 3.2.2 OSTALO GRADIVO

Med ostalim gradivom, na katerega smo naleteli pri raziskovanju na Starih gmajnah, so izdelki iz lesa in drugih rastlinskih delov (npr. semen), kosti in kamna.

#### 3.2.2.1 NAJDBE IZ LESA IN DRUGIH RASTLINSKIH DELOV

Med lesenimi najdbami naj najprej omenimo leseno kolo z osjo, ki je bilo najdeno v jarku 1 na vzhodnem delu naselbine. Ker gre za zelo pomembno najdbo, jo predstavljamo in podrobneje opisujemo na drugem mestu.<sup>17</sup>

Zelo pomembni najdbi sta tudi hrastova drevaka, na katera smo naleteli v jarku 4 in nedaleč stran od kolesa v jarku 1. Tudi v tem primeru smo pripravili poseben prispevek, kjer predstavljamo okoliščino odkritja, najdbi in kako smo prišli do datacij čolnov.<sup>18</sup>

Podobno lahko rečemo tudi za lesena toporišča sekir. Na Starih gmajnah smo našli več njihovih fragmentov. Zelo živahno je bilo pri ugotavljanju lesne vrste fragmenta toporišča kamnite kladivaste sekire (*t. 3.14: 1,2*), za katerega se je na koncu izkazalo, da je iz drenovega lesa, ki je zelo trd in trden in ima visoko udarno žilavost.<sup>19</sup> Drugačne vrste les je bil uporabljen za toporišče sekire iz rogovja, ki je bila odkrita v sondi 3.<sup>20</sup> Zanimiv je tudi del lesenega predmeta, verjetno držala.<sup>21</sup>

Med pomembnimi lesenimi najdbami je treba izpostaviti tudi kratek lok (*sl. 3.29*). Najdba je bila odkrita v sondi 2, na meji med kvadrantom 11 in 12 med izkopom 3. reznja (*sl. 3.30*). Lok je ohranjen skoraj v celotni. Dolžina znaša 64,4 cm. Na enem koncu je dobro viden utor za tetivo. Preiskava lesa je pokazala, da je bil narejen iz grčave tisine veje.<sup>22</sup>

Gre za drugi lok z Ljubljanskega barja. Lok s Hočevarice je daljši, saj meri v dolžino kar 122,3 cm in je kakovostneje izdelan.<sup>23</sup> Po Junkmannsovi klasifikaciji<sup>24</sup> sodi daljši lok v skupino lokov za mladostnike, medtem ko je lok s Starih gmajn tipičen primerek t. i. otroških lokov: je kratek in narejen iz veje slabše kakovosti. Namenjen naj bi bil igri.<sup>25</sup>

V jarku 1 je bila nedaleč proč od kolesa in osi odkrita tudi lesena posoda. Podobne poznamo npr. z bližnje Blatne Brezovice.<sup>26</sup>

### 3.2.2 OTHER FINDS

We also have to mention objects made of wood and other vegetal parts (e.g. seed), bones and stone.

#### 3.2.2.1 FINDS, MADE OF WOOD AND OTHER VEGETAL PARTS

We first have to point out a wooden wheel with its axle that was found in ditch 1, at the eastern part of the settlement. As it is a very important find and we will introduce it in more detail later.<sup>17</sup>

Very important are also finds of two oak logboats, discovered in ditch 4 and close to the wheel in ditch 1. These will also be introduced in more detail in later chapter.<sup>18</sup>

Similar can also be said for wooden handles of axes. Several fragments were found at Stare gmajne. The analysis of finding out the wood species of a fragment of the handle of a stone shaft-hole axe (*Pl. 3.14: 1,2*) was therefore vivacious. It turned out that it is cornel, which is very hard and solid and has high impact strength.<sup>19</sup> Different wood species were used for the handle of the antler axe that was found in trench 3.<sup>20</sup> Fragment of a wooden object, probably a handle, is also interesting.<sup>21</sup>

A short bow (*Fig. 3.29*) is also an important wooden find. It was discovered in trench 2, at the boundary between quadrants 11 and 12 at the excavation of deepening 3 (*Fig. 3.30*). The bow is almost entirely preserved. It is 64.4 cm long. String nock is clearly visible on one end. Analysis of wood showed that it was made of yew branch with knurs.<sup>22</sup>

This is the second bow that was found at the Ljubljansko barje. Bow from Hočevarica is longer, measuring 122.3 cm in length and it is of a good quality.<sup>23</sup> According to Junkmanns classification<sup>24</sup> the longer bow belongs to a group of bows for adolescents, while the bow from Stare gmajne is a typical example of a so-called children's bow: it is short and made of a poor quality branch. It was used in play.<sup>25</sup>

In ditch 1, not far from the wheel and its axle, a wooden vessel was discovered. Similar vessels were found at e.g. the nearby site of Blatna Brezovica.<sup>26</sup>

Remains of yarn are one of most interesting finds from Stare gmajne (*Fig. 3.31*). The yarn is composed of interwoven threads and was found in trench 2,

<sup>17</sup> Glej poglavje 8 v tem zborniku.

<sup>18</sup> Glej poglavje 9 v tem zborniku.

<sup>19</sup> Glej Tolar, Čufar, Velušček 2008.

<sup>20</sup> Poglavje 10.3.2 v tem zborniku.

<sup>21</sup> Poglavje 10.3.3 v tem zborniku.

<sup>22</sup> Poglavje 10.3.4 v tem zborniku.

<sup>23</sup> Velušček 2004b, 41-44.

<sup>24</sup> Junkmanns 1999.

<sup>25</sup> Velušček 2004b, 44.

<sup>26</sup> Korošec 1963, t. 19: 1.

<sup>17</sup> See Chapter 8 in this monograph.

<sup>18</sup> See Chapter 9 in this monograph.

<sup>19</sup> See Tolar, Čufar, Velušček 2008.

<sup>20</sup> See Chapter 10.3.2 in this monograph.

<sup>21</sup> See Chapter 10.3.3 in this monograph.

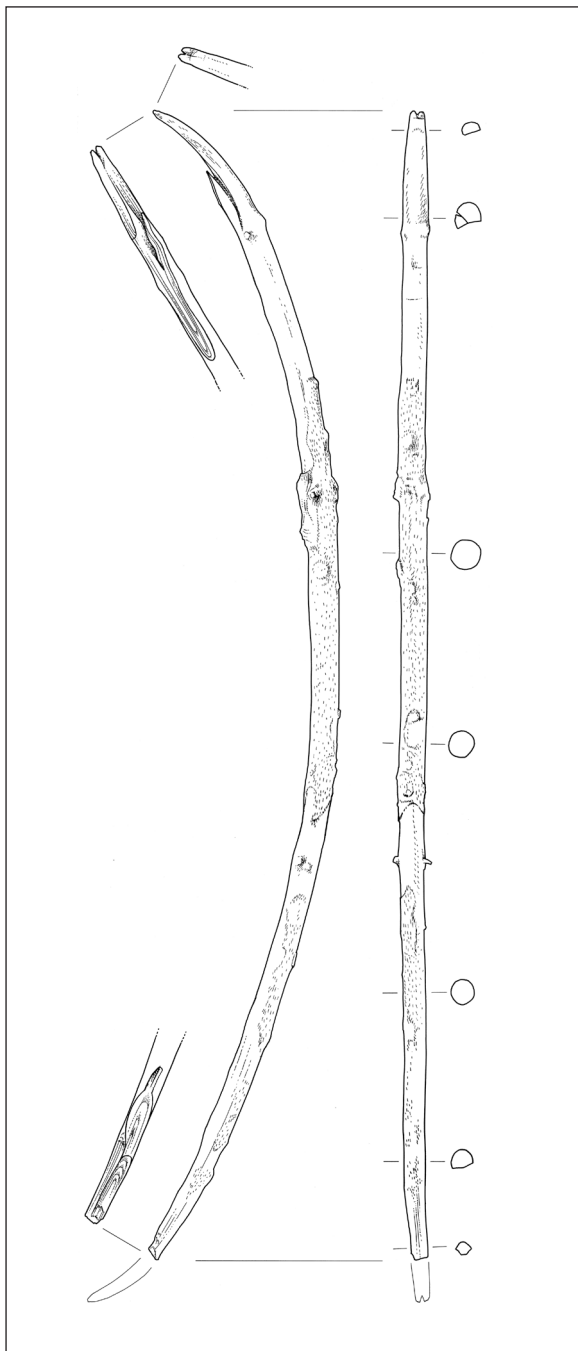
<sup>22</sup> See Chapter 10.3.4 in this monograph.

<sup>23</sup> Velušček 2004b, 41-44.

<sup>24</sup> Junkmanns 1999.

<sup>25</sup> Velušček 2004b, 44.

<sup>26</sup> Korošec 1963, t. 19: 1.



Sl. 3.29: Stare gmajne. Sonda 2. Lok iz lesa tise (*Taxus baccata*).  
Risba: T. Korošec. M = 1 : 4.

Fig. 3.29: Stare gmajne. Trench 2. Bow made of yew wood (*Taxus baccata*). Drawn by: T. Korošec. Scale = 1 : 4.

Sl. 3.32: Sonda 2, kv. 4, reženj 4. Ogrlične jagode iz rastlinskih delov. Foto: T. Korošec.

Fig. 3.32: Trench 2, quadrant 4, deepening 4. Necklace beads made of vegetal parts. Photo: T. Korošec.

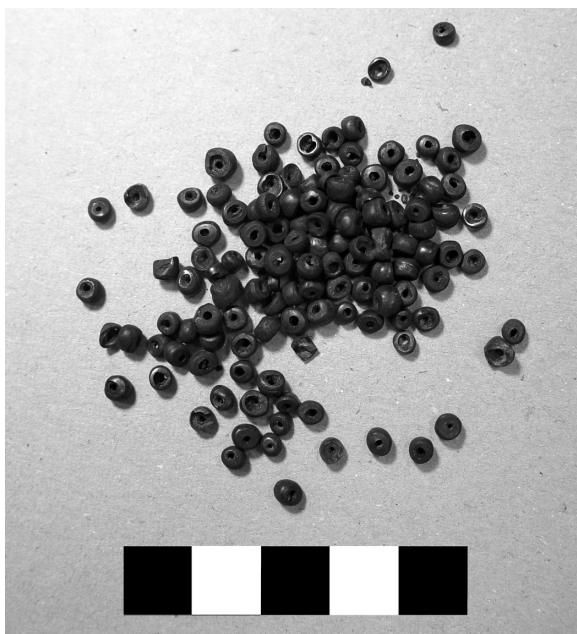


Sl. 3.30: Sonda 2, kv. 11-12, reženj 3. Lok *in situ*. Foto: M. Turk.  
Fig. 3.30: Trench 2, quadrants 11-12, deepening 3. Bow *in situ*.  
Photo: M. Turk.



Sl. 3.31: Preja iz sonde 2 v laboratoriju Narodnega muzeja Slovenije. Foto: G. Pajagič Bregar.

Fig. 3.31: Yarn from trench 2 in laboratory of The National Museum of Slovenia. Photo: G. Pajagič Bregar.





Ena izmed najzanimivejših najdb s Starih gamajn so tudi ostanki preje (sl. 3.31). Gre za umetelno spletene nitke, ki smo jih našli v sondi 2, kv. 8 ( $x_2 = 2,70$ ,  $y_2 = 1,70$ ), reženj 4, med višinama 288,90 in 289,01, na območju, kjer je bilo veliko žganine, tudi zogljenelih žitnih zrn. Najdbo je podrobno preučila G. Pajagič Bregar s sodelavci.<sup>27</sup> Preja je bila verjetno narejena iz vlaknastih niti ene izmed trav (*Poaceae*).

Med najdbami, ki so narejene iz delov rastlin, so tudi jagode za ogrlice iz koščic, lesa in drugih rastlinskih delov (sl. 3.32). Veliko število, več kot 500, smo jih našli v sondi 2, od tega največ med izkopom 4. reznja.

Leta 1995 smo na Starih gmajnah našli jagodo, ki je bila po mnenju A. Šerclja<sup>28</sup> najverjetneje narejena iz drevesne skorje, zelo verjetno hrastove ali jelševe. Podobne jagode poznamo tudi s Hočevarice in drugih kolišč na Ljubljanskem barju.<sup>29</sup>

### 3.2.2.2 KAMNITE NAJDBE

Številne so tudi kamnite najdbe. Prepoznali smo nakitne predmete, orodja ali sestavne dele orodij ter navadne kamne, ki jih je na Ljubljansko barje zagotovo prinesel človek, njihova uporabnost pa je neugotovljiva, morda so služili kot arhitekturni elementi ali za nekaj povsem drugega.

Med nakitnimi predmeti omenimo veliki cevasti jagodi (sl. 3.33), verjetno iz kalcita. Podobne najdemo npr. na Maharskem prekopu,<sup>30</sup> kjer se enako kot na Starih gmajnah pojavljajo tudi manjši kalcitni ogrlični obročki.<sup>31</sup> Poleg teh je bilo najdeno še približno 10 manjših, verjetno kamnitih ogrličnih obročkov, ki jih nismo podrobneje analizirali. Po velikosti spominjajo na obročke, ki jih poznamo s Hočevarice.<sup>32</sup>

<sup>27</sup> Poglavje 15 v tem zborniku.

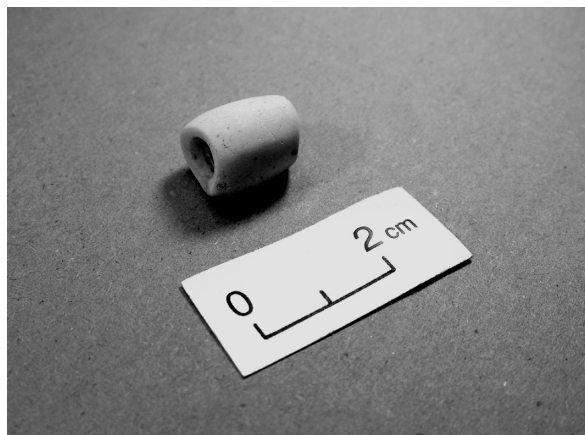
<sup>28</sup> Neobjavljeno poročilo; hrani IZA ZRC SAZU.

<sup>29</sup> Velušček 2004b, 40–41, 45.

<sup>30</sup> Bregant 1975, t. 8: 16; 12: 1.

<sup>31</sup> Bregant 1975, t. 8: 15,17,19.

<sup>32</sup> Velušček 2004b, sl. 3.1.20.



quadrant 8 ( $x_2 = 2,70$ ,  $y_2 = 1,70$ ), deepening 4, at height between 288.90 and 289.01 m, in charcoal-rich area including some charred cereal grains. G. Pajagič Bregar with co-workers<sup>27</sup> studied the find in details. The yarn was probably made of fibrous grass threads (*Poaceae*).

Among finds, made from parts of plants, we also have to mention necklace beads, which were made of small bones, wood and other vegetal parts (Fig. 3.32). A large number of them, over 500, yielded from trench 2, most of them during the excavation of deepening 4.

In 1995, a bead was found at Stare gmajne, that was, according to A. Šerclj<sup>28</sup> possibly made of bark, very probably oak or alder. Similar beads have been found at Hočevarica and other pile-dwellings at the Ljubljansko barje.<sup>29</sup>

### 3.2.2.2 STONE FINDS

Also stone finds are numerous. We recognized jewellery, tools or component parts of tools and ordinary stones, that were definitely brought to the Ljubljansko barje by human. However, their usability is indeterminate, they were perhaps used as architectural elements or for some other unknown reason.

We must mention two large tubular beads (Fig. 3.33), probably made of calcite. Similar finds were found at e.g. Maharski prekop,<sup>30</sup> where, similarly as at Stare gmajne, also smaller calcite necklace ringlets occur.<sup>31</sup> Beside these, c. 10 smaller, probably stone necklace ringlets were found. However, these were not analysed in detail. Their size is similar as the sizes of beads known from Hočevarica.<sup>32</sup>

Arrowheads are frequent among tools or component parts of tools. It seems that they were made of chert, varying from grey to brown in colour. As much as 12 of them originate from trench 2, majority of them from deepening 6–4. They occur in two basic types: with a short tang (e.g. Pl. 3.18: 4) and without a tang (e.g. Pls. 3.3: 8; 3.18: 7). Among other finds that were probably made of chert, we also have to mention wedge-shaped tools (e.g. Pl. 3.13: 9) and a borer.<sup>33</sup>

<sup>27</sup> See Chapter 15 in this monograph.

<sup>28</sup> Unpublished report; stored at Institute of Archaeology ZRC SAZU.

<sup>29</sup> Velušček 2004b, 40–41, 45.

<sup>30</sup> Bregant 1975, Pls. 8: 16; 12: 1.

<sup>31</sup> Bregant 1975, Pl. 8: 15,17,19.

<sup>32</sup> Velušček 2004b, Fig. 3.1.20.

<sup>33</sup> Similar as e.g. Velušček 2004, Fig. 3.1.24.

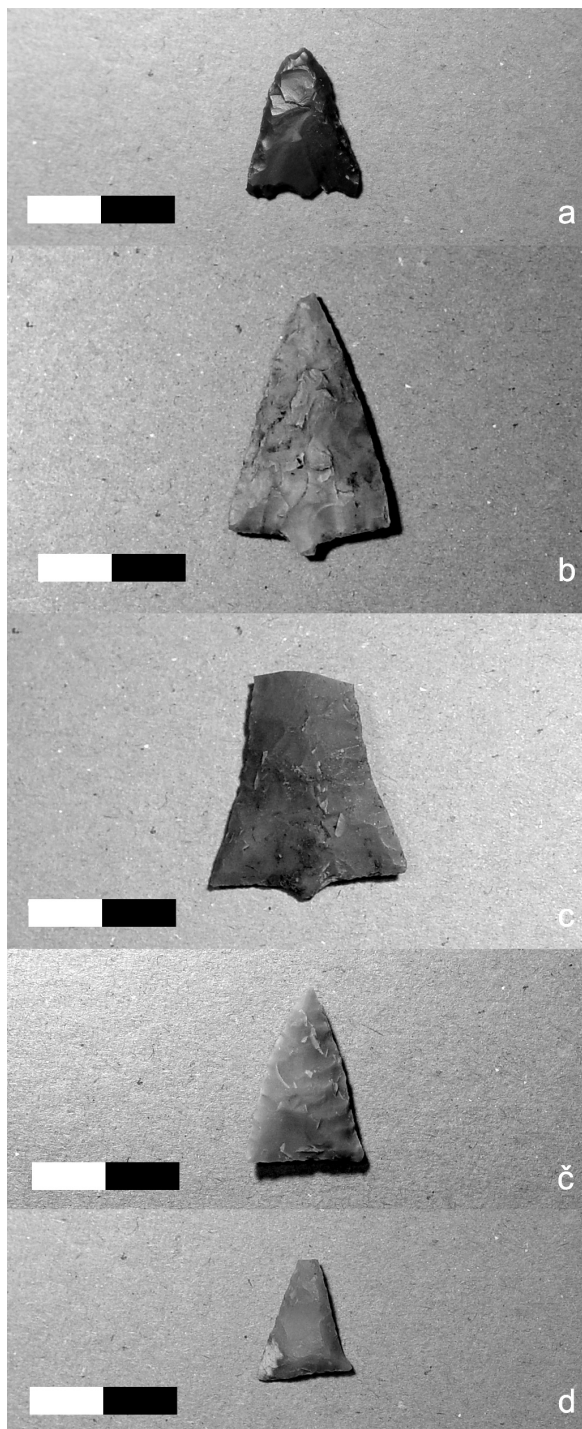
Sl. 3.33: Sonda 3, kv. 5, reženj 8. Ogrlični obroček, verjetno, iz kalcita. Foto: T. Korošec.

Fig. 3.33: Trench 3, quadrant 5, deepening 8. Necklace ringlet, probably calcite. Photo: T. Korošec.



Med orodji ali sestavnimi deli orodij so pogoste puščične osti. Na pogled se zdi, da so narejene iz roženec različnih barv od sive do rjave. Kar 12 jih izvira iz sonde 2, med njimi večina iz režnjev 6–4. Pojavljajo se v dveh osnovnih tipih: s kratkim pecljem (npr. t. 3.18: 4) in brez peclja (npr. t. 3.3: 8; 3.18: 7). Med ostalimi najdbami domnevno iz roženca je treba omeniti tudi klinasta orodja (npr. t. 3.13: 9) in sveder.<sup>33</sup>

<sup>33</sup> Podobno kot npr. pri Velušček 2004, sl. 3.1.24.



Stone axes and whetstones were also found at Stare gmajne (Pls. 3.6: 7; 3.29: 8). Shaft-hole (Pls. 3.1: 5; 3.12: 1; 3.14: 1) and flat axes (Pl. 3.16: 13) occur. As mentioned, partly preserved handle (Pl. 3.14: 2) was found in a shaft-hole of an almost entirely preserved stone axe (Pl. 3.14: 1; Figs. 3.35, 3.36). The petrographic analysis of the two shaft-hole axes<sup>34</sup> showed, that they are made of metaultramafite. This is a magmatic rock, perhaps originating from the Eastern Alps. Although the latter is not doubtlessly proved

<sup>34</sup> See Chapter 12 in this monograph.



Sl. 3.35: Odvodni jarek 12, odsek 24. Kladivasta sekira iz metaultramafita. Foto: D. Valoh. Dl. = 16,5 cm.

Fig. 3.35: Drainage ditch 12, section 24. Shaft-hole axe, made of metaultramafite. Photo: D. Valoh. Length = 16.5 cm.

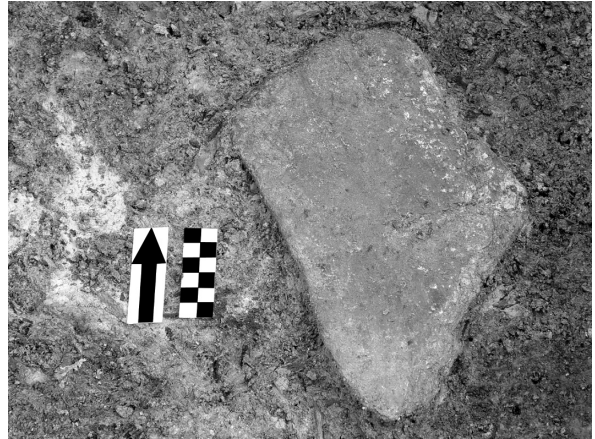


Sl. 3.36: Odvodni jarek 12, odsek 24. Detajl v ušesu kladivaste sekire iz metaultramafita. Foto: D. Valoh.

Fig. 3.36: Drainage ditch 12, section 24. Detail of a shaft-hole of the metaultramafite shaft-hole axe. Photo: D. Valoh.

Sl. 3.34: Sonda 2. Kamnite puščične osti: a) kv. 9, reženj 4; b) sonda 2; c) kv. 6, reženj 5; č) kv. 4, reženj 6; d) kv. 2, reženj 4. Foto: T. Korošec.

Fig. 3.34: Trench 2. Stone arrowheads: a) quadrant 9, deepening 4; b) trench 2; c) quadrant 6, deepening 5; č) quadrant 4, deepening 6; d) quadrant 2, deepening 4. Photo: T. Korošec.

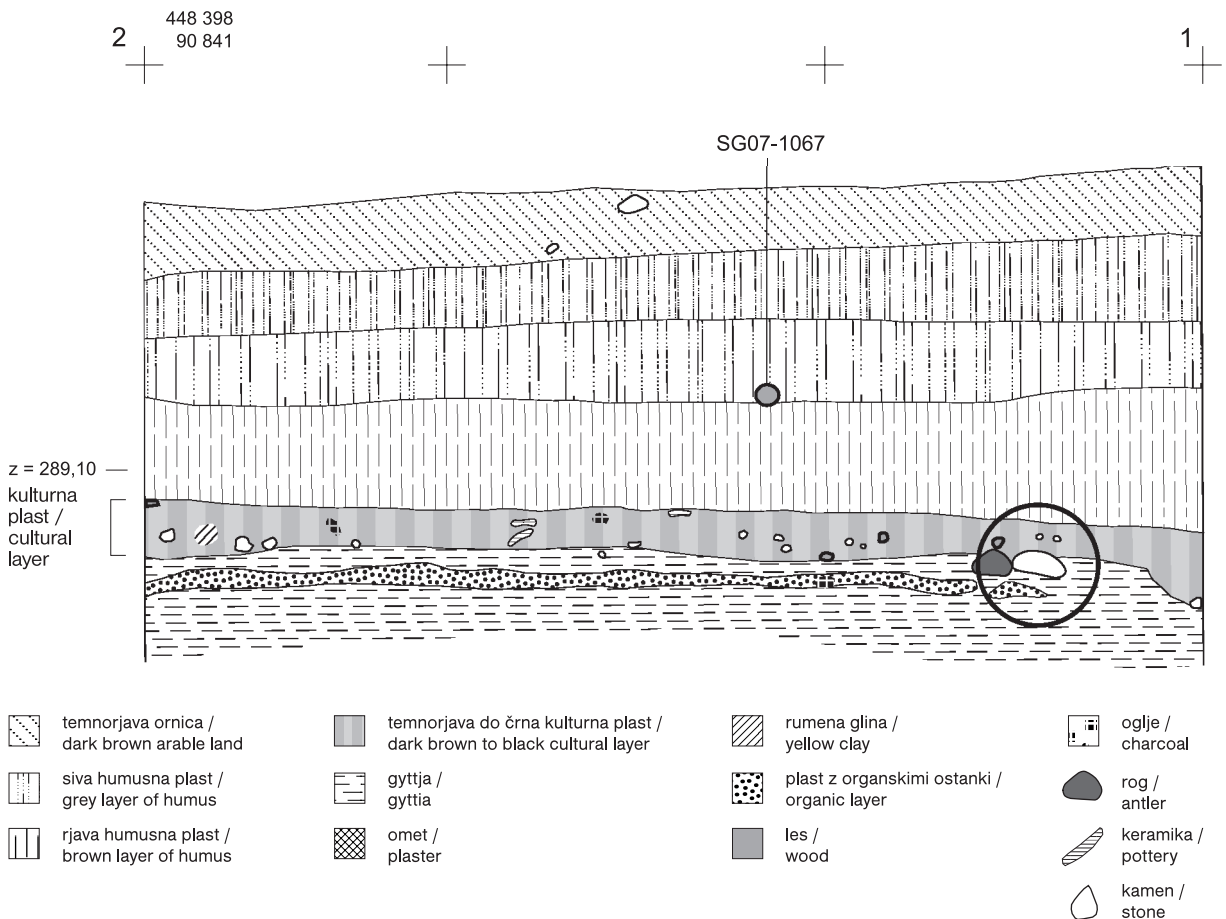


Sl. 3.38: Sonda 2, kv. 15, reženj 3. Žrmlje iz kremenovo sljudnatega peščenjaka *in situ*. Foto: M. Turk.

Fig. 3.38: Trench 2, quadrant 15, deepening 3. Quern, made of quartz micaceous sandstone *in situ*. Photo: M. Turk.

Sl. 3.37: Odvodni jarek 12, odsek 29. Ploščata ali kalupasta sekira iz žada ali eklogita. Foto: D. Valoh. Dl. = 5,2 cm.

Fig. 3.37: Drainage ditch 12, section 29. Flat axe, made of jade or eclogite. Photo: D. Valoh. Length = 5.2 cm.



Sl. 3.39: Sonda 3, južni profil. Lega talilne posode je označen s krogom. Risba: T. Korošec. M = 1 : 20.

Fig. 3.39: Trench 3. Southern section. Position of crucible is encircled. Drawn by: T. Korošec. Scale = 1 : 20.

Na Starih gmajnah smo našli tudi kamnite sekire in bruse (*t. 3.6: 7; 3.29: 8*). Ločimo kladivaste (*t. 3.1: 5; 3.12: 1; 3.14: 1*) in ploščate oz. kalupaste sekire (*t. 3.16: 13*). Kot omenjeno se je v ušesu skoraj cele kladivaste sekire (*t. 3.14: 1; sl. 3.35, 3.36*) ohranil tudi del toporišča iz drenovega lesa (*t. 3.14: 2*). Analiza kamninske sestave dveh kladivastih sekir<sup>34</sup> je pokazala, da sta narejeni iz metaultramafita, magmatske kamnine, katere izvor je morda iskati v vzhodnih Alpah. Čeprav slednje še ni nedvomno dokazano, takšne surovine ni najti na območju današnje Slovenije. Še bolj zanimiva pa je ploščata ali kalupasta sekira. Narejena je iz žada ali eklogita (*t. 3.16: 13; sl. 3.37*). Na Ljubljansko barje je prišla iz severozahodne Italije.

Analizirana sta bila tudi dva brusa, ki kažeta na lokalno kamnino iz bližnje okolice Ljubljanskega barja.

Med kamnitimi najdbami je tudi veliko žrnelj. Njihovo surovinsko sestavo je preučil J. Turk.<sup>35</sup> Ugotovil

yet, such raw materials cannot be found in present-day Slovenia. The flat axe is still more interesting. It is made of jade or eclogite (*Pl. 3.16: 13; Fig. 3.37*). It came to the Ljubljansko barje from northwestern Italy.

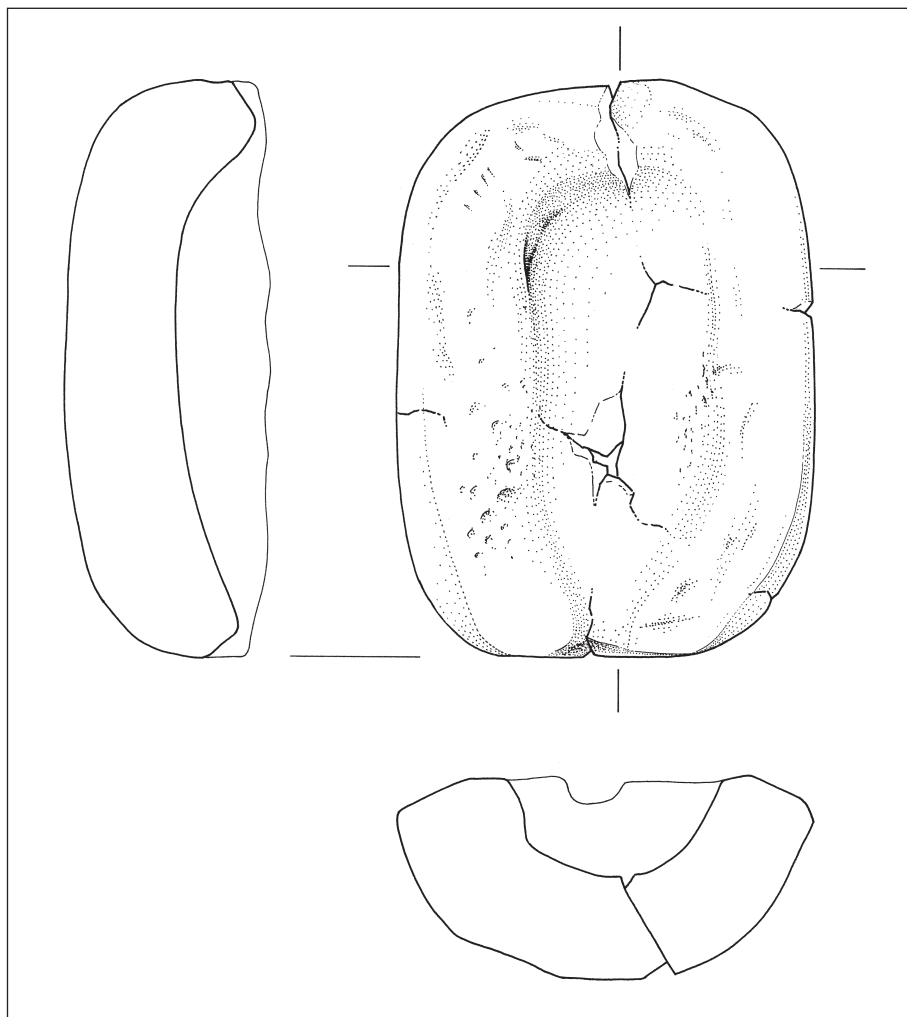
The two whetstones were also analysed. They were made of local rock originating from immediate environs of the Ljubljansko barje.

Many querns were also found. Stone composition was studied by J. Turk.<sup>35</sup> He found out that quartz sandstone and conglomerate querns prevail. The origin of these rocks is the northern hinterland of the Ljubljansko barje. Finds, made of quartz porphyry, originate from some other area. Quartz porphyry cannot be found near the Ljubljansko barje; it is present in wider surroundings of Blegoš and Kranj; between Jelovica and Kranj and near Preddvor. Also fragments of querns made of oolitic limestone are interesting. This material can be found on the opposite side of the Ljubljansko barje, in gravelly deposits of the Iška river.

<sup>34</sup> Glej poglavje 12 v tem zborniku.

<sup>35</sup> Poglavje 13 v tem zborniku.

<sup>35</sup> See Chapter 13 in this monograph.



Sl. 3.40: Sonda 3. Talilna posoda iz kremenasto glinastega muljevca. Risba: T. Korošec. M = 1 : 2.

Fig. 3.40: Trench 3. Crucible, made of quartz-feldspathic siltite. Drawn by: T. Korošec. Scale = 1 : 2.



je, da prevladujejo žrmlje iz kremenovih peščenjakov in konglomeratov. Njihov izvor je iskati na severnem obrobju Ljubljanskega barja. Od bolj daleč sta prišli najdbi iz kremenovega porfirja, ki ga v okolici Ljubljanskega barja ni, najdemo pa ga v širši okolici Blegoša in Kranja: med Jelovico in Kranjem ter v okolici Preddvora. Zanimiva sta tudi odlomka žrnelj iz oolitnega apnenca, ki ga nahajamo na drugem koncu Ljubljanskega barja v prodnatih nanosih Iške.

Zelo zanimiva je tudi talilna posoda<sup>36</sup> iz kamna (sl. 3.40). Glede na surovino je najverjetneje lokalnega izvora, narejena je namreč iz kremenasto glinastega muljevca.<sup>37</sup> Posoda je bila najdena v sondi 3 (sl. 3.39), nedaleč stran od glinaste talilne posode (prim. s sl. 3.1). Tudi na tej posodi so s prostim očesom vidni sledovi gorenja. Z metodo XRF je bilo ugotovljeno, da je bila v stiku z bakrom.<sup>38</sup>

Posebno pozornost zaslužijo tudi navadni kamni. Analiza<sup>39</sup> je pokazala, da izvirajo iz bližnje okolice Ljubljanskega barja. Trije površinsko reliefno kondenzirani dolomitni in en apnenčev blok pa verjetno izhajajo iz kakšne jame v okolici, kar potrjuje tudi najdba fragmenta sige. Čemu so ti predmeti služili, ni dognano.

### 3.2.2.3 NAJDBE IZ KOSTI IN DRUGIH ŽIVALSKIH DELOV

Skupino najdb, ki jih omenjamo v tem sklopu, zakrožamo z najdbami iz kosti in drugih živalskih delov. Prevladujejo izdelki, ki so bili namenjeni vsakodnevnim opravilom: razna šila, bodala, sekire itd. Izčrpno analizo je opravil B. Toškan.<sup>40</sup> Ugotovil je, da so koliščarji kot surovino najraje uporabljali kosti lovnih živali (predvsem komolčnice ter dlančnice/stopalnice). Razmeroma veliko število je tudi izdelkov in polizdelkov iz rogovja.

## 3.3 ARHITEKTURNI OSTANKI

Na Ljubljanskem barju naletimo med ostanki, ki jih lahko pripišemo arhitekturi, najpogosteje na vertikalne kole. Na Starih gmajnah prevladujejo koli iz lesa jesena in hrasta. Drugih drevesnih vrst je manj kot 20 %. Analiza je pokazala, da so koliščarji s Starih gmajn za nosilne kole uporabljali les, ki je bil posekan v mladem gozdu, oz. mlada drevesa, kar je tudi olajšalo transport in pripravo kolov. Zdi pa se tudi, da so sčasoma na vzhodnem delu naselbine bili prisiljeni poseči tudi po debelejših, v glav-

<sup>36</sup> Glede namembnosti velja enako kot za glinasto talilno posodo (glej poglavje 3.2.1.1.8.4 v tem prispevku).

<sup>37</sup> Glej poglavje 12 v tem zborniku.

<sup>38</sup> Glej poglavje 11.3.2 v tem zborniku.

<sup>39</sup> Poglavje 13.3.1.2 v tem zborniku.

<sup>40</sup> Poglavje 14 v tem zborniku.

Stone crucible<sup>36</sup> is also very interesting (Fig. 3.40). It is most probably of a local origin, considering the raw material being quartz-feldspathic siltite.<sup>37</sup> The pot was found in trench 3 (Fig. 3.39), not far from clay crucible (compare with Fig. 3.1). Traces of combustion are visible with a naked eye. With XRF procedure proved presence of copper.<sup>38</sup>

Ordinary stones also earn special attention. Analysis<sup>39</sup> showed that they originate from immediate environs of the Ljubljansko barje. Three weathered dolomite and one limestone block probably originate from a cave nearby, which can further be confirmed by a fragment of calcareous sinter. The purpose of these objects is unknown.

### 3.2.2.3 FINDS MADE OF BONE AND OTHER ANIMAL PARTS

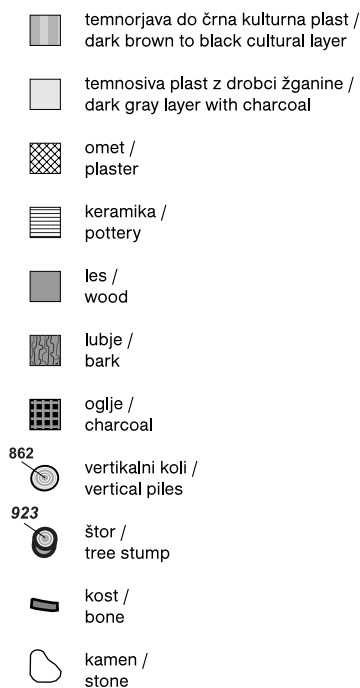
Group of finds, mentioned in this assembly, can be concluded with finds made of bone and other animal parts. Objects used for daily tasks prevail: various awls,

<sup>36</sup> It was used the same way as the clay crucible (see Chapter 3.2.1.1.8.4 in this monograph).

<sup>37</sup> See Chapter 12 in this monograph.

<sup>38</sup> See Chapter 11.3.2 in this monograph.

<sup>39</sup> See Chapter 13.3.1.2 in this monograph.



Sl. 3.41: Sonda 2. Lesene strukture v planumu po izkopu 5. režnja. Risba: T. Korošec.

Fig. 3.41: Trench 2. Wooden structures in planum after excavation of deepening 5. Drawn by: T. Korošec.

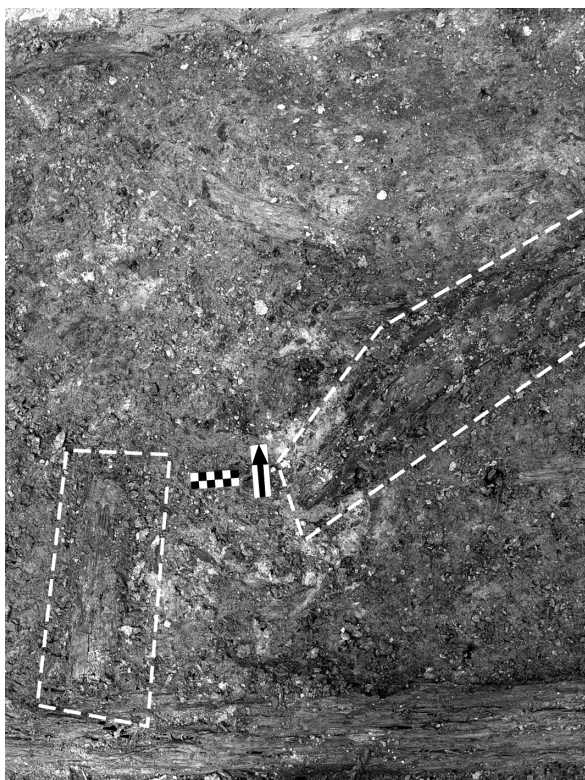






Sl. 3.42: Sonda 2. Lesene strukture v planumu po izkopu 5. režnja, z = 288,76 m. Foto: M. Turk.

Fig. 3.42: Trench 2. Wooden structures in planum after excavation of deepening 5, z = 288.76 m. Photo: M. Turk.



Sl. 3.43: Sonda 2, kv. 10-11. Ožgani kosi lesa v režnju 4, z = 288,81 m. Foto: M. Turk.

Fig. 3.43: Trench 2, quadrants 10-11. Burnt pieces of wood in deepening 4, z = 288.81 m. Photo: M. Turk.

daggers, axes etc. B. Toškan<sup>40</sup> made a detailed analysis of these objects. He discovered that pile-dwellers preferred to use mammalian bones of hunting animal species (mostly ulnae and metacarpals/metatarsals). A large number of antler and part-finished products are also present.

### 3.3 ARCHITECTURAL REMAINS

Vertical piles are the most frequently found remains that we can ascribe to architectural remains at the Ljubljansko barje. Ash and oak piles prevail at Stare gmajne. Others tree species represent less than 20 % of the entire assembly. Analysis showed that pile-dwellers from Stare gmajne used wood from young forest or used young trees for foundation piles, which also eased transport and preparation of piles. It also appears that, at the eastern part of the settlement, they later used thicker, mainly older oak trees and sometimes also other, less suitable species of wood.<sup>41</sup>

Horizontal piles and parts of trees were also found.<sup>42</sup> They are mostly thin, worked branches, bark, and a shorter board was also found (see Figs. 3.41, 3.42). There are only a few remains of horizontal piles, mostly short burnt pieces (Fig. 3.43). These and, at some places extraordinarily thick, charcoal layer (e.g. Fig. 3.9) indicate that a fire occurred in trench 2.

<sup>40</sup> See Chapter 14 in this monograph.

<sup>41</sup> See Chapter 7 in this monograph.

<sup>42</sup> Compare with Harej 1981-1982, App. 1; Coles 2006, 50-57.





Sl. 3.44: Sonda 2. Horizontalni koli in kosi drevesne skorje v kv. 1. Foto: M. Turk.  
 Fig. 3.44: Trench 2. Horizontal piles and pieces of bark in quadrant 1. Photo: M. Turk.

nem starejših hrastovih drevesih, v posameznih obdobjih pa tudi po drugih sicer manj primernih vrstah lesa.<sup>41</sup>

Poleg vertikalnih kolov najdemo tudi horizontalno ležeče kole in dele dreves.<sup>42</sup> V večini primerov gre za tanjše obdelane špice oz. veje, najti je tudi krajšo desko, prevladuje pa skorja (glej sl. 3.41, 3.42). Ostankev debelejših horizontalnih kolov je malo, večinoma gre za krajše ožgane kose (sl. 3.43), ki poleg mestoma izredno debele plasti žganine (npr. sl. 3.9) pričajo, da je bil na območju sonde 2 požar.

Nekaj horizontalnih kolov smo odkrili med izkopom 5. režnja v kv. 1 (sl. 3.44). Ležijo brez reda med ostanki drevesne skorje. V 3. režnju kv. 10–12 pa je bil najden do 10 cm debel horizontalen kol, ki je sondo presekalo po celotni širini (sl. 3.45). V vseh primerih gre najverjetneje za arhitekturne elemente, čemu natančno pa naj bi ta les služil, je na podlagi zbranih podatkov iz tako majhnih sond težko reči.

So pa raziskave v sondi 2 postregle z zanimivimi podatki o okolju, v katero je bilo umeščeno kolišče oz. vsaj ta del kolišča, in morda tudi z neposrednim dokazom o obstoju koliščarskih stavb na Starih gmajnah, tj. stavb ali kolib na kolih, katerih pod je dvignjen od tal.

V sondi 1 in predvsem v sondi 2 smo, kot omenjeno,<sup>43</sup> naleteli na šture, kar dokazuje, da so drevesa rastla na mestu, kjer so bili štore najdeni (sl. 3.41). Ko-

Some horizontal piles were discovered at the excavation of deepening 5, quadrant 1 (Fig. 3.44). They were lying in no order between the remains of bark. A horizontal, up to 10 cm thick, pile was found in deepening 3, quadrants 10–12, which cut the entire width of the trench (Fig. 3.45). All piles mentioned are most probably architectural elements. However, based on collected data from such a small trench, it is not easy to discuss their purpose.

On the other hand, research in trench 2 gave interesting data about the environment during the time of the pile-dwelling, or at least this part of the pile-dwelling and perhaps a direct evidence of the existence of pile-dwelling buildings at Stare gmajne, i.e. buildings or huts on piles with the floor lifted from the ground level.

As mentioned above, we came across stumps in trench 1 and, predominantly, in trench 2.<sup>43</sup> This proves that trees were growing on places where stumps were found (Fig. 3.41). Root of an alder stump SG06-923 was positioned between 288.53 and 288.63 m, with its trunk kept up to 288.82 m. Trunk of the stump SG06-936 was kept up to 288.91 m, which means, that trees were growing on this location before the construction of the pile-dwelling took place. Pile-dwellers either fell these trees, such as stump SG06-936 from which obviously several trunks were growing (Fig. 3.41), or used them as building material, such as perhaps stump SG06-923 (Fig. 3.41), for construction of a hut in trench 2. Moreover, upper parts of both stumps are burnt, which probably

<sup>41</sup> Poglavje 7 v tem zborniku.

<sup>42</sup> Prim. Harej 1981–1982, pril. 1; Coles 2006, 50–57.

<sup>43</sup> Poglavje 3.1.2.2 v tem prispevku.

<sup>43</sup> See Chapter 3.1.2.2 in this monograph.

renina jelševega štora SG06-923 je ležala med višinama 288,53 in 288,63 m, deblo pa je bilo ohranjeno vse do višine 288,82 cm, pri štoru SG06-936 celo do 288,91 m, kar pomeni, da sta na tem mestu drevesi rastle že pred gradnjo koliščarja in da so z njima imeli opravke tudi koliščarji. Koliščarji so drevesi ali posekali, kar velja za štor SG06-936 iz katerega je očitno pognalo več debel (*sl. 3.41*), ali uporabili kot gradbeni element, kar bi morda lahko veljalo za štor SG06-923 (*sl. 3.41*), pri kolibi, ki je stala na območju sonde 2. Dejstvo je tudi, da sta oba štora na zgornjem delu ožgana in sta verjetno gorela v omenjenem požaru, ki je prizadejal del naselbine, kjer je bila locirana sonda 2.

Kakor koli že, lega jelševega štora potrjuje, da je bila naselbina na tem mestu zelo verjetno postavljena v močvirnato oz. barjansko okolje, kar se ujema z raziskavo, ki jo je opravil J. Turk.<sup>44</sup> Da je bil pod kolibe dvignjen nad štorom, pa ne moremo z zanesljivostjo reči, saj pri raziskovanju nismo ugotovili tlorisov koliščarskih kolib, poleg tega je bila tudi sonda premajhna. V primeru, da je bil objekt postavljen nad štorom, kot je npr. SG06-936, je bil pod kolibe zagotovo dvignjen od tal, in gre dejansko za kolibo na kolih, kar se sicer predpostavlja za stavbe na vseh koliščarskih naselbinah na Ljubljanskem barju.<sup>45</sup>

### 3.4 KATALOG NAJDB / CATALOGUE OF FINDS

Tabla 3.1

1. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 1; neposredno pod kulturno plastjo; leto 2002.
2. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 1; pod kulturno plastjo ob pestu; leto 2002.
3. Frag. ustja z ostenjem; frag. razčlenjenega držaja/rebra; odtisi; rjava; grobozrnata; lega: sonda 1; kulturna plast; leto 2002.
4. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 1; kulturna plast; leto 2002.
5. Frag. kladivaste sekire; metaultramafit;<sup>46</sup> siva; lega: sonda 1; na dnu kulturne plasti; leto 2002.
6. Frag. ustja; odtisi; rjava; grobozrnata; lega: jarek 1; odsek 118; leto 2002.
7. Frag. ustja z ostenjem; siva; grobozrnata; lega: jarek 1; odsek 120; leto 2002.
8. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 1; odsek 122; leto 2002.
9. Frag. ustja z ostenjem; frag. razčlenjenega držaja; temnosiva; grobozrnata; lega: jarek 1; odsek 125; leto 2002.

Tabla 3.2

1. Frag. ustja z ostenjem; razčlenjen držaj; odtisi; temnosiva; grobozrnata; lega: jarek 1; odsek 127; leto 2002.
2. Frag. ustja z ostenjem; razčlenjen držaj; temnosiva; grobozrnata; lega: jarek 1; odsek 128; leto 2002.

<sup>44</sup> Glej poglavje 2 v tem zborniku in prim. s Tancik 1965, 62.

<sup>45</sup> Glej npr. Korošec 1955, 78–81; Velušček 2005b, 202.

<sup>46</sup> Poglavje 12 v tem zborniku.



Sl. 3.45: Horizontalen kol iz 3. reznja v sondi 2 med izkopavanjem. Pogled z zahoda. Foto: M. Turk.

Fig. 3.45: Horizontal pile from deepening 3, trench 2, during excavation. View from the west. Photo: M. Turk.

happened at the already mentioned fire destroyed part of the settlement in trench 2.

Nonetheless, position of the alder stump confirms that the settlement was very probably located in swampy or moor environment here. This corresponds with the research done by J. Turk.<sup>44</sup> However, we cannot claim with certainty that the floor of the hut was lifted above the stump. No evidence for this was found at research and the trench was too small to determine ground plans of pile-dwelling huts. If the building was built above a stump, such as SG06-936, the floor of the hut would definitely be lifted above the ground level and this would actually be a hut on piles. We assume that this type of structure was used in all pile-dwelling settlements at the Ljubljansko barje.<sup>45</sup>

<sup>44</sup> See Chapter 2 in this monograph and compare with Tancik 1965, 62.

<sup>45</sup> See e.g. Korošec 1955, 78–81; Velušček 2005b, 202.



3. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 1; odsek 129; leto 2002.
4. Frag. ostenja; frag. držaja; vrezi; temnosiva; grobozrnata; lega: jarek 1; odsek 129; leto 2002.
5. Frag. ustja z ostenjem; bradavica z odtisom; temnosiva; grobozrnata; lega: jarek 1; odsek 129; leto 2002.
6. Frag. ustja z ostenjem; frag. razčlenjenega držaja; temnosiva; grobozrnata; lega: jarek 1; odsek 129; leto 2002.
7. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 1; odsek 129.
8. Frag. ustja z ostenjem; frag. razčlenjenega držaja; temnosiva; grobozrnata; lega: jarek 1; odsek 129; leto 2002.

Tabla 3.3

1. Frag. ustja z ostenjem; frag. razčlenjenega držaja/rebra; temnosiva; grobozrnata; lega: jarek 1; odsek 129; leto 2002.
2. Frag. ustja z ostenjem; frag. razčlenjenega držaja/rebra; siva; grobozrnata; lega: jarek 1; odsek 129; leto 2002.
3. Manjša posoda; siva; grobozrnata; lega: jarek 1; odsek 129; leto 2002.
4. Frag. vretenca; temnosiva; grobozrnata; lega: jarek 1; odsek 129; leto 2002.
5. Frag. ustja z ostenjem; odtisi; temnosiva; grobozrnata; lega: jarek 1; odsek 130; leto 2002.
6. Frag. ustja z ostenjem; razčlenjen držaj; temnosiva; grobozrnata; lega: jarek 1; odsek 130; x = 103 m; leto 2002.
7. Frag. ustja z ostenjem; frag. razčlenjenega držaja; temnorjava; grobozrnata; lega: jarek 1; odsek 130; leto 2002.
8. Pušična ost; sivozelena; lega: jarek 1; odsek 130; leto 2002.

Tabla 3.4

1. Frag. ustja z ostenjem; siva; grobozrnata; lega: jarek 1; odsek 131; leto 2002.
2. Frag. ustja z ostenjem; siva; grobozrnata; lega: jarek 1; odsek 131; leto 2002.
3. Frag. vretenca; siva; grobozrnata; lega: jarek 1; odsek 131; leto 2002.
4. Frag. ustja z ostenjem; frag. razčlenjenega držaja; temnosiva; grobozrnata; lega: jarek 1; odsek 132; leto 2002.
5. Frag. ustja z ostenjem; frag. razčlenjenega držaja; siva; grobozrnata; lega: jarek 1; odsek 132; leto 2002.
6. Frag. vretenca; temnorjava; grobozrnata; lega: jarek 1; odsek 132; leto 2002.
7. Frag. ustja z ostenjem; frag. razčlenjenega držaja; temnosiva; grobozrnata; lega: jarek 1; odsek 133; leto 2002.
8. Frag. ostenja; frag. razčlenjenega držaja/rebra; odtisi; temnosiva; grobozrnata; lega: jarek 1; odsek 133; leto 2002.
9. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 1; odsek 133; leto 2002.
10. Frag. ustja z ostenjem; držaj; temnosiva; grobozrnata; lega: jarek 1; odsek 134; leto 2002.
11. Frag. vretenca; temnosiva; grobozrnata; teža: 46 g (polovica); lega: jarek 1; odsek 134; leto 2002.

Tabla 3.5

1. Frag. ustja z ostenjem; frag. razčlenjenega držaja/rebra; temnosiva; grobozrnata; lega: jarek 1; odsek 135; leto 2002.
2. Frag. ustja z ostenjem; frag. razčlenjenega držaja; siva; grobozrnata; lega: jarek 1; odsek 136; leto 2002.
3. Manjša posoda; rjava; grobozrnata; lega: jarek 1; odsek 136; leto 2002.
4. Frag. ustja z ostenjem; rdeča; drobnazrnata; lega: jarek 1; odsek 136; leto 2002.

5. Frag. ustja z ostenjem; temnosiva; drobnazrnata; lega: jarek 1; odsek 136; leto 2002.
6. Frag. ustja z ostenjem; frag. razčlenjenega držaja/rebra; temnosiva; grobozrnata; lega: jarek 1; odsek 136; leto 2002.
7. Frag. ustja z ostenjem; držaj; temnosiva; grobozrnata; lega: jarek 1; odsek 136; leto 2002.
8. Frag. ostenja; vrezi; temnosiva; grobozrnata; lega: jarek 1; odsek 136; leto 2002.
9. Frag. ostenja; vrezi; temnosiva; grobozrnata; lega: jarek 1; odsek 136; leto 2002.
10. Frag. ostenja; ročaj; odtisi; vrezi; temnosiva; grobozrnata; lega: jarek 1; odsek 136; leto 2002.

Tabla 3.6

1. Frag. ustja z ostenjem; frag. razčlenjenega držaja/rebra; na ustju žleb; siva; grobozrnata; lega: jarek 2; odsek 88; leto 2002.
2. Frag. ustja z ostenjem; odtisi; siva; grobozrnata; lega: jarek 2; odsek 89; leto 2002.
3. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 2; odsek 90; leto 2002.
4. Frag. posode; odtisi; temnosiva; grobozrnata; lega: jarek 2; odsek 92; leto 2002.
5. Frag. ustja z ostenjem; frag. razčlenjenega držaja/rebra; odtisi; temnosiva; grobozrnata; lega: jarek 2; odsek 93; leto 2002.
6. Frag. ustja z ostenjem; frag. razčlenjenih držajev; siva; grobozrnata; lega: jarek 2; odsek 93; leto 2002.
7. Podolgovat predmet na uho/brus; muljevec ali drobnazrnati kremenasto glinasti tuf s kloritom;<sup>47</sup> zelena; lega: jarek 2; odsek 93; x = 52,50 m; leto 2002.

Tabla 3.7

1. Frag. ustja z ostenjem; siva; grobozrnata; lega: jarek 2; odsek 94; leto 2002.
2. Frag. ustja z ostenjem; temnorjava; grobozrnata; lega: jarek 2; odsek 95; leto 2002.
3. Frag. ustja z ostenjem; temnosiva; drobnazrnata; lega: z njive ob jarku 2; leto 2002.
4. Frag. ustja z ostenjem; držaj; siva; grobozrnata; lega: jarek 3; odsek 59; leto 2002.
5. Vretence; temnosiva; grobozrnata; teža: 39 g; lega: jarek 3; odsek 59; x = 36,80 m; leto 2002.
6. Frag. ustja z ostenjem; nastavek za držaj; siva; grobozrnata; lega: jarek 3; odsek 60; leto 2002.
7. Frag. ustja z ostenjem; temnorjava; grobozrnata; lega: jarek 3; odsek 60; leto 2002.
8. Frag. ustja z ostenjem; frag. držaja; temnosiva; grobozrnata; lega: jarek 3; odsek 60; leto 2002.

Tabla 3.8

1. Frag. ustja z ostenjem; temnorjava; grobozrnata; lega: jarek 3; odsek 61; leto 2002.
2. Frag. ustja z ostenjem; frag. razčlenjenega držaja; temnosiva; grobozrnata; lega: jarek 3; odsek 61; leto 2002.
3. Frag. ustja z ostenjem; frag. držaja; temnosiva; drobnazrnata; lega: jarek 3; odsek 61; leto 2002.
4. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 3; odsek 62; leto 2002.
5. Frag. ostenja; frag. držaja; temnosiva; grobozrnata; lega: jarek 3; odsek 63; leto 2002.
6. Frag. ustja z ostenjem; siva; grobozrnata; lega: jarek 3; odsek 63; leto 2002.

<sup>47</sup> Poglavje 12 v tem zborniku.

7. Frag. ustja z ostenjem; frag. nastavek za ročaj; temnosiva; grobozrnata; lega: jarek 3; odsek 66; leto 2002.

8. Frag. ustja z ostenjem; siva; grobozrnata; lega: jarek 3; odsek 66; leto 2002.

Tabla 3.9

1. Frag. ustja z ostenjem; temnosiva; drobnazrnata; lega: jarek 3; odsek 67; leto 2002.

2. Posoda; temnosiva; grobozrnata; lega: jarek 3; odsek 67; leto 2002.

3. Frag. ustja z ostenjem; držaj; uho; temnosiva; grobozrnata; lega: jarek 3; odsek 67; leto 2002.

4. Frag. ustja z ostenjem; frag. razčlenjenega držaja; odtisi; siva; grobozrnata; lega: jarek 3; odsek 68; leto 2002.

5. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 4; odsek 35; leto 2002.

6. Frag. ustja z ostenjem; frag. razčlenjenega držaja/rebra; temnosiva; grobozrnata; lega: jarek 4; odsek 36; leto 2002.

Tabla 3.10

1. Frag. ustja z ostenjem; frag. razčlenjenega držaja; rjava; drobnazrnata; lega: jarek 4; odsek 38; leto 2002.

2. Vretence; temnosiva; grobozrnata; teža: 187 g; lega: jarek 4; odsek 39; x = 54,85 m; leto 2002.

3. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 4; odsek 39; leto 2002.

4. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 4; odsek 39; leto 2002.

5. Frag. ustja z ostenjem; odtisi; siva; grobozrnata; lega: jarek 4; odsek 40; leto 2002.

6. Frag. ustja z ostenjem; frag. razčlenjenega držaja/rebra; temnosiva; grobozrnata; lega: jarek 4; odsek 40; leto 2002.

7. Frag. ustja z ostenjem; frag. razčlenjenega držaja/rebra; odtisi; siva; grobozrnata; lega: jarek 4; odsek 41; leto 2002.

8. Frag. ustja z ostenjem; frag. nastavka za ročaj; temnosiva; grobozrnata; lega: jarek 4; odsek 41; leto 2002.

Tabla 3.11

1. Frag. ustja z ostenjem; frag. razčlenjenega držaja; siva; drobnazrnata; lega: jarek 4; odsek 46; leto 2002.

2. Frag. ustja z ostenjem; frag. razčlenjenega držaja/rebra; temnosiva; grobozrnata; lega: jarek 5; odsek 13; leto 2002.

3. Frag. dna z ostenjem; odtisi; vrezi; temnosiva; grobozrnata; lega: jarek 5; odsek 20; leto 2002.

4. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 5; leto 1995.

5. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 5; leto 1995.

6. Frag. ustja z ostenjem; frag. razčlenjenega držaja; siva; grobozrnata; lega: jarek 5; leto 1995.

7. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 5; leto 1995.

8. Frag. dna; odtisi; siva; drobnazrnata; lega: jarek 5; leto 1995.

9. Frag. ustja z ostenjem; držaj; siva; drobnazrnata; lega: jarek 5; leto 1995.

10. Frag. vretenca; temnosiva; grobozrnata; lega: jarek 5; leto 1995.

11. Vretence; vrezi; temnosiva; grobozrnata; teža: 159 g; lega: jarek 5; leto 1995.

Tabla 3.12

1. Frag. kladivaste sekire; metaltramafit;<sup>48</sup> temnosiva; grobozrnata; lega: z njive ob jarku 5; leto 2004.

2. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 6; odsek 29; x = 114–116 m; vzhodna stena jarka; leto 2004.

3. Frag. ostenja; temnosiva; grobozrnata; lega: jarek 6; odsek 29; x = 114–116 m; vzhodna stena jarka; leto 2004.

4. Frag. ustja; siva; grobozrnata; lega: jarek 6; odsek 29; x = 114–116 m; vzhodna stena jarka; leto 2004.

5. Frag. ustja z ostenjem; frag. razčlenjenega držaja/rebra; temnosiva; grobozrnata; lega: jarek 6; odsek 29; x = 114–116 m; vzhodna stena jarka; leto 2004.

6. Frag. ostenja; frag. razčlenjenega držaja/rebra; siva; grobozrnata; lega: jarek 6; odsek 29; x = 114–116 m; vzhodna stena jarka; leto 2004.

7. Frag. ostenja; frag. razčlenjenega rebra; temnosiva; grobozrnata; lega: jarek 6; odsek 29; x = 114–116 m; vzhodna stena jarka; leto 2004.

Tabla 3.13

1. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 6; odsek 29; x = 114–116 m; vzhodna stena jarka; leto 2004.

2. Frag. ostenja; frag. razčlenjenega držaja; temnosiva; grobozrnata; lega: jarek 6; odsek 29; x = 114–116 m; vzhodna stena jarka; leto 2004.

3. Frag. držaja; temnosiva; grobozrnata; lega: jarek 6; odsek 29; x = 114–116 m; vzhodna stena jarka; leto 2004.

4. Frag. dna; siva; grobozrnata; lega: jarek 6; odsek 29; x = 114–116 m; vzhodna stena jarka; leto 2004.

5. Vretence; siva; grobozrnata; lega: jarek 6; odsek 29; x = 114–116 m; vzhodna stena jarka; leto 2004.

6. Frag. vretenca; temnosiva; grobozrnata; lega: jarek 6; odsek 29; x = 114–116 m; vzhodna stena jarka; leto 2004.

7. Frag. zajemalke; rjava; grobozrnata; lega: jarek 6; odsek 29; x = 114–116 m; vzhodna stena jarka; leto 2004.

8. Frag. dna z ostenjem; siva; grobozrnata; lega: jarek 6; odsek 35; leto 2004.

9. Klina; kamen; siva; lega: jarek 6; leto 1995.

Tabla 3.14

1. Kladivasta sekira; metaltramafit;<sup>49</sup> temnosiva; lega: jarek 12; odsek 24; x = 94 m; leto 2004.

2. Frag. toporišča; dren;<sup>50</sup> rjava; lega: jarek 12; odsek 24; x = 94 m; leto 2004.

3. Frag. ustja z ostenjem; siva; grobozrnata; lega: jarek 12; odsek 28; x = 110–112 m; vzhodna stena jarka; leto 2004.

4. Frag. ustja z ostenjem; siva; grobozrnata; lega: jarek 12; odsek 28; x = 110–112 m; vzhodna stena jarka; leto 2004.

5. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 12; odsek 28; x = 110–112 m; vzhodna stena jarka; leto 2004.

Tabla 3.15

1. Frag. ustja z ostenjem; siva; grobozrnata; lega: jarek 12; odsek 28; leto 2004.

2. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 12; odsek 28; leto 2004.

<sup>48</sup> Sekira je po mnenju A. Horvata (iz neobjavljenega poročila *Petrografska analiza kamnitih sekir iz Ljubljanskega barja*, Ljubljana, 7. 6. 2004, hrani IzA ZRC SAZU) narejena iz enake surovine kot kladivasta sekira na t. 3.14: 1, ki je po mnenju F. Bernardinija in sodelavcev iz metaltramafita (glej poglavje 12 v tem zborniku).

<sup>49</sup> Poglavje 12 v tem zborniku.

<sup>50</sup> Poglavje 10 v tem zborniku.

3. Frag. ustja z ostenjem; siva; grobozrnata; lega: jarek 12; odsek 28; x = 110–112 m; vzhodna stena jarka; leto 2004.
4. Frag. ustja z ostenjem; siva; grobozrnata; lega: jarek 12; odsek 28; leto 2004.
5. Frag. ustja z ostenjem; siva; grobozrnata; lega: jarek 12; odsek 28; x = 110–112 m; vzhodna stena jarka; leto 2004.
6. Frag. ustja z ostenjem; siva; grobozrnata; lega: jarek 12; odsek 28; leto 2004.
7. Frag. ustja; temnosiva; grobozrnata; lega: jarek 12; odsek 28; leto 2004.
8. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 12; odsek 28; leto 2004.
9. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 12; odsek 28; leto 2004.
10. Frag. ustja z ostenjem; siva; grobozrnata; lega: jarek 12; odsek 28; leto 2004.
11. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 12; odsek 28; leto 2004.
12. Frag. ostenja; frag. razčlenjenega držaja; temnosiva; grobozrnata; lega: jarek 12; odsek 28; leto 2004.
13. Frag. ostenja; siva; grobozrnata; lega: jarek 12; odsek 28; leto 2004.
14. Frag. ostenjem; frag. rebri; siva; grobozrnata; lega: jarek 12; odsek 28; leto 2004.
15. Frag. ostenja; frag. rebri; siva; grobozrnata; lega: jarek 12; odsek 28; leto 2004.

Tabla 3.16

1. Frag. dna z ostenjem; temnosiva; grobozrnata; lega: jarek 12; odsek 28; leto 2004.
2. Frag. dna z ostenjem; siva; grobozrnata; lega: jarek 12; odsek 28; leto 2004.
3. Frag. ostenja; frag. razčlenjenega držaja/rebra; temnosiva; grobozrnata; lega: jarek 12; odsek 28; leto 2004.
4. Frag. razčlenjenega držaja; siva; grobozrnata; lega: jarek 12; odsek 28; leto 2004.
5. Frag. vretenca; odtisi; temnosiva; grobozrnata; lega: jarek 12; odsek 28; leto 2004.
6. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 12; odsek 29; leto 2004.
7. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 12; odsek 29; leto 2004.
8. Frag. ostenja; razčlenjen držaj; temnosiva; grobozrnata; lega: jarek 12; odsek 29; leto 2004.
9. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 12; odsek 29; leto 2004.
10. Frag. ustja; temnosiva; grobozrnata; lega: jarek 12; odsek 29; leto 2004.
11. Frag. ustja; siva; grobozrnata; lega: jarek 12; odsek 29; leto 2004.
12. Frag. dna z ostenjem; siva; grobozrnata; lega: jarek 12; odsek 29; leto 2004.
13. Ploščata sekira; žad ali eklogit;<sup>51</sup> temnozeleno; lega: jarek 12; odsek 29; x = 113,40 m; leto 2004.

Tabla 3.17

1. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 12; odsek 30; leto 2004.
2. Frag. ustja z ostenjem; frag. razčlenjenega držaja; temnosiva; grobozrnata; lega: jarek 12; odsek 30; leto 2004.
3. Frag. ustja z ostenjem; frag. držaja; temnosiva; grobozrnata; lega: jarek 12; odsek 30; leto 2004.
4. Frag. ustja z ostenjem; odtis; temnosiva; grobozrnata; lega: jarek 12; odsek 30; leto 2004.

<sup>51</sup> Poglavlje 12 v tem zborniku.

5. Frag. ustja z ostenjem; siva; grobozrnata; lega: jarek 12; odsek 30; leto 2004.
6. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 12; odsek 30; leto 2004.
7. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 12; odsek 30; leto 2004.
8. Frag. ustja z ostenjem; siva; grobozrnata; lega: jarek 12; odsek 30; leto 2004.
9. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 12; odsek 30; leto 2004.
10. Frag. ostenja; siva; grobozrnata; lega: jarek 12; odsek 30; leto 2004.

Tabla 3.18

1. Frag. ostenja; frag. razčlenjenega držaja; siva; grobozrnata; lega: jarek 12; odsek 30; leto 2004.
2. Frag. dna z ostenjem; frag. držaja; temnosiva; grobozrnata; lega: jarek 12; odsek 30; leto 2004.
3. Frag. ostenja; frag. držaja; temnosiva; grobozrnata; lega: jarek 12; odsek 30; leto 2004.
4. Puščična ost; siva; lega: jarek 12; odsek 30; leto 2004.
5. Frag. žrmlje; kremenov peščenjak;<sup>52</sup> siva; lega: jarek 12; odsek 30; leto 2004.
6. Frag. vretenca; temnosiva; grobozrnata; lega: jarek 12; odsek 31; leto 2004.
7. Puščična ost; zelena; lega: jarek 12; odsek 31; leto 2004.
8. Frag. ustja z ostenjem; temnosiva; drobnazrnata; lega: jarek 12; odsek 32; leto 2004.
9. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 12; odsek 32; leto 2004.
10. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 22; leto 2004.
11. Krogla/terilni kamen?; tuf;<sup>53</sup> siva; lega: jarek 13; odsek 22; leto 2004.

Tabla 3.19

1. Frag. ustja z ostenjem; siva; grobozrnata; lega: ob jarku 13; z njive pri odseku 24; leto 2004.
2. Frag. ustja z ostenjem; rjava; drobnazrnata; lega: ob jarku 13; z njive pri odseku 24; leto 2004.
3. Frag. ustja z ostenjem; siva; grobozrnata; lega: ob jarku 13; z njive pri odseku 24; leto 2004.
4. Frag. ustja z ostenjem; odtisi; siva; drobnazrnata; lega: ob jarku 13; z njive pri odseku 24; leto 2004.
5. Frag. ustja z ostenjem; odtisi; siva; drobnazrnata; lega: ob jarku 13; z njive pri odseku 24; leto 2004.
6. Frag. ustja z ostenjem; odtisi; temnosiva; grobozrnata; lega: ob jarku 13; z njive pri odseku 24; leto 2004.
7. Frag. ostenja; metličast ornament; temnosiva; drobnazrnata; lega: ob jarku 13; z njive pri odseku 24; leto 2004.
8. Frag. dna z ostenjem; siva; grobozrnata; lega: ob jarku 13; z njive pri odseku 24; leto 2004.
9. Frag. ustja z ostenjem; frag. ročaja; siva; grobozrnata; lega: ob jarku 13; z njive pri odseku 24; leto 2004.
10. Frag. ostenja; frag. ročaja; temnosiva; drobnazrnata; lega: ob jarku 13; z njive pri odseku 24; leto 2004.
11. Frag. ostenja; ročaj; siva; drobnazrnata; lega: ob jarku 13; z njive pri odseku 24; leto 2004.
12. Frag. ročaja; temnosiva; grobozrnata; lega: ob jarku 13; z njive pri odseku 24; leto 2004.
13. Frag. ustja talilne posode; siva; lega: jarek 13; odsek 24; x = 93,50 m; leto 2004.

<sup>52</sup> Poglavlje 13 v tem zborniku.<sup>53</sup> Poglavlje 13 v tem zborniku.

14. Frag. ustja talilne posode; siva; lega: jarek 13; odsek 24; x = 92,84–93,24 m; y = 1,28–1,38 m; leto 2004.

15. Frag. talilna posoda; siva; lega: jarek 13; odsek 24; x = 92,84–93,50 m; y = 1,28–1,38 m; leto 2004.

*Tabla 3.20*

1. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 25; leto 2004.
2. Frag. ostenja; frag. držaja; siva; grobozrnata; lega: jarek 13; odsek 25; leto 2004.
3. Frag. ostenja; plastična nalepka; temnosiva; grobozrnata; lega: jarek 13; odsek 25; leto 2004.
4. Frag. ustja; temnosiva; grobozrnata; lega: jarek 13; odsek 27; leto 2004.
5. Frag. ustja z ostenjem; bradavica; temnosiva; grobozrnata; lega: jarek 13; odsek 29; leto 2004.
6. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
7. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
8. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
9. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.

*Tabla 3.21*

1. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; x = 116–118 m; vzhodna stena jarka; leto 2004.
2. Frag. ustja z ostenjem; siva; grobozrnata; lega: jarek 13; odsek 30; x = 116–118 m; vzhodna stena jarka; leto 2004.
3. Frag. ustja z ostenjem; siva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
4. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
5. Frag. ustja z ostenjem; siva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
6. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
7. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
8. Frag. ustja; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
9. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
10. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; x = 116–118 m; vzhodna stena jarka; leto 2004.

*Tabla 3.22*

1. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
2. Frag. ustja z ostenjem; vrezi; siva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
3. Frag. ustja z ostenjem; siva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
4. Frag. ustja z ostenjem; siva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
5. Frag. ustja z ostenjem; siva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
6. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
7. Frag. ustja z ostenjem; držaj; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
8. Frag. ustja z ostenjem; frag. držaja; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.

9. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.

*Tabla 3.23*

1. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
2. Frag. ustja z ostenjem; siva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
3. Frag. ustja z ostenjem; rjava; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
4. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
5. Frag. ustja; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
6. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
7. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
8. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
9. Frag. ustja; siva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
10. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
11. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
12. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; x = 116–118 m; vzhodna stena jarka; leto 2004.
13. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.

*Tabla 3.24*

1. Frag. ustja z ostenjem; siva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
2. Frag. ustja z ostenjem; frag. bradavice; odtisi; siva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
3. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
4. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
5. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
6. Frag. ostenja; odtisi; siva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
7. Frag. ostenja; rebro; vrez; odtisi; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
8. Frag. ostenja; vrezi; siva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
9. Frag. ostenja; razčlenjen držaj; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
10. Frag. ostenja; farg. razčlenjenega držaja; siva; grobozrnata; lega: jarek 13; odsek 30; x = 116–118 m; vzhodna stena jarka; leto 2004.
11. Frag. ostenja; razčlenjen držaj; siva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
12. Frag. ostenja; frag. razčlenjenega držaja; temnosiva; grobozrnata; lega: jarek 13; odsek 30; x = 116–118 m; vzhodna stena jarka; leto 2004.
13. Frag. ostenja; frag. razčlenjenega držaja; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
14. Frag. ostenja; rebro; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
15. Frag. ostenja; rebro; siva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
16. Frag. ostenja; rebro; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.



17. Frag. ostenja; rebri; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.

*Tabla 3.25*

1. Frag. dna z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
2. Frag. dna z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
3. Frag. dna; siva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
4. Frag. dna z ostenjem; temnorjava; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
5. Frag. dna z ostenjem; odtisi; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
6. Frag. dna z ostenjem; siva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
7. Frag. dna z ostenjem; siva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
8. Frag. dna; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
9. Frag. dna z ostenjem; siva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
10. Frag. dna z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
11. Frag. dna z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
12. Frag. dna z ostenjem; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
13. Frag. dna z ostenjem; temnorjava; grobozrnata; lega: jarek 13; odsek 30; leto 2004.

*Tabla 3.26*

1. Frag. vretenca; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
2. Frag. zajemalke; temnosiva; grobozrnata; lega: jarek 13; odsek 30; leto 2004.
3. Kamnita plošča/tolkač; kamnina ni determinirana; siva; lega: jarek 13; odsek 30; leto 2004.
4. Frag. ostenja; frag. razčlenjenega držaja/rebra; grobozrnata; lega: jarek 13; odsek 34; leto 2004.
5. Frag. ustja z ostenjem; frag. razčlenjenega držaja/rebra; temnorjava; grobozrnata; lega: sonda 2; kv. 3; reženj 6; leto 2006.
6. Frag. ustja z ostenjem; temnosiva; drobozrnata; lega: sonda 2; kv. 3; reženj 6; opomba: frag. iste posode najdeni tudi v kv. 5; reženj 6; leto 2006.
7. Frag. ustja z ostenjem; siva; drobozrnata; lega: sonda 2; kv. 13; reženj 6; leto 2006.
8. Frag. vretenca; temnosiva; grobozrnata; teža: 18 g (približno petina vretenca); lega: sonda 2; kv. 3; reženj 6; leto 2006.
9. Frag. ustja z ostenjem; frag. nastavek za držaj; temnosiva; drobozrnata; lega: sonda 2; kv. 4; reženj 5; leto 2006.
10. Frag. ustja z ostenjem; držaj; temnosiva; drobozrnata; lega: sonda 2; kv. 4; reženj 5; leto 2006.
11. Frag. ustja z ostenjem; držaj; temnosiva; grobozrnata; lega: sonda 2; kv. 6; reženj 5; leto 2006.
12. Frag. ustja z ostenjem; držaj; posoda je imela 4 držaje; temnosiva; grobozrnata; lega: sonda 2; kv. 4; reženj 5; opomba: frag. iste posode najdeni tudi v kv. 5; reženj 6; leto 2006.

*Tabla 3.27*

1. Frag. ustja z ostenjem; razčlenjen držaj; temnosiva; lega: sonda 2; kv. 1;  $x_2 = 0,35$  m;  $y_2 = 0,75$  m; reženj 5;  $z = 288,8$  m; leto 2006.

2. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 2; kv. 2; reženj 5; leto 2006.
3. Frag. ustja z ostenjem; temnorjava; grobozrnata; lega: sonda 2; kv. 8; reženj 5; leto 2006.
4. Frag. ustja z ostenjem; frag. razčlenjenega rebra/držaja; odtisi; temnosiva; grobozrnata; lega: sonda 2; kv. 14; reženj 5; leto 2006.
5. Frag. ustja z ostenjem; frag. razčlenjenega rebra/držaja; temnosiva; grobozrnata; lega: sonda 2; kv. 4; reženj 5; leto 2006.
6. Frag. ustja z ostenjem; frag. razčlenjenega držaja; temnorjava; grobozrnata; lega: sonda 2; kv. 2; reženj 5; leto 2006.
7. Frag. ustja z ostenjem; temnosiva; drobozrnata; lega: sonda 2; kv. 1; reženj 5; leto 2006.
8. Frag. ostenja; vrezi; temnosiva; drobozrnata; lega: sonda 2; kv. 1; reženj 5; leto 2006.
9. Frag. ustja z ostenjem; frag. razčlenjenega držaja; temnosiva; grobozrnata; lega: sonda 2; kv. 3; reženj 5; leto 2006.

*Tabla 3.28*

1. Skoraj cela votla utež; temnorjava; grobozrnata; teža: 1410 g (ohranjeni del izpraznjene uteži); lega: sonda 2; kv. 13;  $x_2 = 4,34$  m;  $y_2 = 0,5$  m; reženj 5;  $z = 288,90$  (najvišja točka); 288,74 (najnižja točka); leto 2006.
2. Frag. ustja z ostenjem; temnosiva; drobozrnata; lega: sonda 2; kv. 3; reženj 4, spodaj (v sivkastorumeni glini); leto 2006.
3. Frag. ostenja; frag. razčlenjenega držaja; temnosiva; grobozrnata; lega: sonda 2; kv. 3; reženj 4, spodaj (v sivkastorumeni glini); leto 2006.
4. Frag. zajemalke; siva; drobozrnata; lega: sonda 2; kv. 2; reženj 4, spodaj (v sivkastorumeni glini); leto 2006.
5. Frag. ustja z ostenjem; frag. razčlenjenega držaja; temnosiva; grobozrnata; lega: sonda 2; čiščenje zahodnega profila; leto 2006.
6. Frag. ostenja; vrezi; bela inkrustacija; temnosiva; drobozrnata; lega: sonda 2; čiščenje zahodnega profila; leto 2006.
7. Frag. ustja z ostenjem; frag. razčlenjenega držaja; temnosiva; grobozrnata; lega: sonda 2; čiščenje zahodnega profila; leto 2006.

*Tabla 3.29*

1. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 3; kv. 4; reženj 8; leto 2007.
2. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 3; kv. 9; reženj 8; leto 2007.
3. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 3; kv. 4; reženj 8; leto 2007.
4. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 3; kv. 1; reženj 8; leto 2007.
5. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 3; kv. 1; reženj 8; leto 2007.
6. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 3; kv. 1; reženj 8; leto 2007.
7. Frag. ostenja; frag. razčlenjenega držaja; temnosiva; grobozrnata; lega: sonda 3; kv. 1; reženj 8; leto 2007.
8. Podolgovat predmet na uho/brus; nečisti apnenec s kremenom;<sup>54</sup> siva; lega: sonda 3; kv. 1; reženj 8; leto 2007.
9. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 3; kv. 1; reženj 7; leto 2007.
10. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 3; kv. 9; reženj 7; leto 2007.
11. Frag. ostenja; frag. razčlenjenega držaja; rjava; grobozrnata; lega: sonda 3; kv. 11; reženj 7; leto 2007.

<sup>54</sup> Poglavje 12 v tem zborniku.

Tabla 3.30

1. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 3; kv. 1; reženj 7; leto 2007.
2. Frag. ustja z ostenjem; frag. razčlenjenega držaja; temnosiva; grobozrnata; lega: sonda 3; kv. 10; reženj 7, na dnu; leto 2007.
3. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 3; kv. 5; reženj 7; leto 2007.
4. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 3; kv. 8; reženj 7; leto 2007.
5. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 3; kv. 9; reženj 7; leto 2007.
6. Frag. posode; siva; grobozrnata; lega: sonda 3; kv. 4; reženj 7; leto 2007.
7. Frag. ustja z ostenjem; temnosiva; drobnozrnata; lega: sonda 3; kv. 6; reženj 7; leto 2007.
8. Frag. ostenja; frag. razčlenjenega držaja; temnosiva; grobozrnata; lega: sonda 3; kv. 15; reženj 7, na dnu; leto 2007.

Tabla 3.31

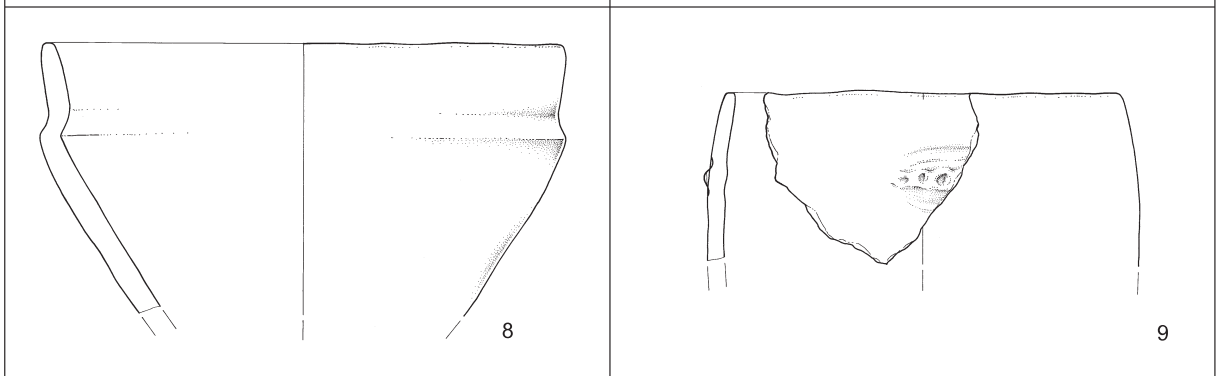
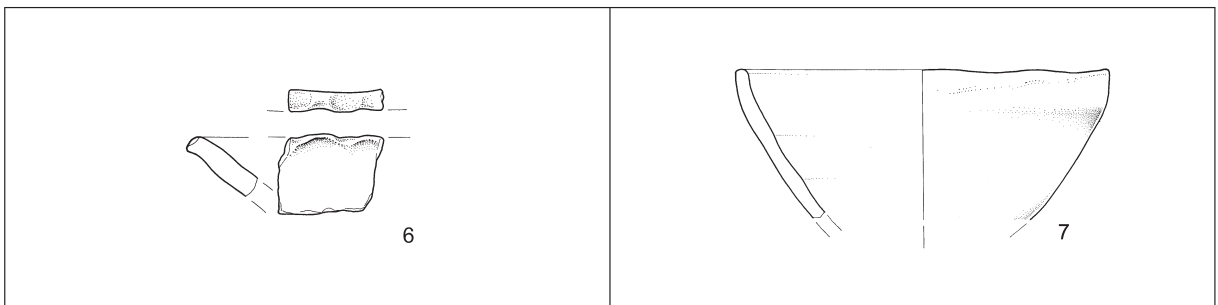
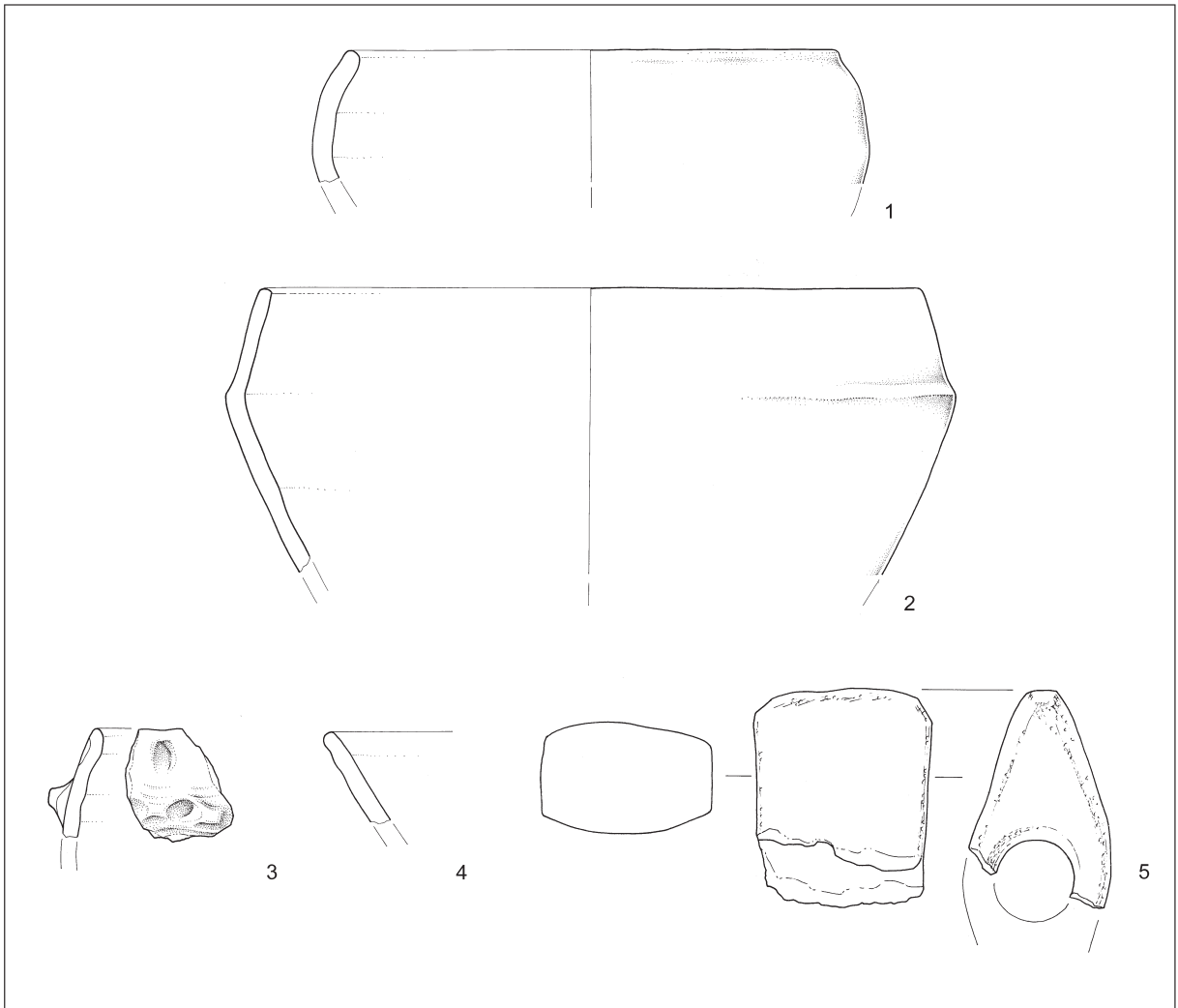
1. Frag. ustja z ostenjem; temnosiva; drobnozrnata; lega: sonda 3; kv. 14; reženj 6; opomba: frag. iste posode v kv. 4; reženj 6, na dnu; leto 2007.
2. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 3; kv. 2; reženj 6; leto 2007.
3. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 3; kv. 10; reženj 6, na dnu; leto 2007.
4. Frag. ustja z ostenjem; temnorjava; drobnozrnata; lega: sonda 3; kv. 3; reženj 6; leto 2007.
5. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 3; kv. 3; reženj 6; leto 2007.
6. Frag. ustja z ostenjem; siva; grobozrnata; lega: sonda 3; kv. 6; reženj 6; leto 2007.
7. Frag. ustja z ostenjem; siva; grobozrnata; lega: sonda 3; kv. 2; reženj 6; leto 2007.
8. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 3; kv. 4; reženj 6; leto 2007.
9. Frag. ustja z ostenjem; temnorjava; grobozrnata; lega: sonda 3; kv. 14; reženj 6; leto 2007.

Tabla 3.32

1. Frag. ustja z ostenjem; rebri; temnosiva; grobozrnata; lega: sonda 3; kv. 9; reženj 6; leto 2007.
2. Frag. posode; frag. držaja; temnosiva; grobozrnata; lega: sonda 3; kv. 7; reženj 6, na dnu; leto 2007.
3. Frag. dna z ostenjem; siva; grobozrnata; lega: sonda 3; kv. 12; reženj 6, na dnu; leto 2007.
4. Frag. ustja z ostenjem; frag. razčlenjenega držaja; temnosiva; drobnozrnata; lega: sonda 3; kv. 2; reženj 6; leto 2007.
5. Frag. posode; držaja; posoda je imela 4 držaje; temnorjava; grobozrnata; lega: sonda 3; kv. 3; reženj 6, na dnu; leto 2007.
6. Frag. ustja z ostenjem; frag. držaja; temnosiva; grobozrnata; lega: sonda 3; kv. 8; reženj 6, na dnu; leto 2007.
7. Frag. ustja z ostenjem; frag. razčlenjenega rebra/držaja; vbodi; žlebovi; temnosiva; grobozrnata; lega: sonda 3; kv. 15; reženj 6; opomba: frag. iste posode v kv. 15; reženj 7, na dnu; leto 2007.
8. Frag. ostenja; razčlenjen držaj; temnosiva; grobozrnata; lega: sonda 3; kv. 9; reženj 6; leto 2007.
9. Frag. dna; odtis pletenine; temnorjava; grobozrnata; lega: sonda 3; kv. 2; reženj 6; leto 2007.
10. Frag. dna z ostenjem; temnosiva; grobozrnata; lega: sonda 3; kv. 8; reženj 6, na dnu; leto 2007.

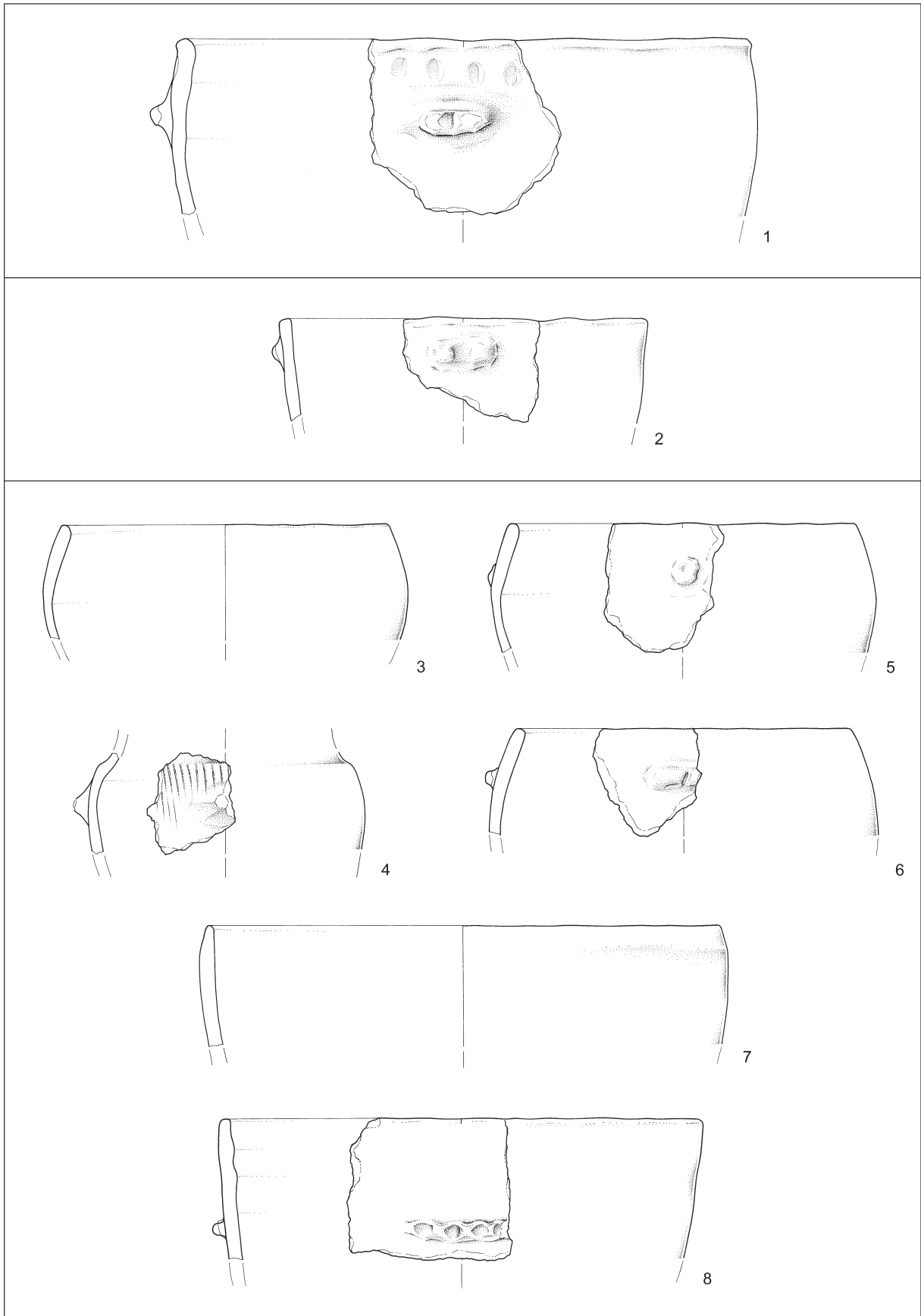
Tabla 3.33

1. Frag. ustja z ostenjem; frag. razčlenjenega držaja/rebra; temnosiva; drobnozrnata; lega: sonda 3; kv. 15; reženj 5; leto 2007.
2. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 3; kv. 8; reženj 5, na dnu; leto 2007.
3. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 3; kv. 9; reženj 5, na dnu; leto 2007.
4. Frag. ustja z ostenjem; frag. razčlenjenega držaja; temnorjava; grobozrnata; lega: sonda 3; kv. 15; čiščenje vzhodnega profila; leto 2007.



T. 3.1: Stare gmajne. 1-4,6-9, keramika. 5, kamen. Risbe: T. Korošec. Keramika: m = 1 : 3; kamen: m = 1 : 2.

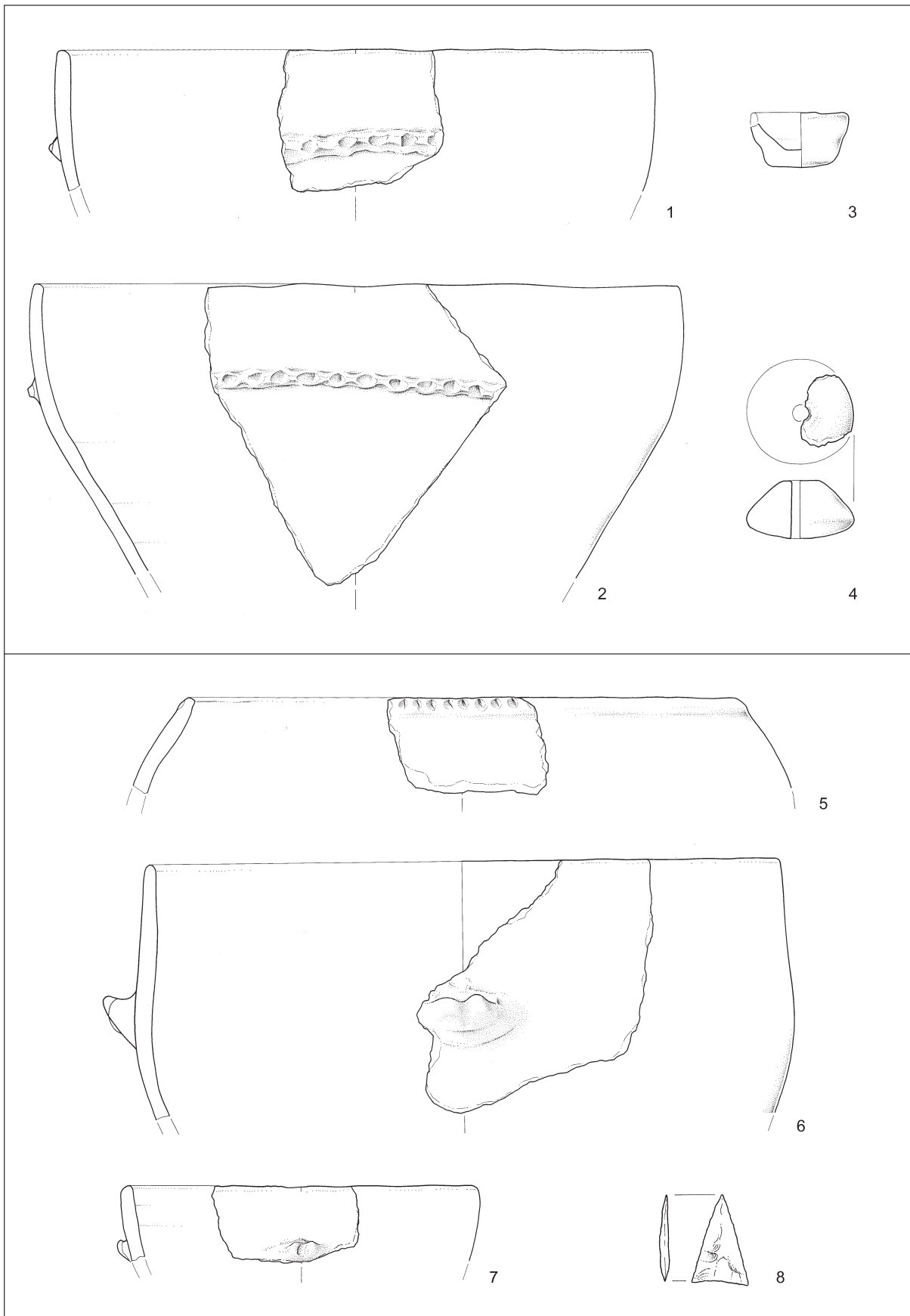
Pl. 3.1: Stare gmajne. 1-4,6-9, pottery. 5, stone. Drawn by: T. Korošec. Pottery: scale = 1 : 3; stone: scale = 1 : 2.



T. 3.2: Stare gmajne. Keramika. Risbe: T. Korošec. M = 1 : 3.

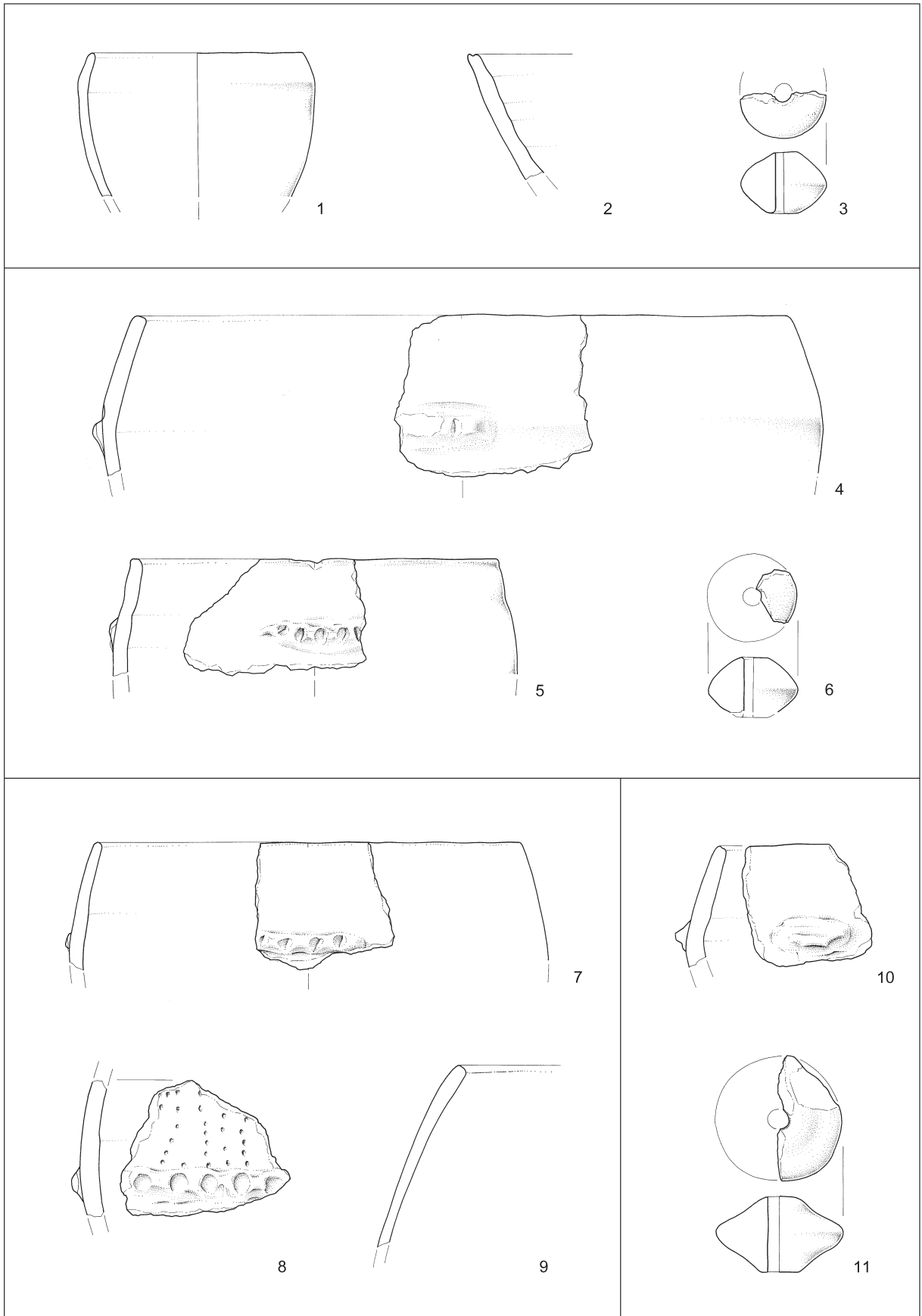
Pl. 3.2: Stare gmajne. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.





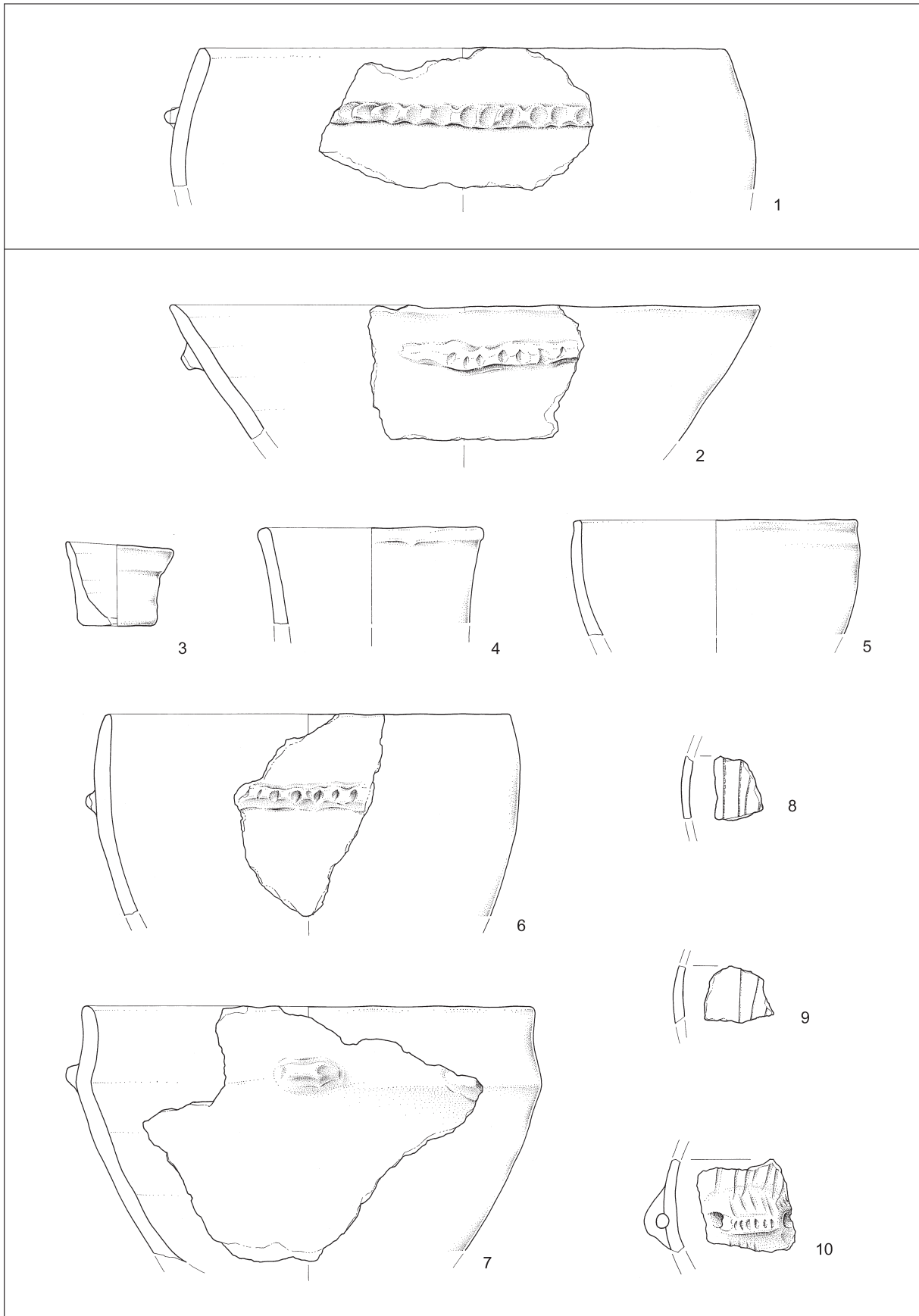
T. 3.3: Stare gmajne. 1-7, keramika. 8, kamen. Risbe: T. Korošec. Keramika: m = 1 : 3; kamen: m = 1 : 2.

Pl. 3.3: Stare gmajne. 1-7, pottery. 8, stone. Drawn by: T. Korošec. Pottery: scale = 1 : 3; stone: scale = 1 : 2.



T. 3.4: Stare gmajne. Keramika. Risbe: T. Korošec. M = 1 : 3.

Pl. 3.4: Stare gmajne. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.



T. 3.5: Stare gmajne. Keramika. Risbe: T. Korošec. M = 1 : 3.

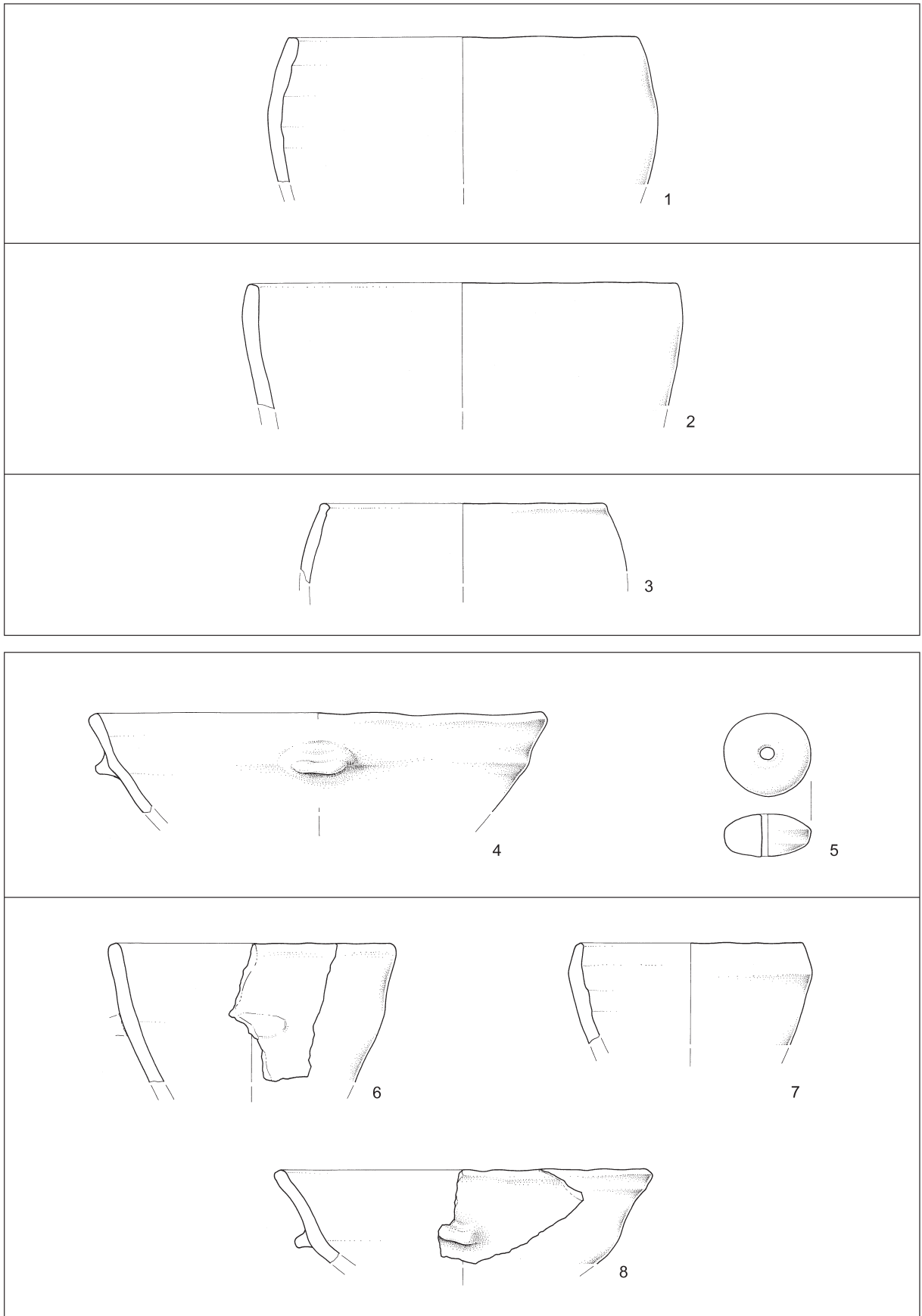
Pl. 3.5: Stare gmajne. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.



T. 3.6: Stare gmajne. 1-6, keramika. 7, kamen. Risbe: T. Korošec. Keramika: m = 1 : 3; kamen: m = 1 : 2.

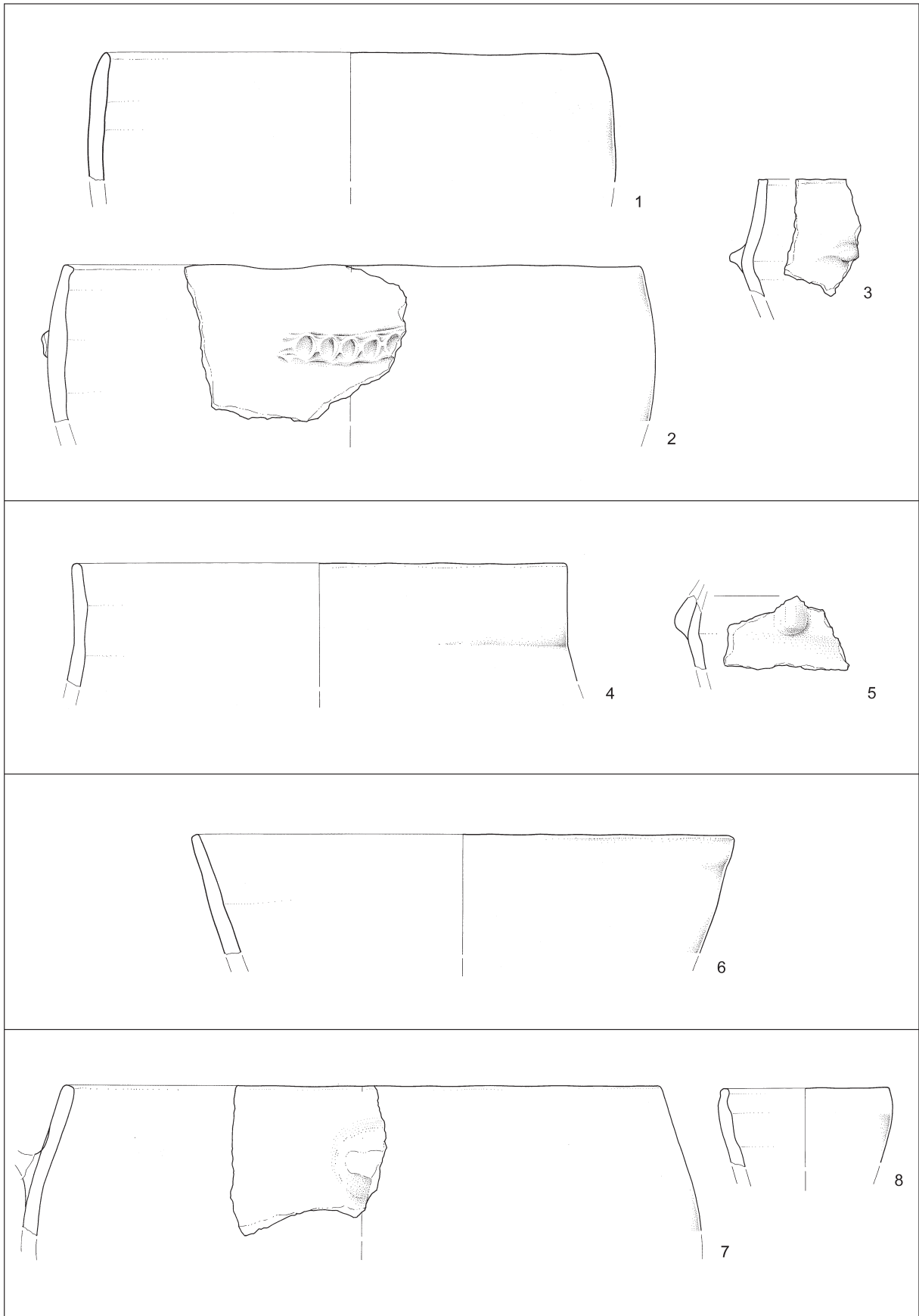
Pl. 3.6: Stare gmajne. 1-6, pottery. 7, stone. Drawn by: T. Korošec. Pottery: scale = 1 : 3; stone: scale = 1 : 2.





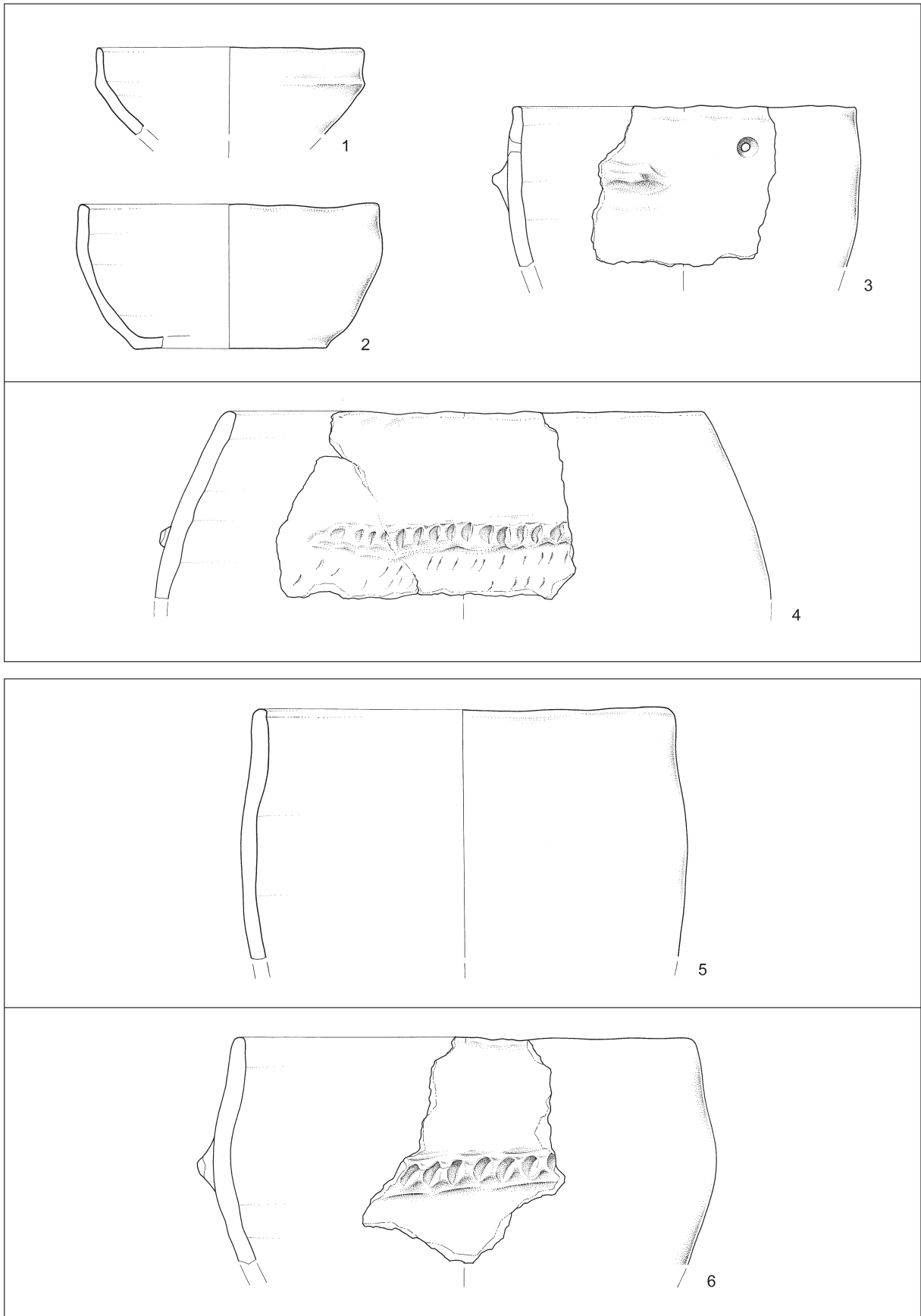
T. 3.7: Stare gmajne. Keramika. Risbe: T. Korošec. M = 1 : 3.

Pl. 3.7: Stare gmajne. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.



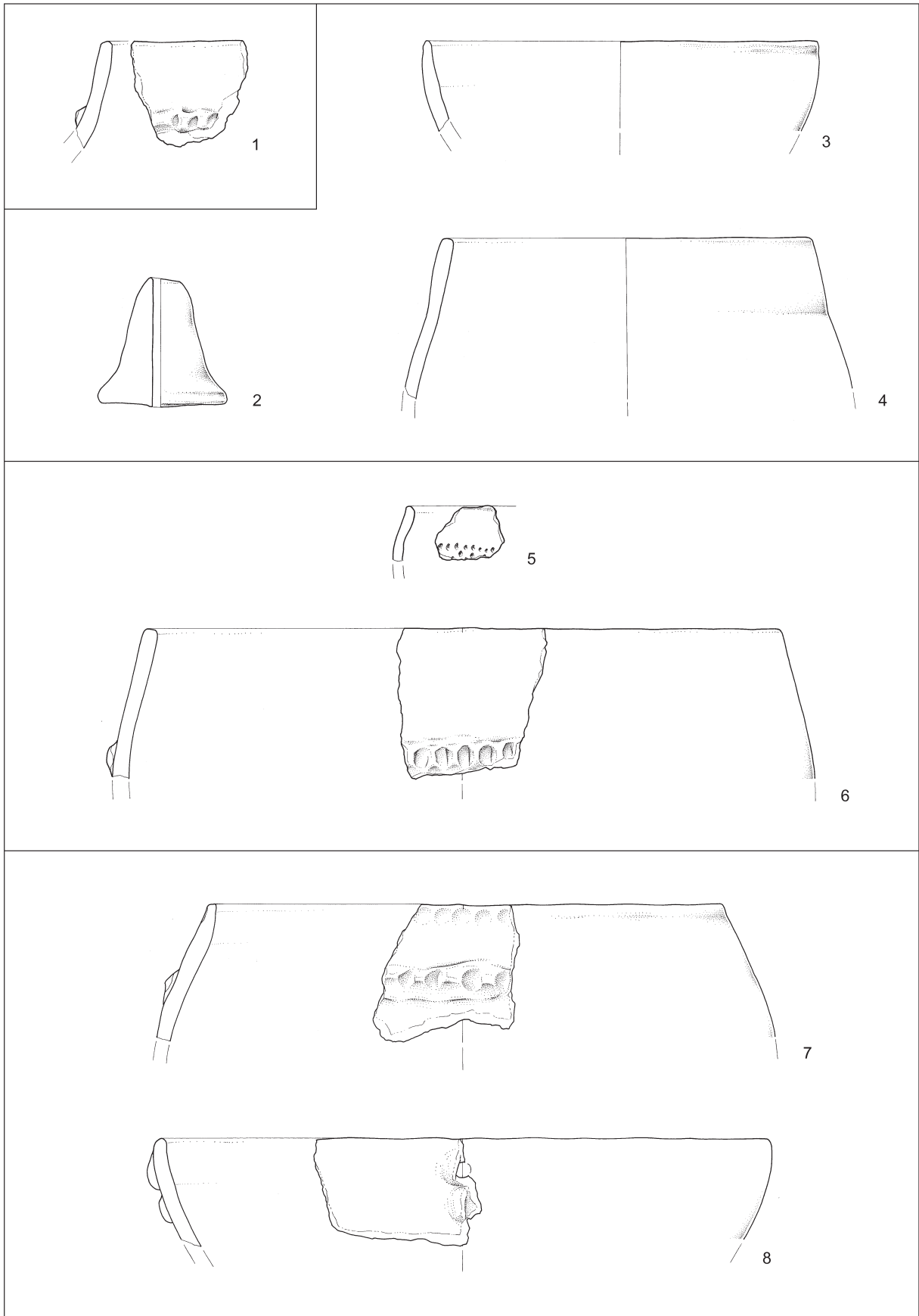
T. 3.8: Stare gmajne. Keramika. Risbe: T. Korošec. M = 1 : 3.

Pl. 3.8: Stare gmajne. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.



*T. 3.9:* Stare gmajne. Keramika. Risbe: T. Korošec. M = 1 : 3.

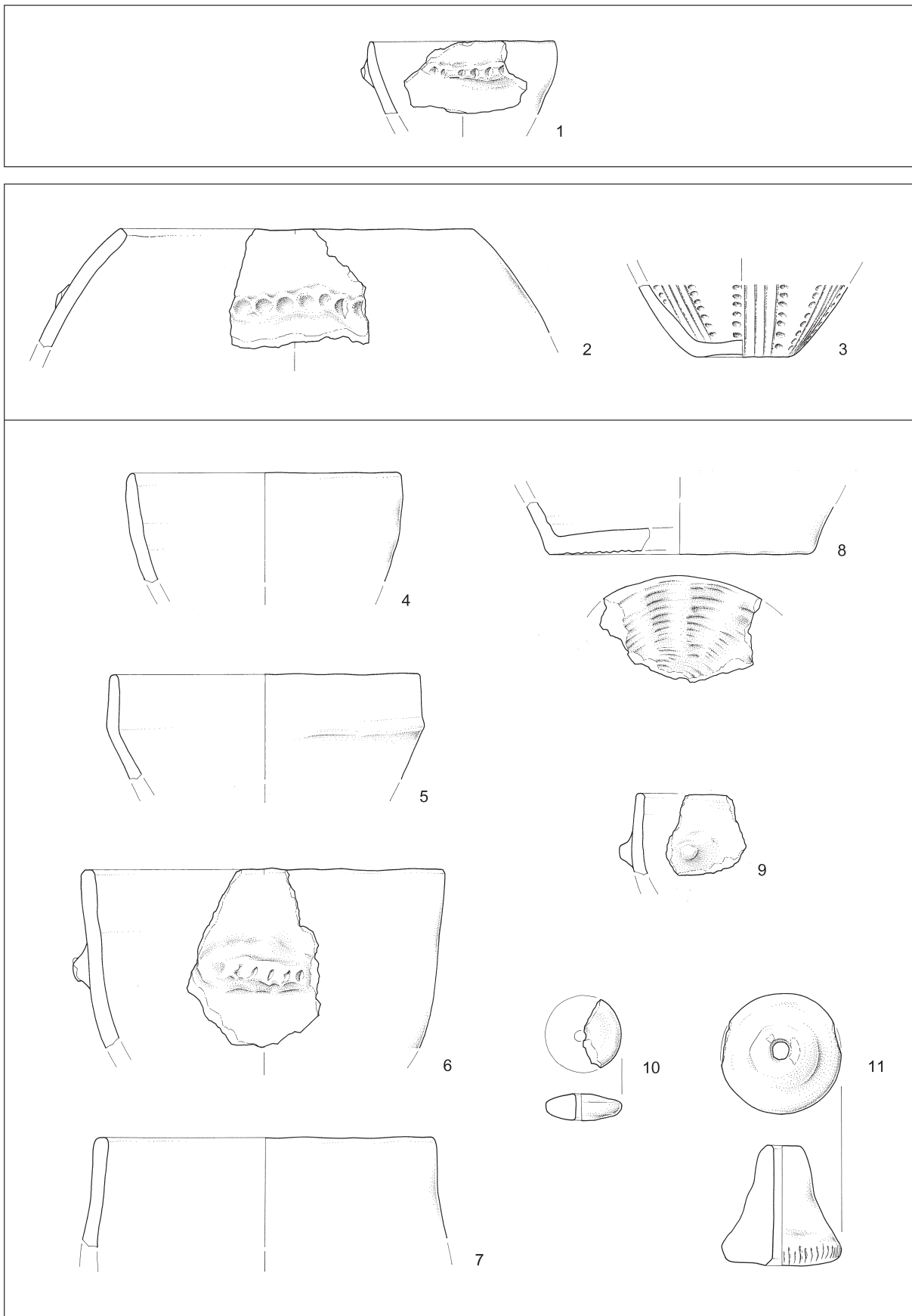
*Pl. 3.9:* Stare gmajne. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.



*T. 3.10:* Stare gmajne. Keramika. Risbe: T. Korošec. M = 1 : 3.

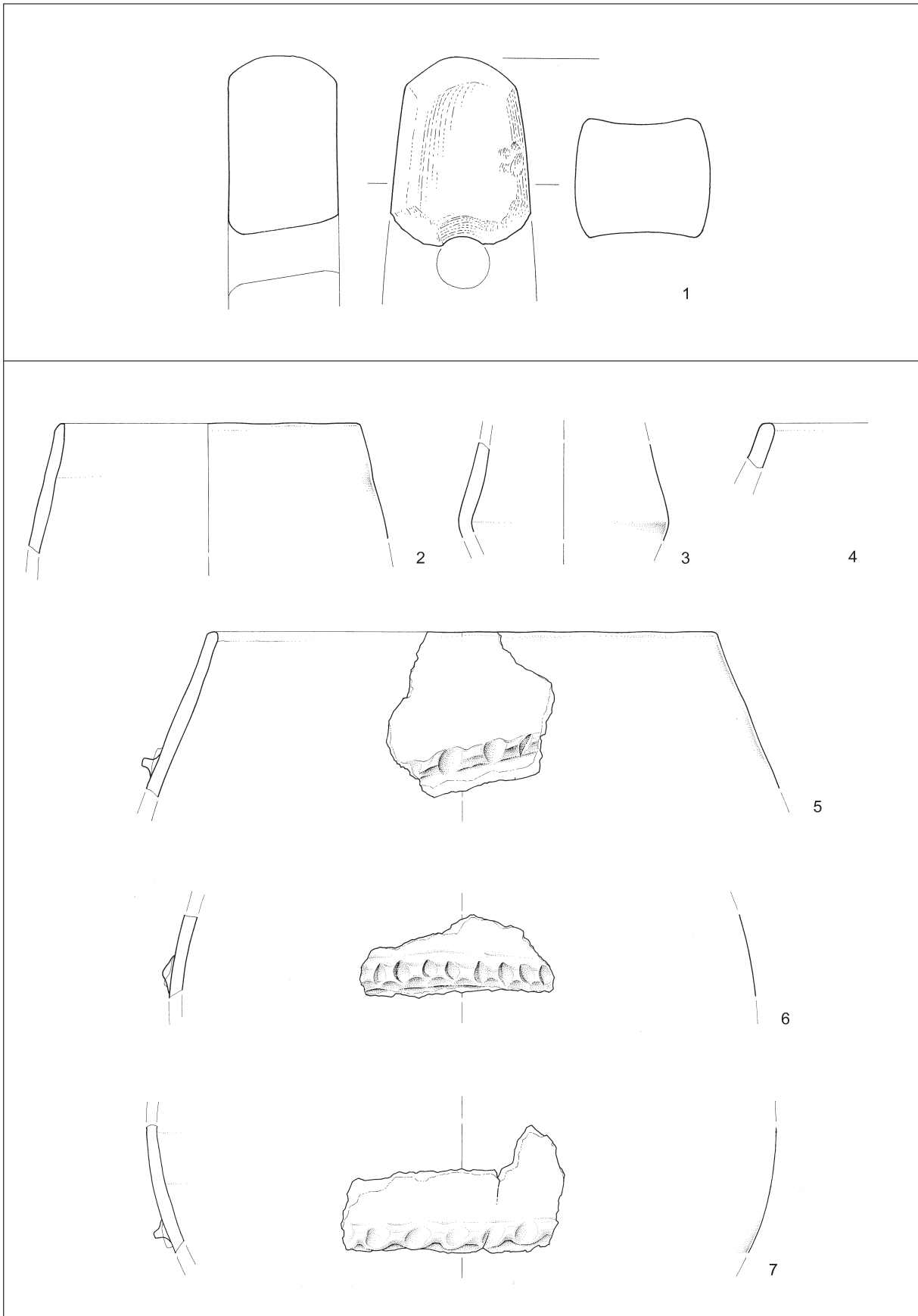
*Pl. 3.10:* Stare gmajne. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.





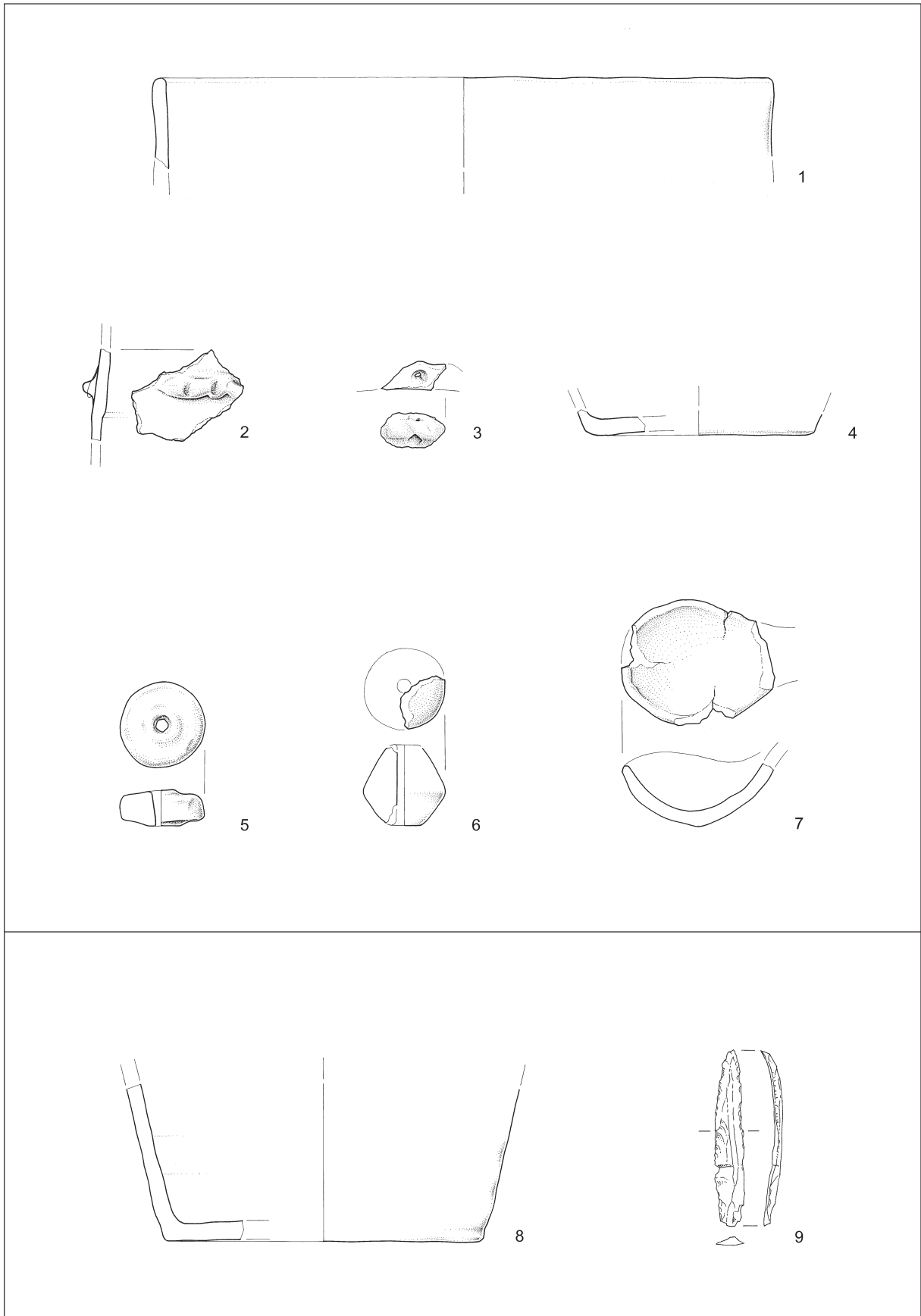
*T. 3.II:* Stare gmajne. Keramika. Risbe: T. Korošec. M = 1 : 3.

*Pl. 3.II:* Stare gmajne. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.



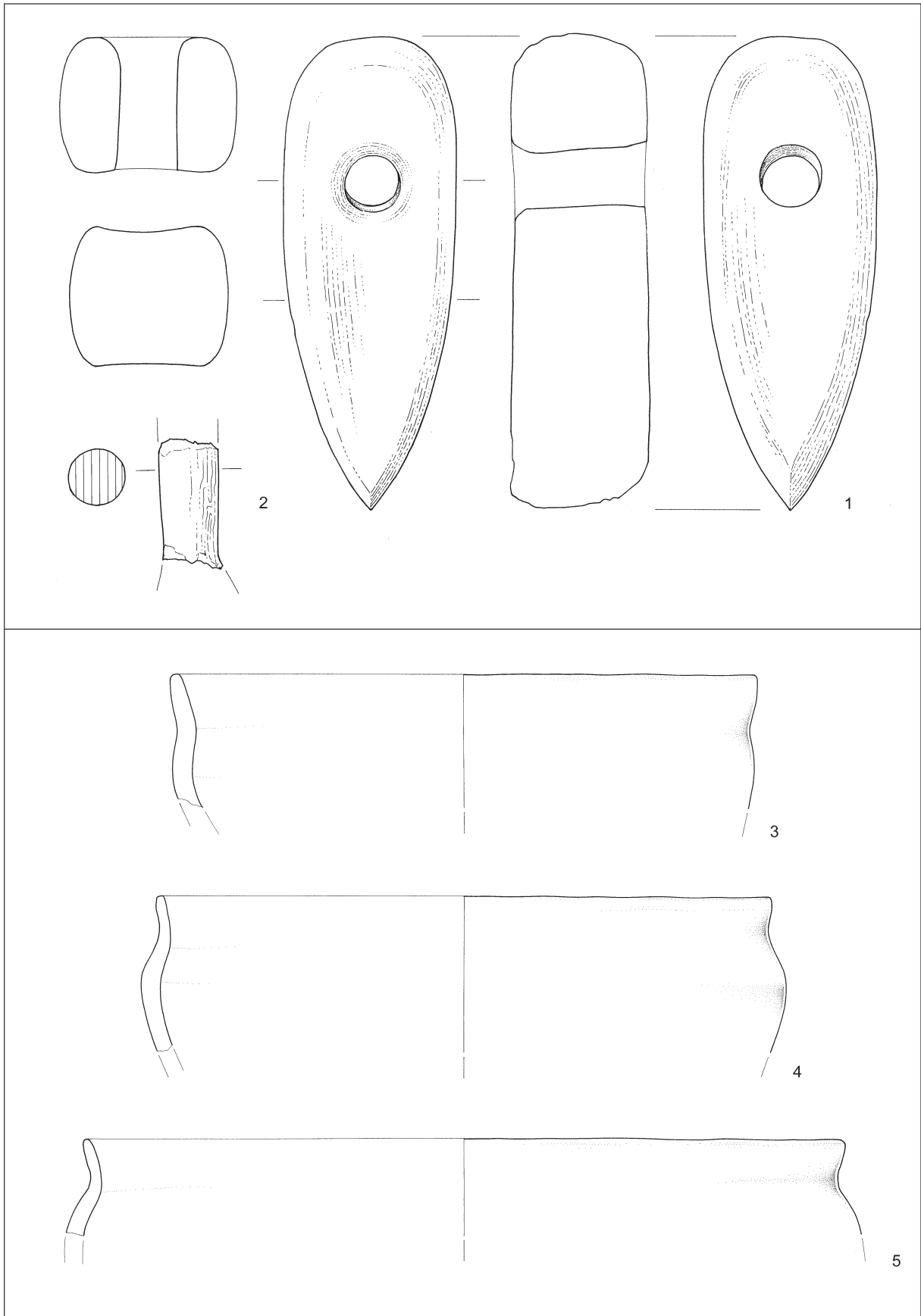
*T. 3.12:* Stare gmajne. 2-7, keramika. 1, kamen. Risbe: T. Korošec. Keramika: m = 1 : 3; kamen: m = 1 : 2.

*Pl. 3.12:* Stare gmajne. 2-7, pottery. 1, stone. Drawn by: T. Korošec. Pottery: scale = 1 : 3; stone: scale = 1 : 2.



*T. 3.13:* Stare gmajne. 1–8, keramika. 9, kamen. Risbe: T. Korošec. Keramika: m = 1 : 3; kamen: m = 1 : 2.

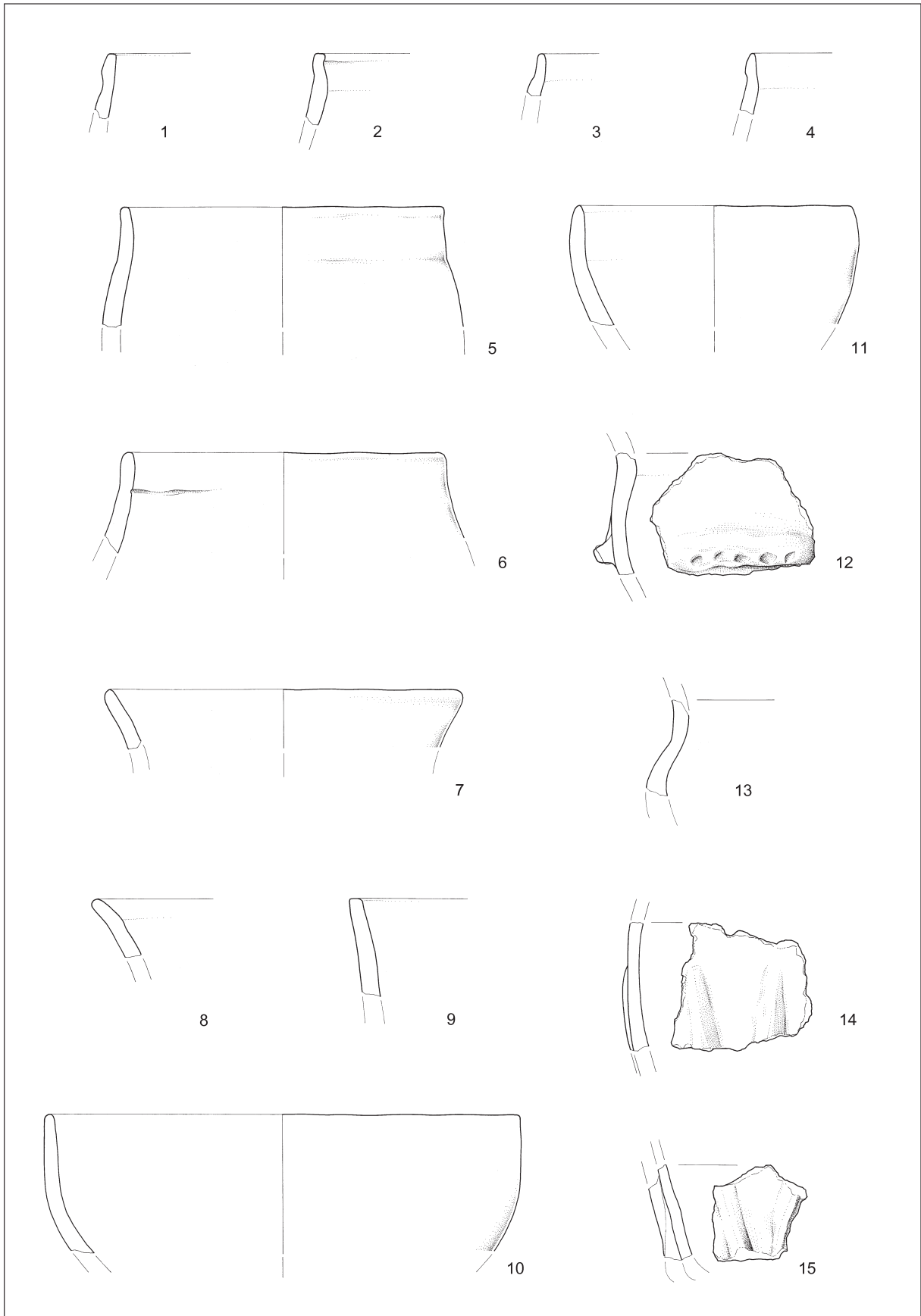
*Pl. 3.13:* Stare gmajne. 1–8, pottery. 9, stone. Drawn by: T. Korošec. Pottery: scale = 1 : 3; stone: scale = 1 : 2.



*T. 3.14:* Stare gmajne. 3-5, keramika. 1, kamen. 2, les. Risbe: T. Korošec. Keramika: m = 1 : 3; kamen in les: m = 1 : 2.

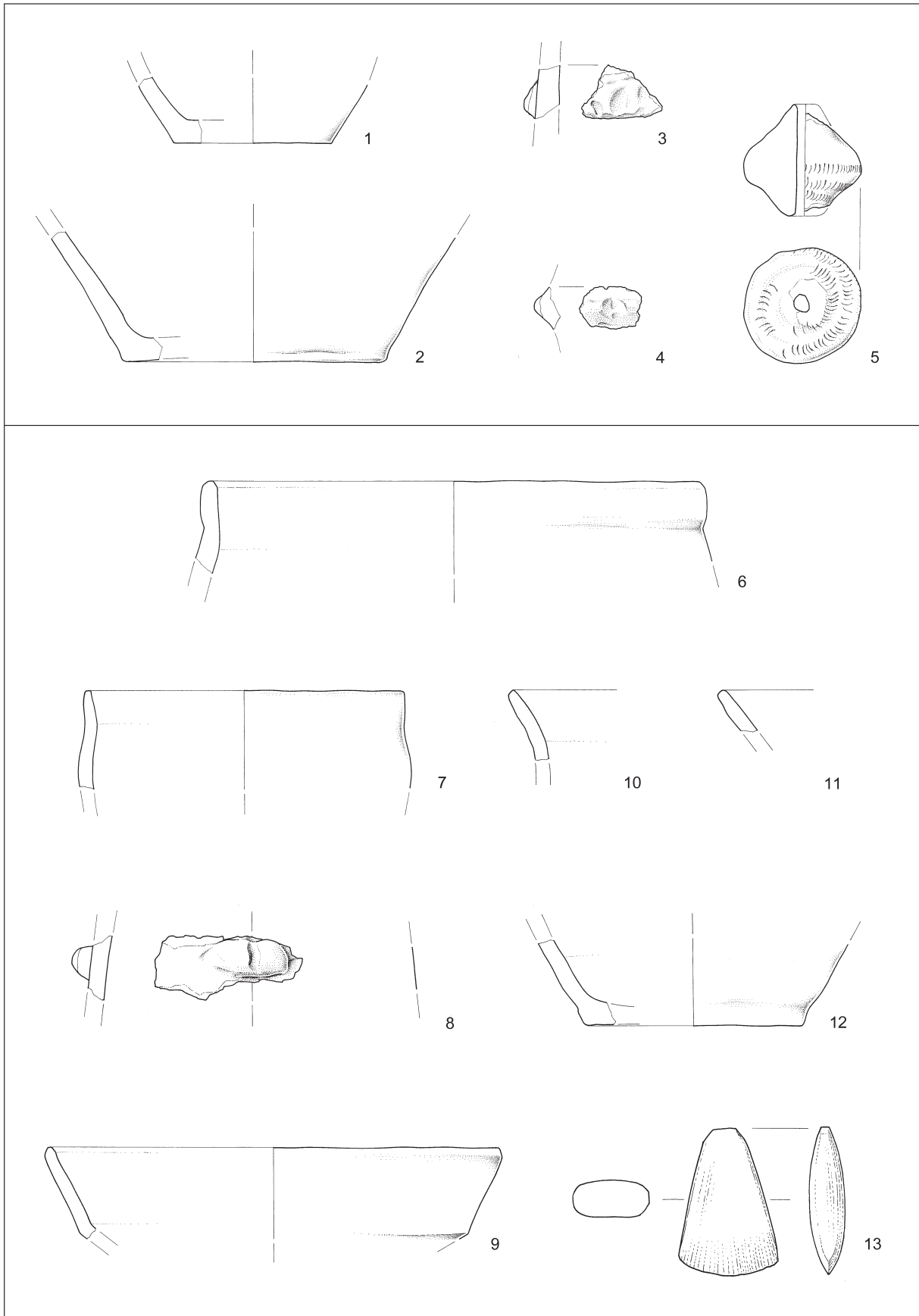
*Pl. 3.14:* Stare gmajne. 3-5, pottery. 1, stone. 2, wood. Drawn by: T. Korošec. Pottery: scale = 1 : 3; stone and wood: scale = 1 : 2.





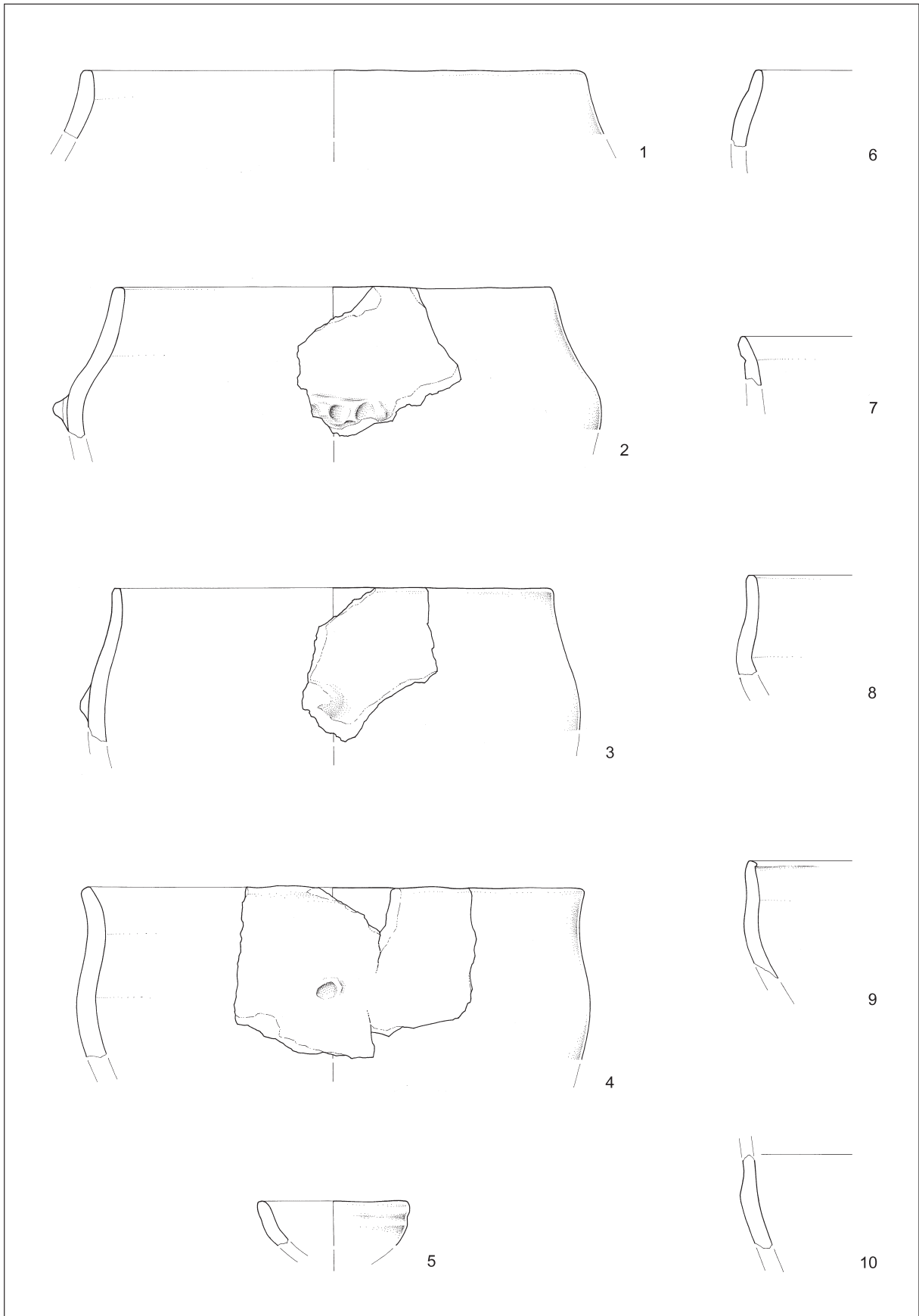
T. 3.15: Stare gmajne. Keramika. Risbe: T. Korošec. M = 1 : 3.

Pl. 3.15: Stare gmajne. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.



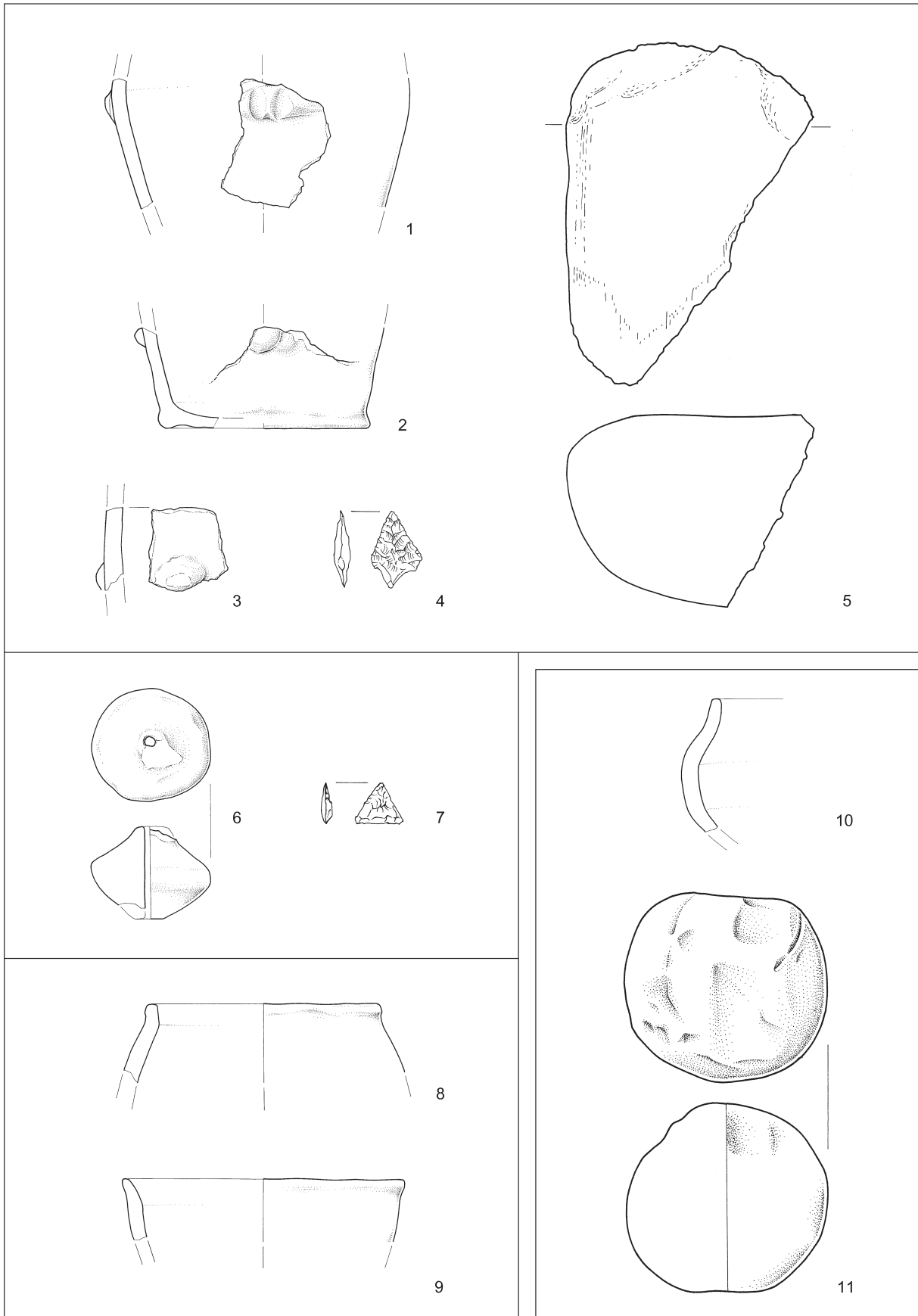
T. 3.16: Stare gmajne. 1-12, keramika. 13, kamen. Risbe: T. Korošec. Keramika: m = 1 : 3; kamen: m = 1 : 2.

Pl. 3.16: Stare gmajne. 1-12, pottery. 13, stone. Drawn by: T. Korošec. Pottery: scale = 1 : 3; stone: scale = 1 : 2.



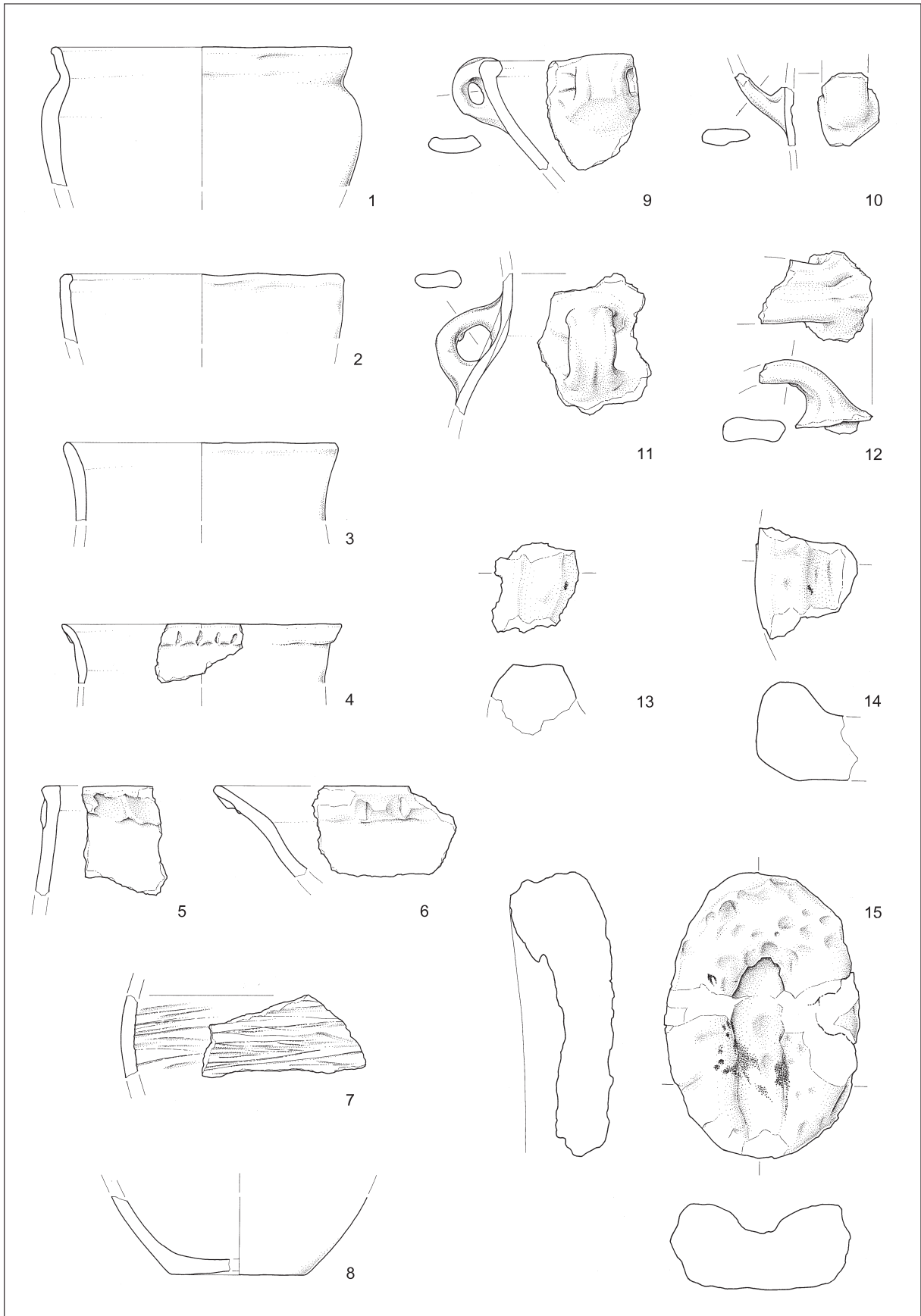
T. 3.17: Stare gmajne. Keramika. Risbe: T. Korošec. M = 1 : 3.

Pl. 3.17: Stare gmajne. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.



T. 3.18: Stare gmajne. 1-3,6,8-10, keramika. 4,5,7,11, kamen. Risbe: T. Korošec. Keramika: m = 1 : 3; kamen: m = 1 : 2.

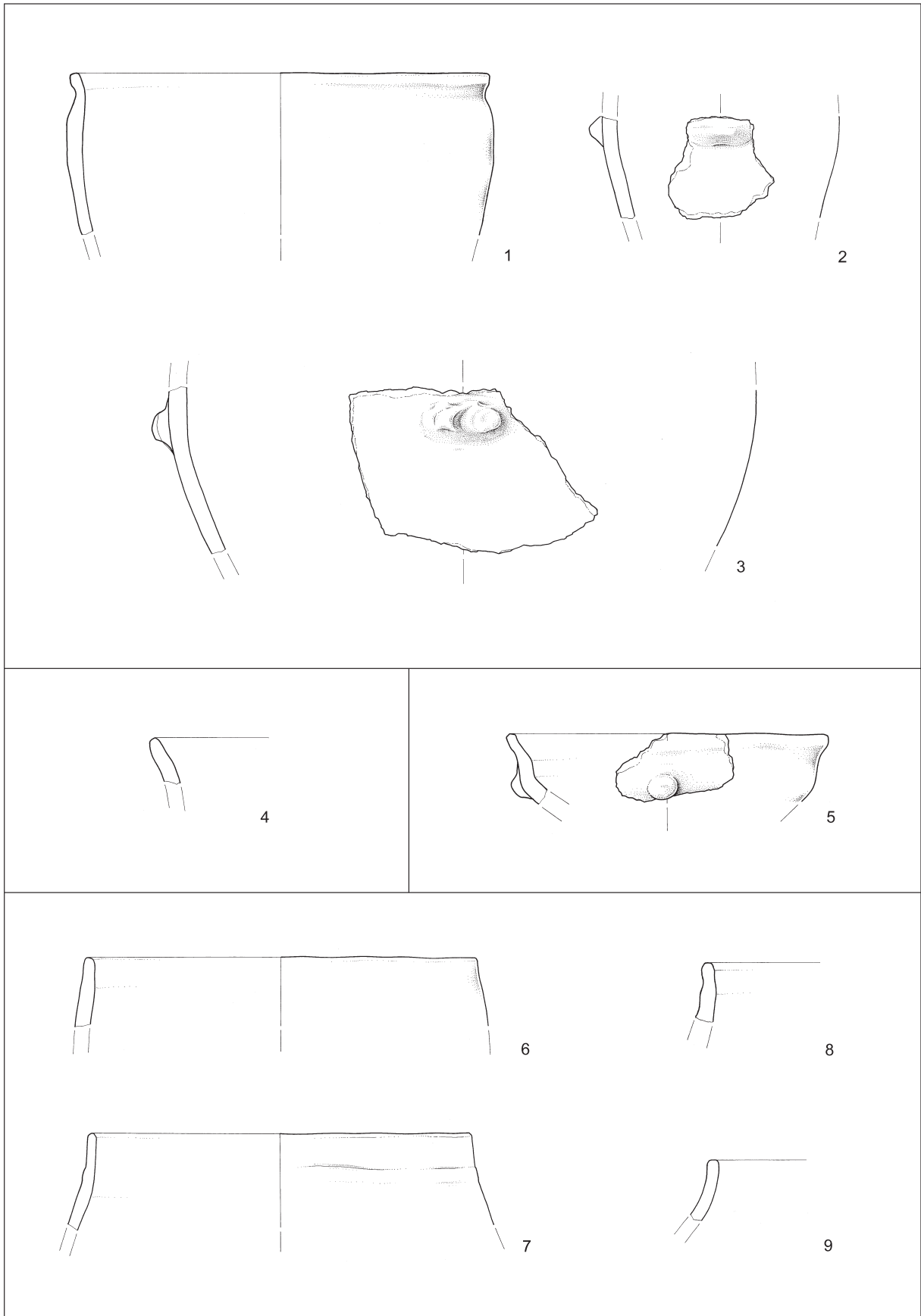
Pl. 3.18: Stare gmajne. 1-3,6,8-10, pottery. 4,5,7,11, stone. Drawn by: T. Korošec. Pottery: scale = 1 : 3; stone: scale = 1 : 2.



*T. 3.19:* Stare gmajne. 1-12, keramika. 13-15, glina. Risbe: T. Korošec. M = 1 : 3.

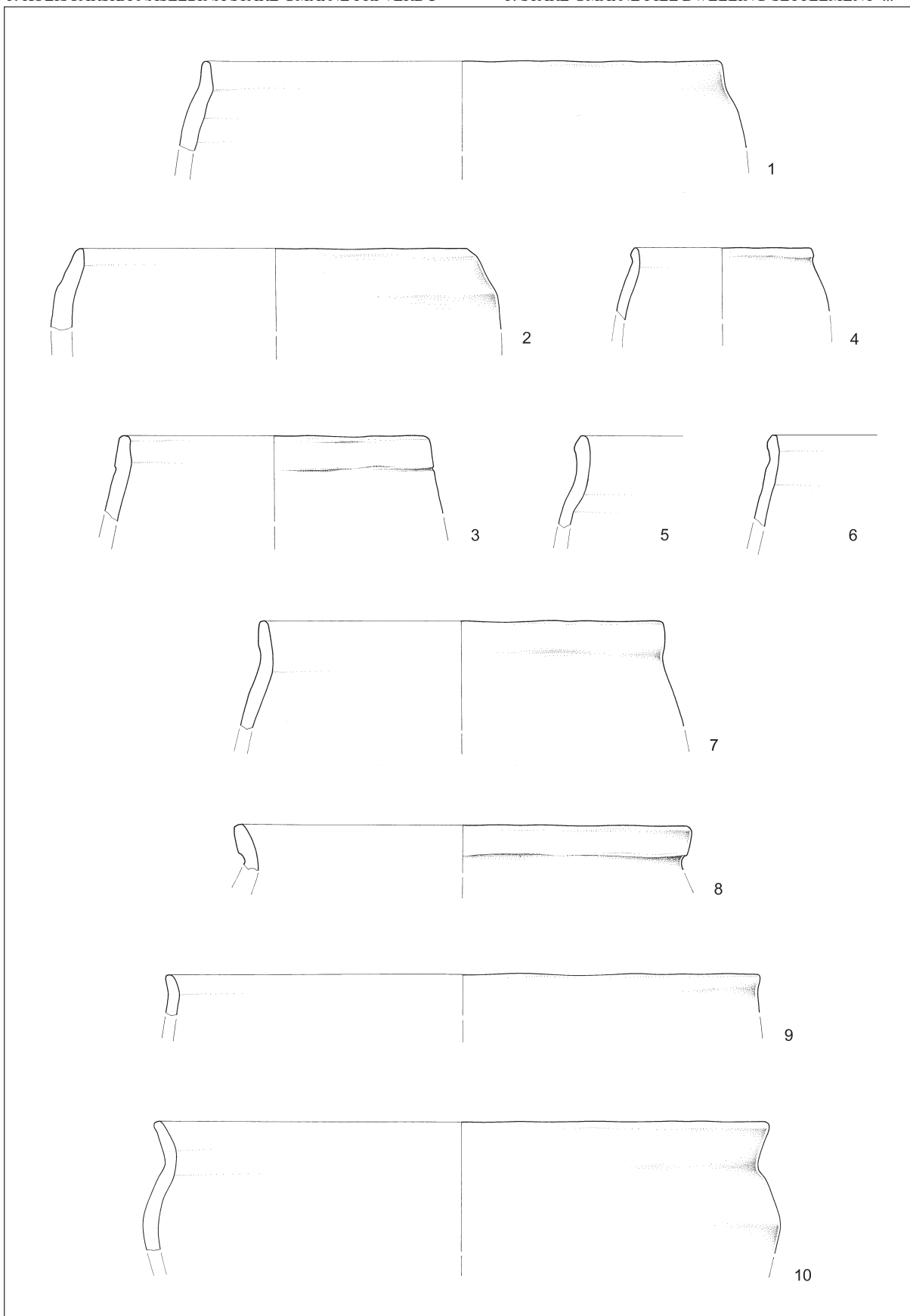
*Pl. 3.19:* Stare gmajne. 1-12, pottery. 13-15, clay. Drawn by: T. Korošec. Pottery: scale = 1 : 3; clay: scale = 1 : 2.





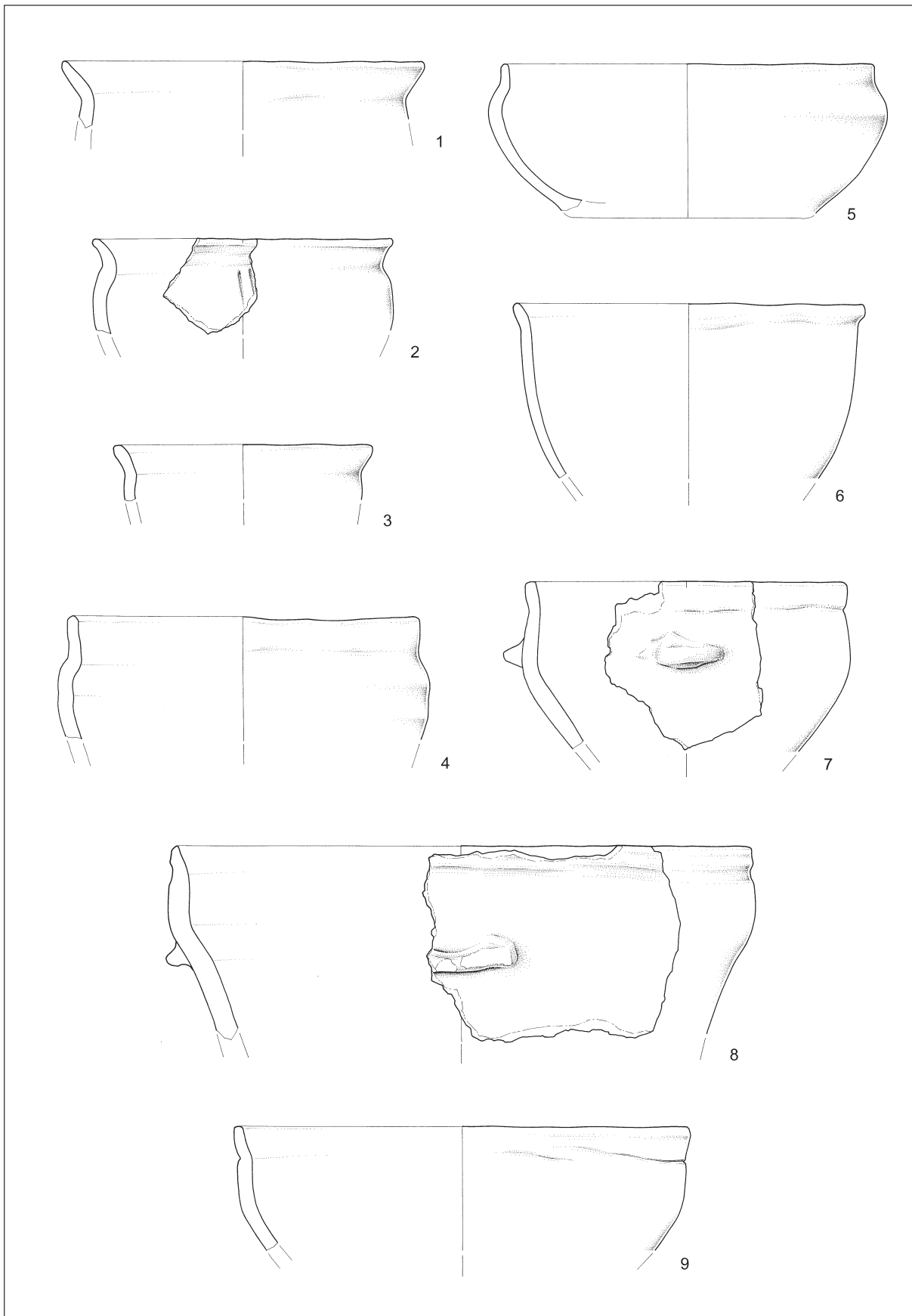
T. 3.20: Stare gmajne. Keramika. Risbe: T. Korošec. M = 1 : 3.

Pl. 3.20: Stare gmajne. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.



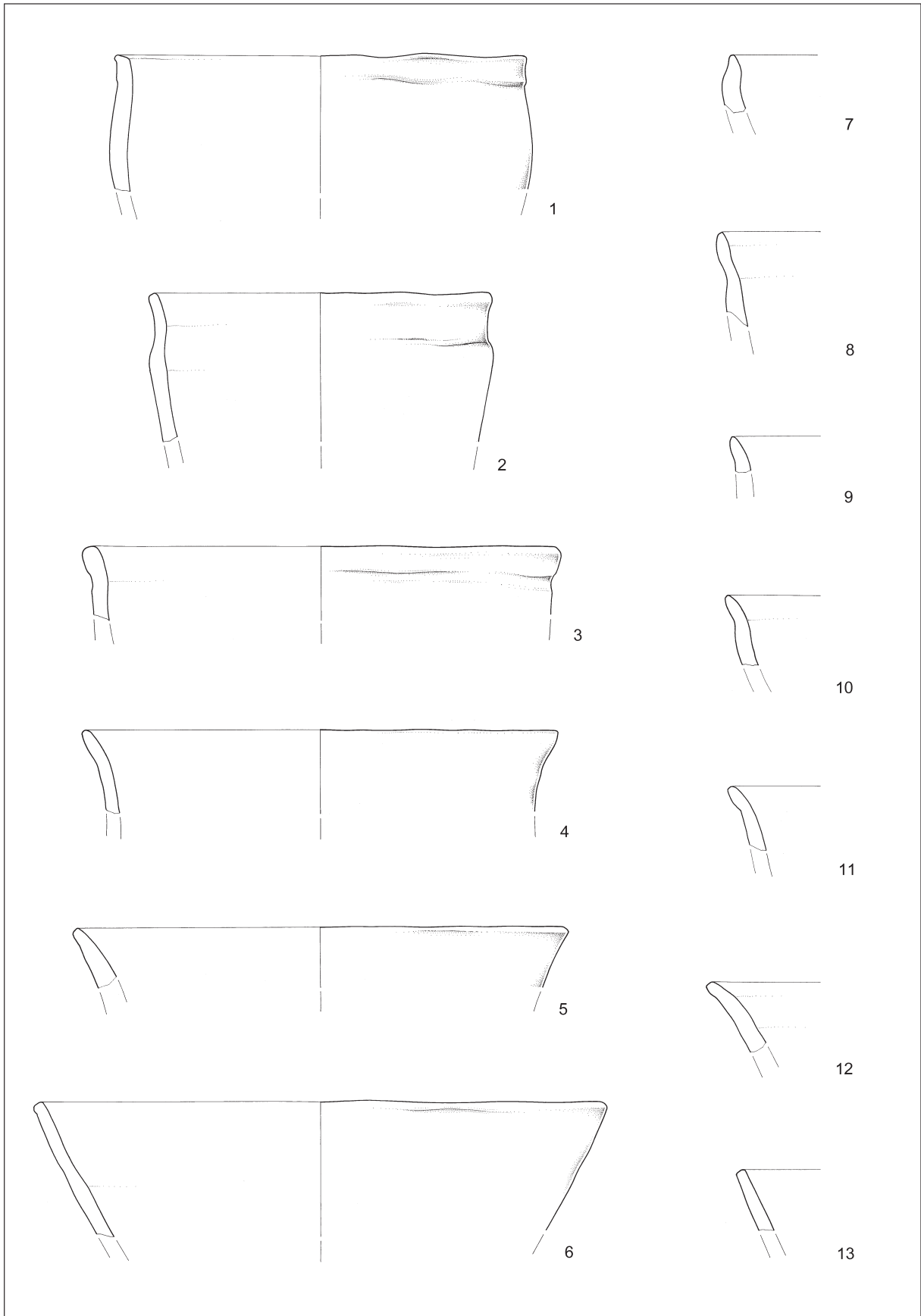
T. 3.21: Stare gmajne. Keramika. Risbe: T. Korošec. M = 1 : 3.

Pl. 3.21: Stare gmajne. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.



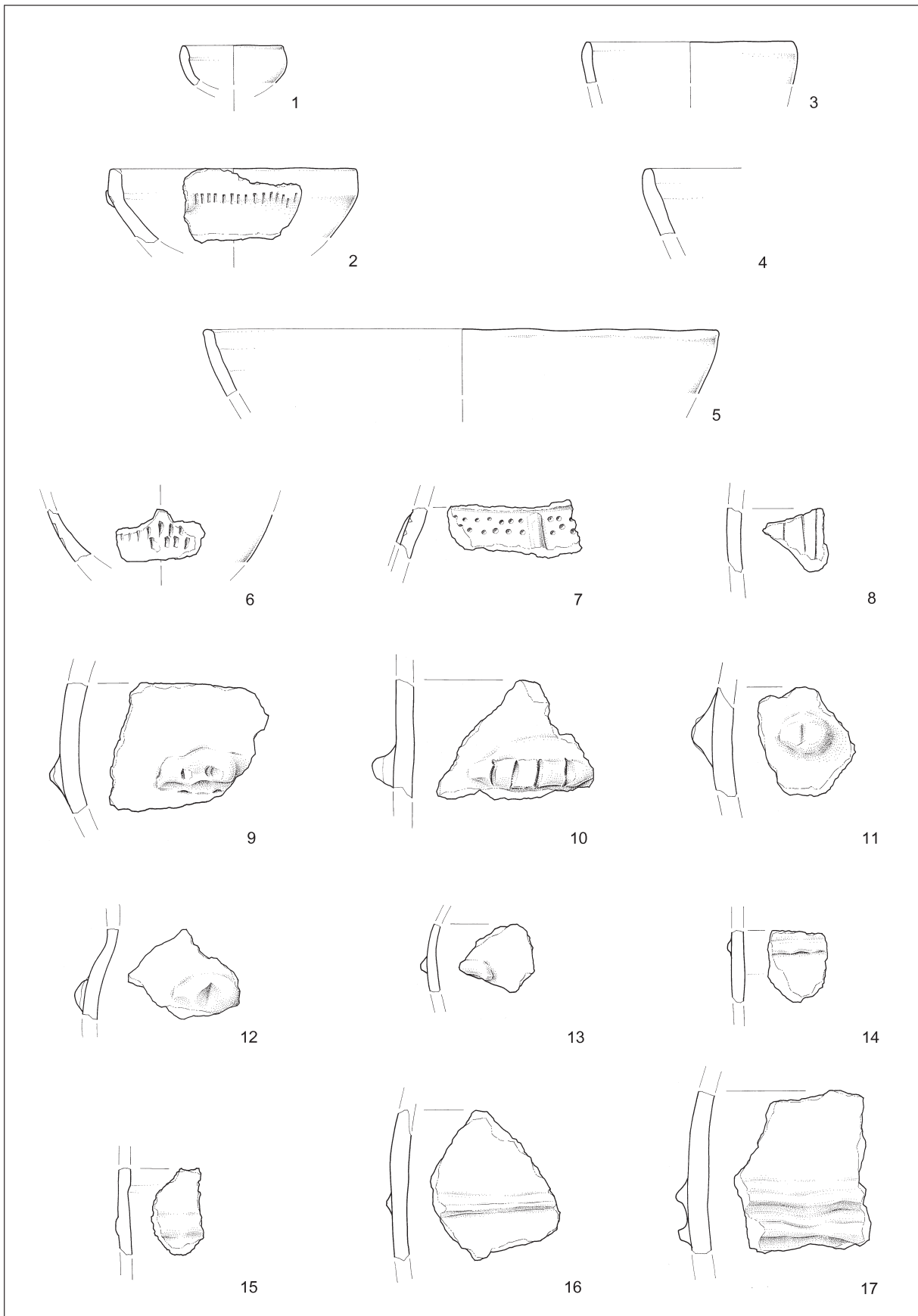
*T. 3.22:* Stare gmajne. Keramika. Risbe: T. Korošec. M = 1 : 3.

*Pl. 3.22:* Stare gmajne. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.



*T. 3.23:* Stare gmajne. Keramika. Risbe: T. Korošec. M = 1 : 3.

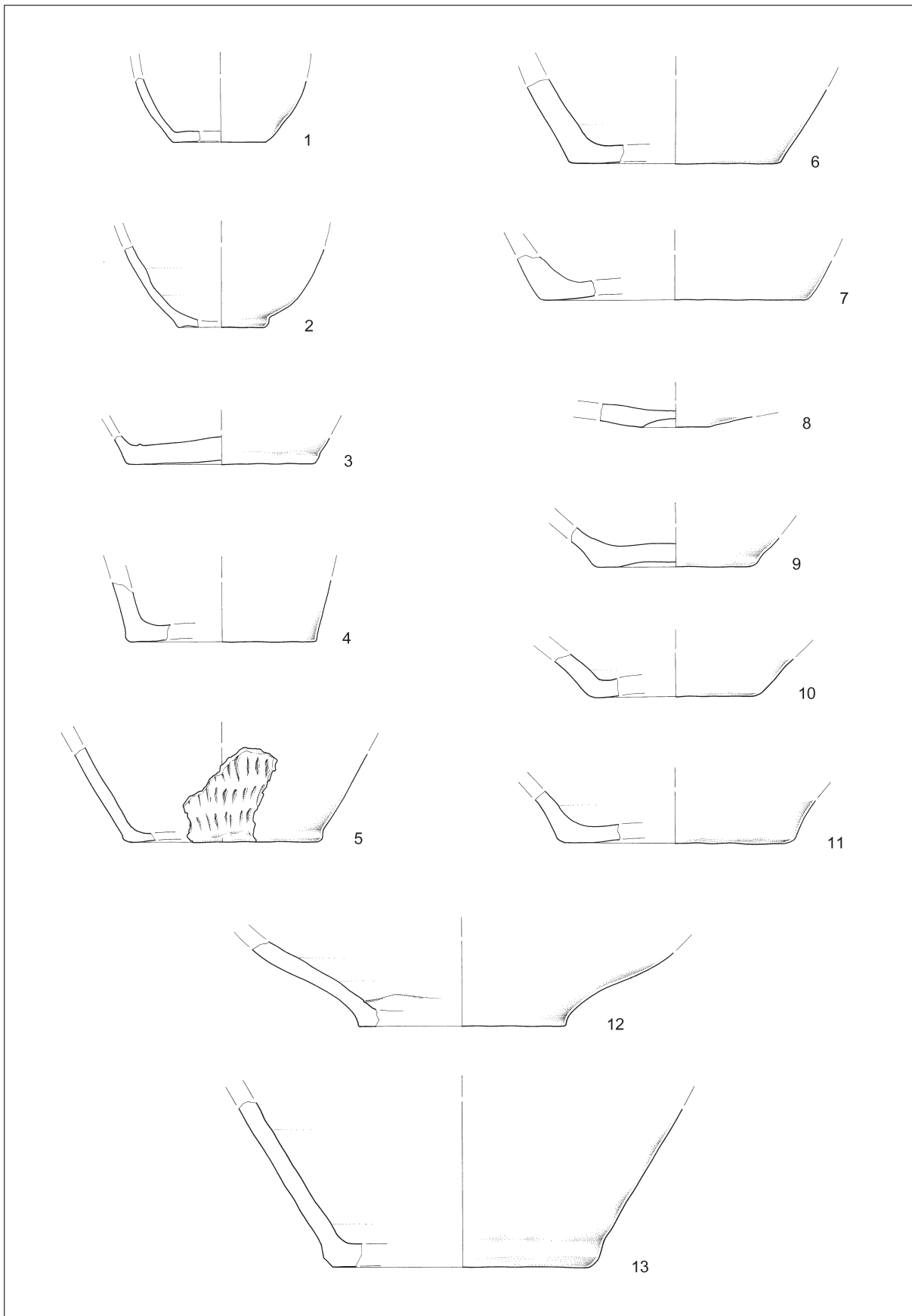
*Pl. 3.23:* Stare gmajne. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.



T. 3.24: Stare gmajne. Keramika. Risbe: T. Korošec. M = 1 : 3.

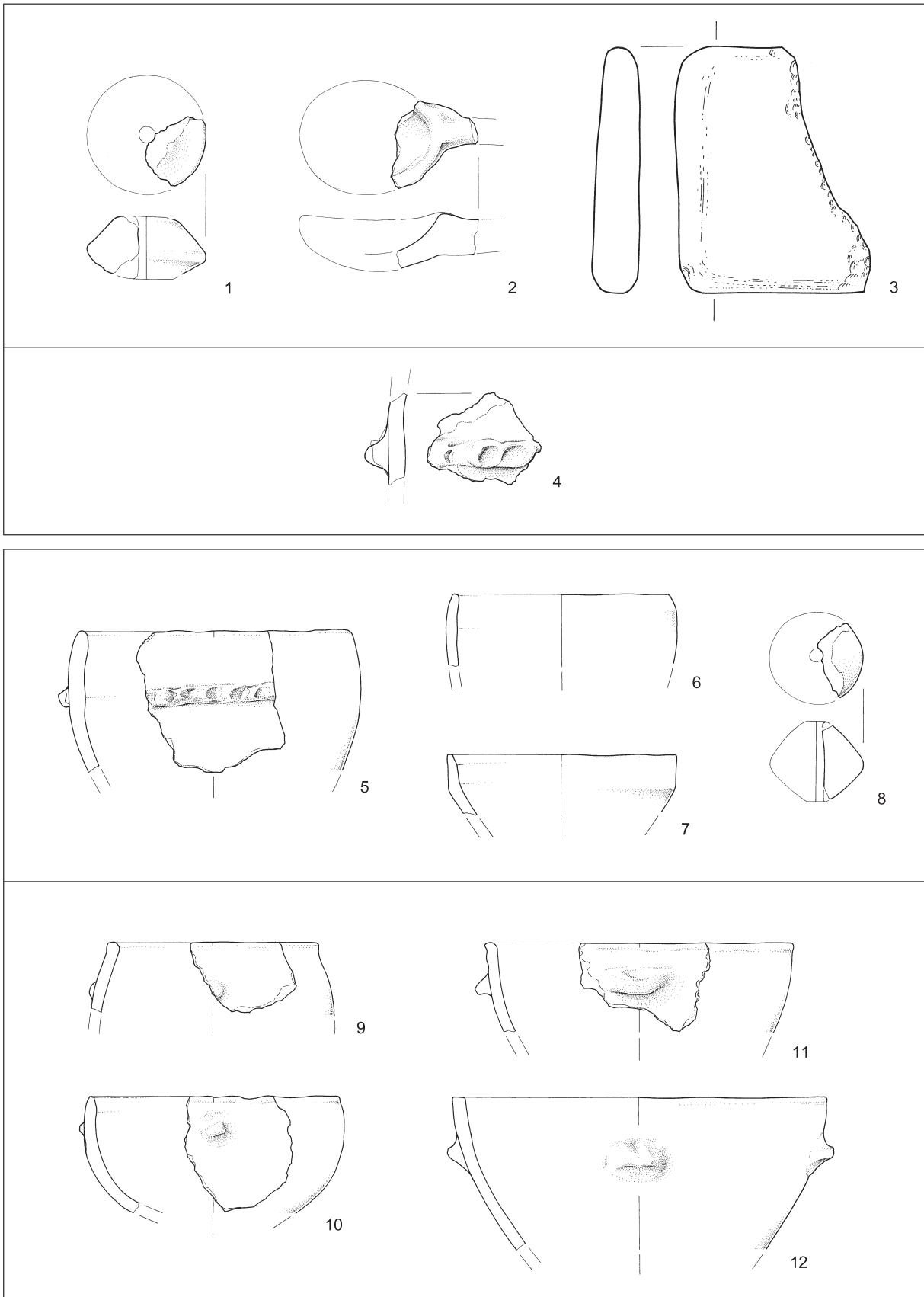
Pl. 3.24: Stare gmajne. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.





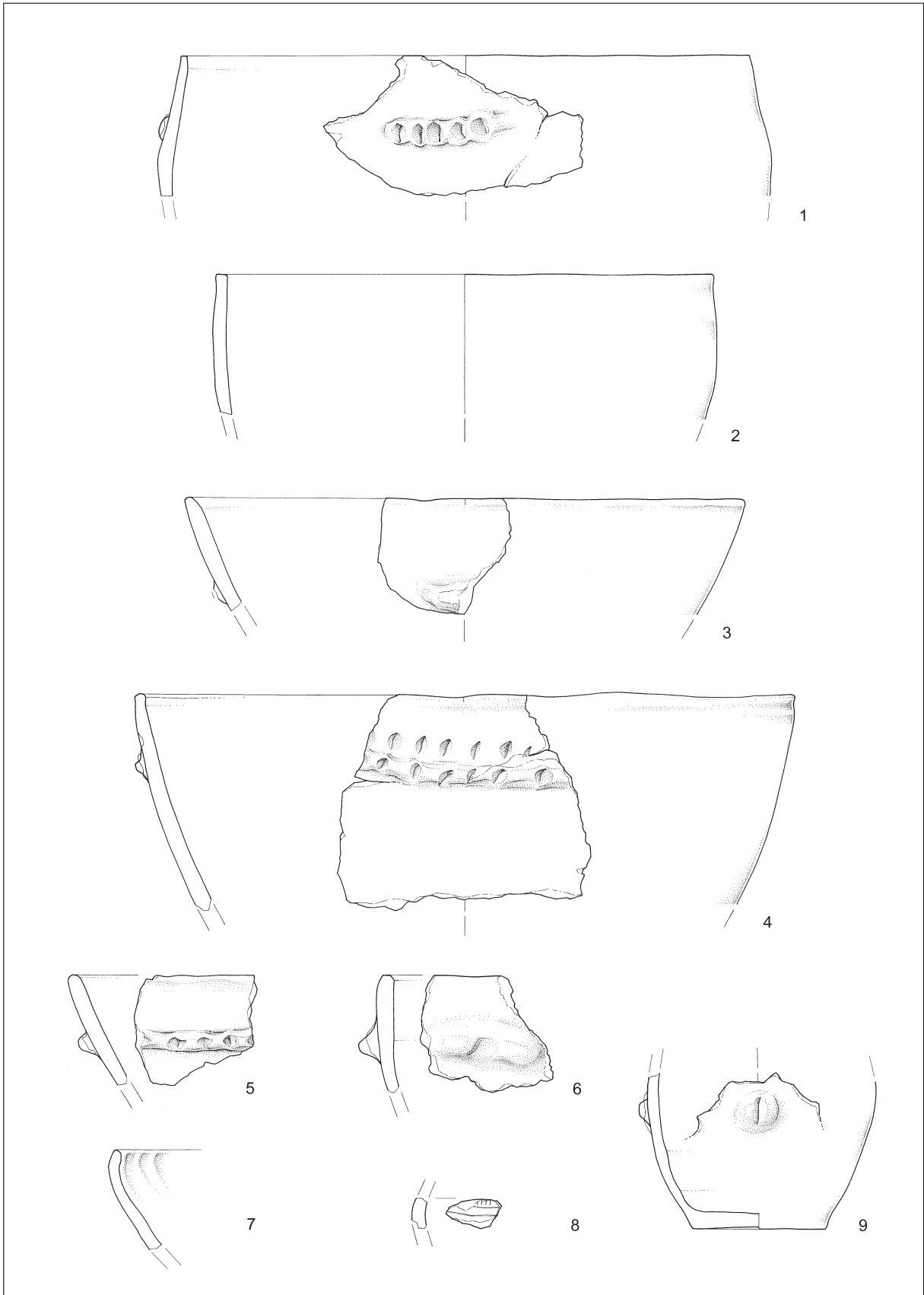
T. 3.25: Stare gmajne. Keramika. Risbe: T. Korošec. M = 1 : 3.

Pl. 3.25: Stare gmajne. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.



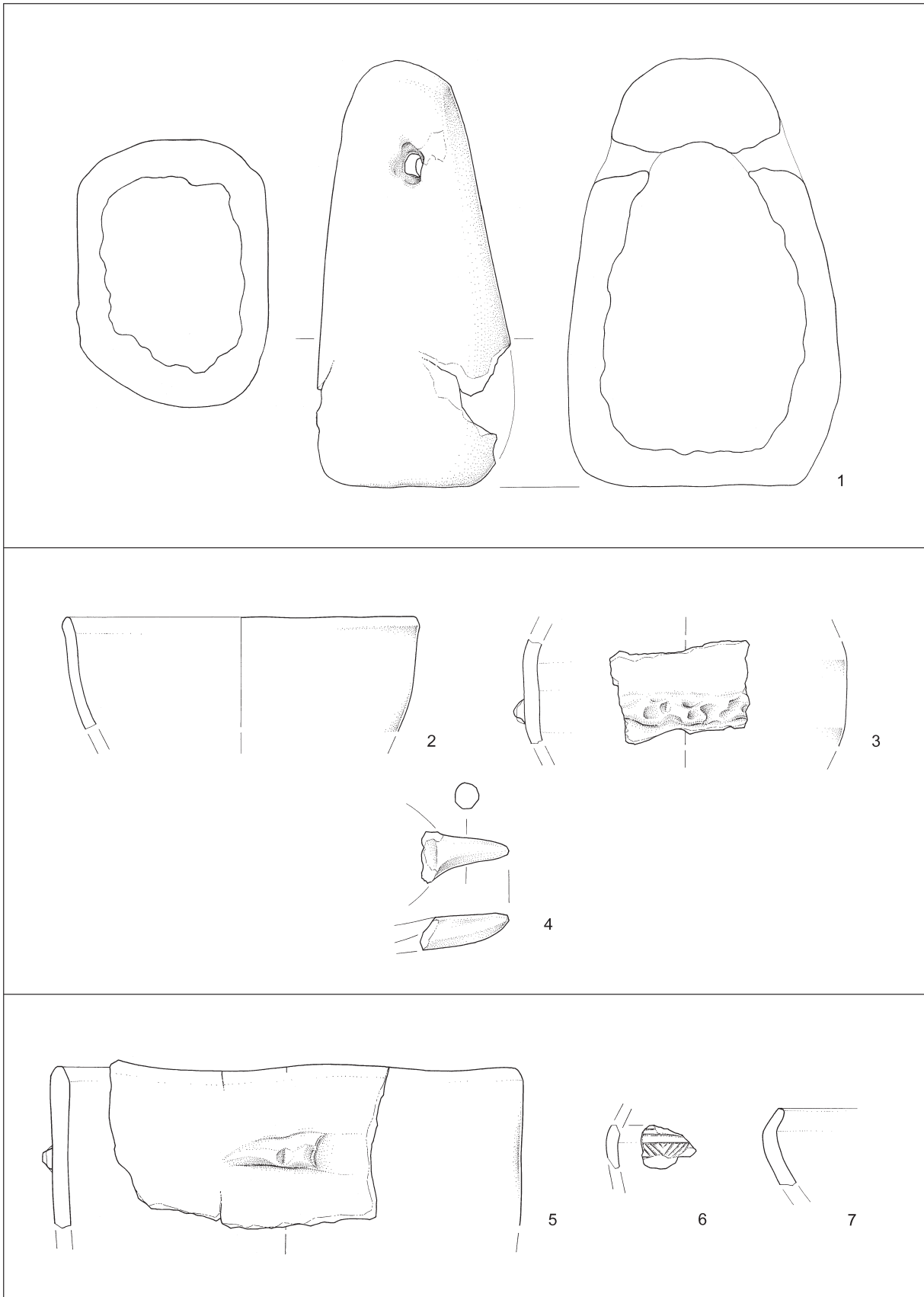
T. 3.26: Stare gmajne. 1,2,4-12, keramika. 3, kamen. Risbe: T. Korošec. Keramika: m = 1 : 3; kamen: m = 1 : 2.

Pl. 3.26: Stare gmajne. 1,2,4-12, pottery. 3, stone. Drawn by: T. Korošec. Pottery: scale = 1 : 3; stone: scale = 1 : 2.



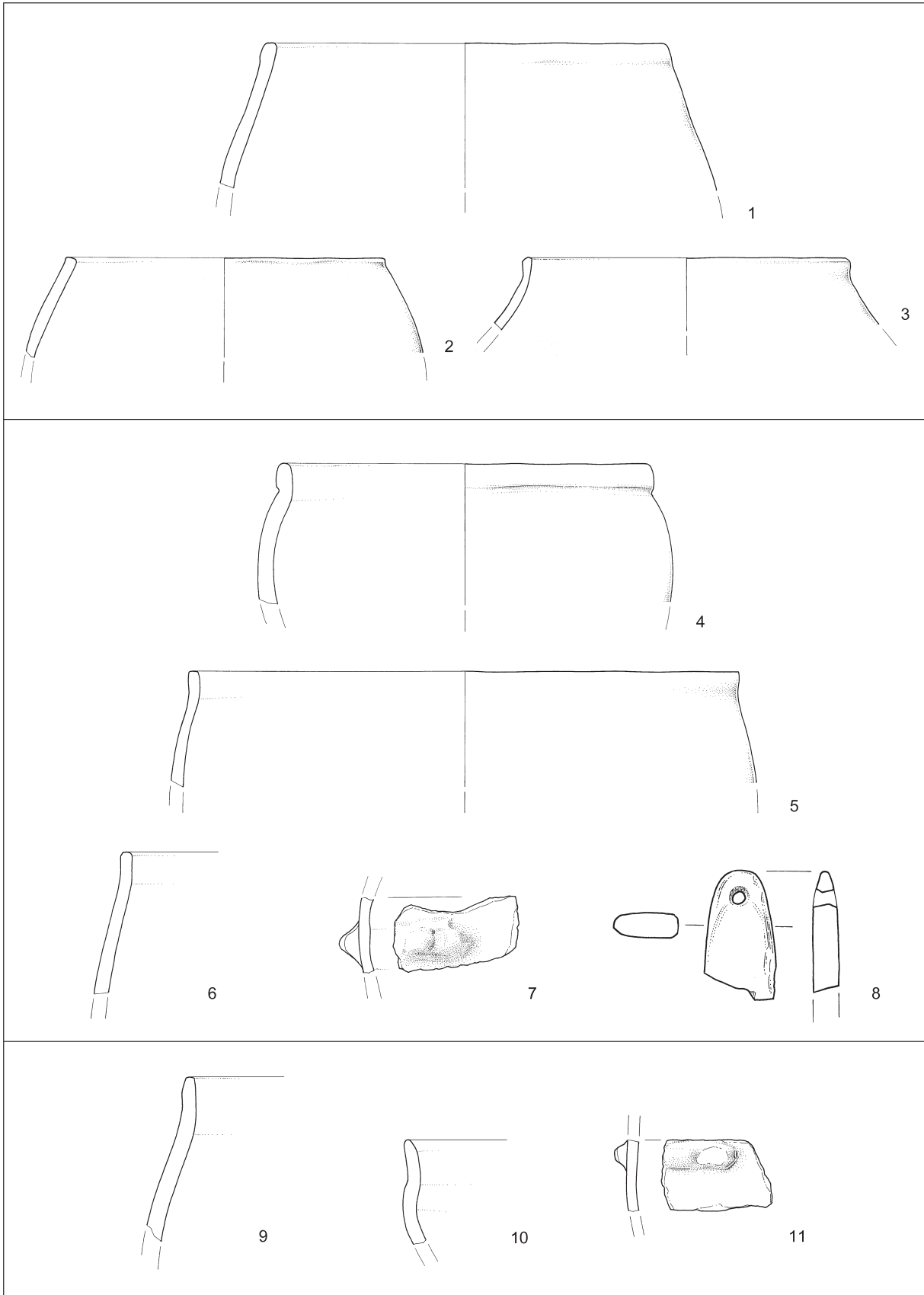
T. 3.27: Stare gmajne. Keramika. Risbe: T. Korošec. M = 1 : 3.

Pl. 3.27: Stare gmajne. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.



T. 3.28: Stare gmajne. 2-7, keramika. 1, glina. Risbe: T. Korošec. M = 1 : 3.

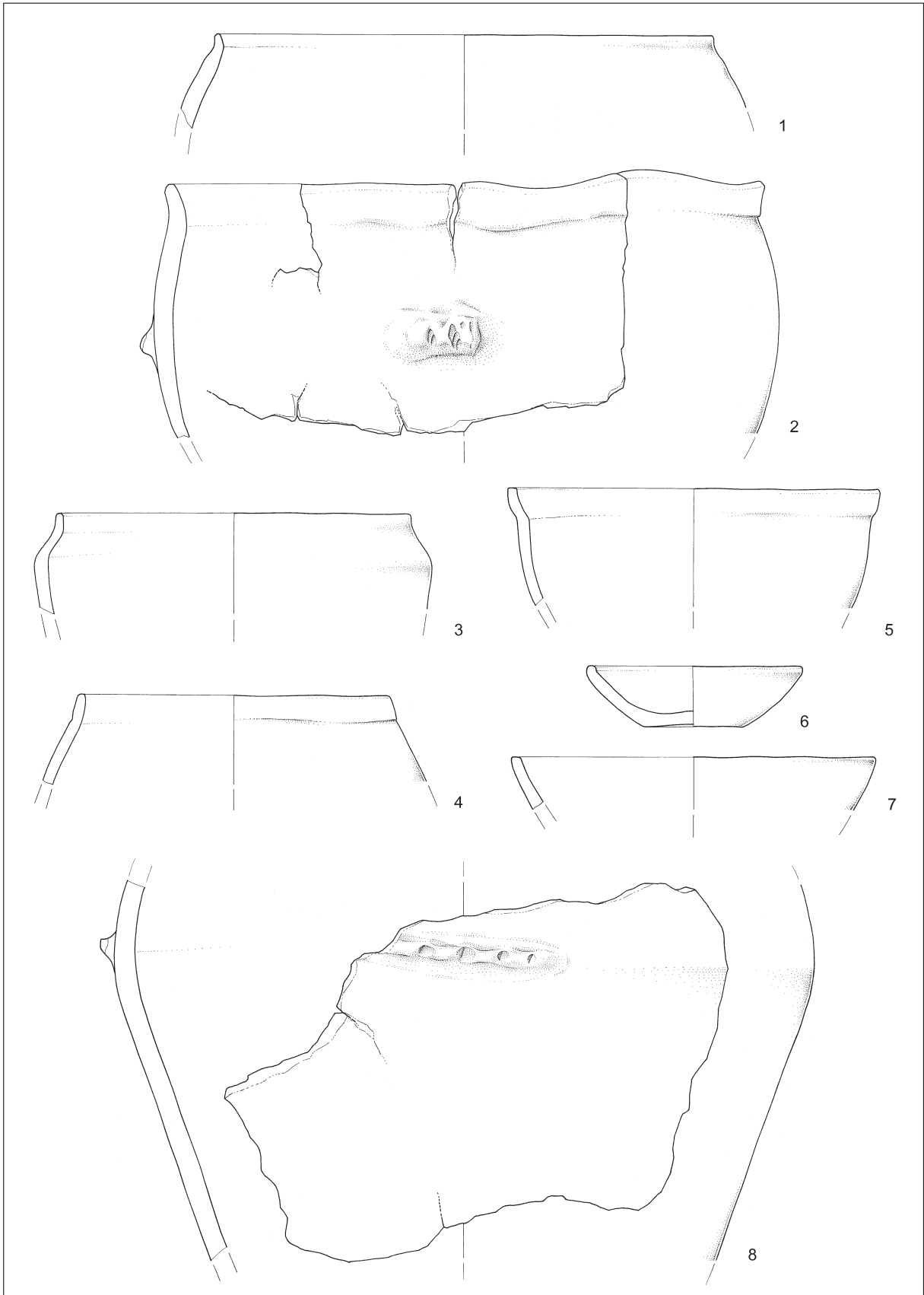
Pl. 3.28: Stare gmajne. 2-7, pottery. 1, clay. Drawn by: T. Korošec. Pottery: scale = 1 : 3; clay: scale = 1 : 2.



T. 3.29: Stare gmajne. 1-7,9-11, keramika. 8, kamen. Risbe: T. Korošec. Keramika: m = 1 : 3; kamen: m = 1 : 2.

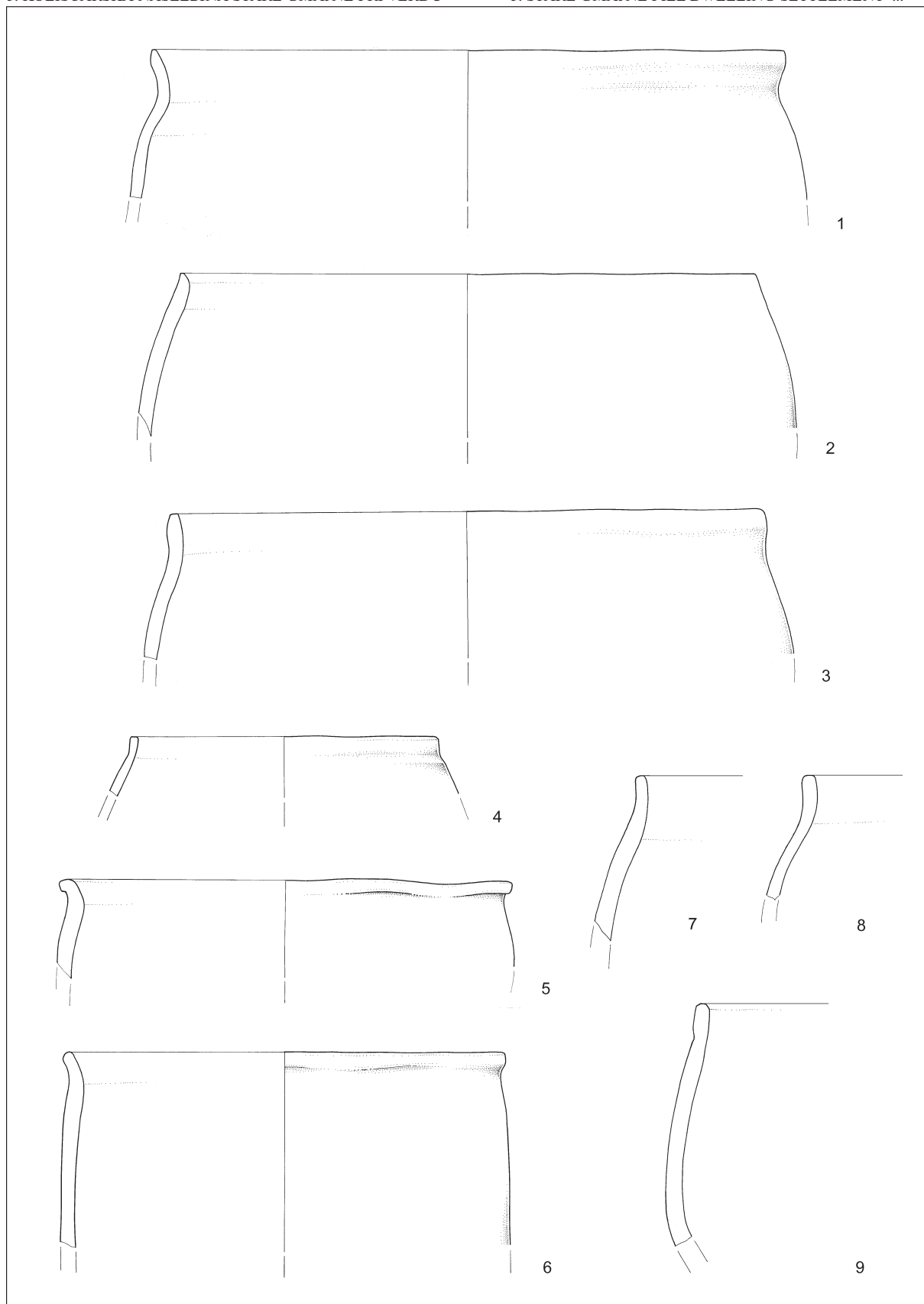
Pl. 3.29: Stare gmajne. 1-7,9-11, pottery. 8, stone. Drawn by: T. Korošec. Pottery: scale = 1 : 3; stone: scale = 1 : 2.





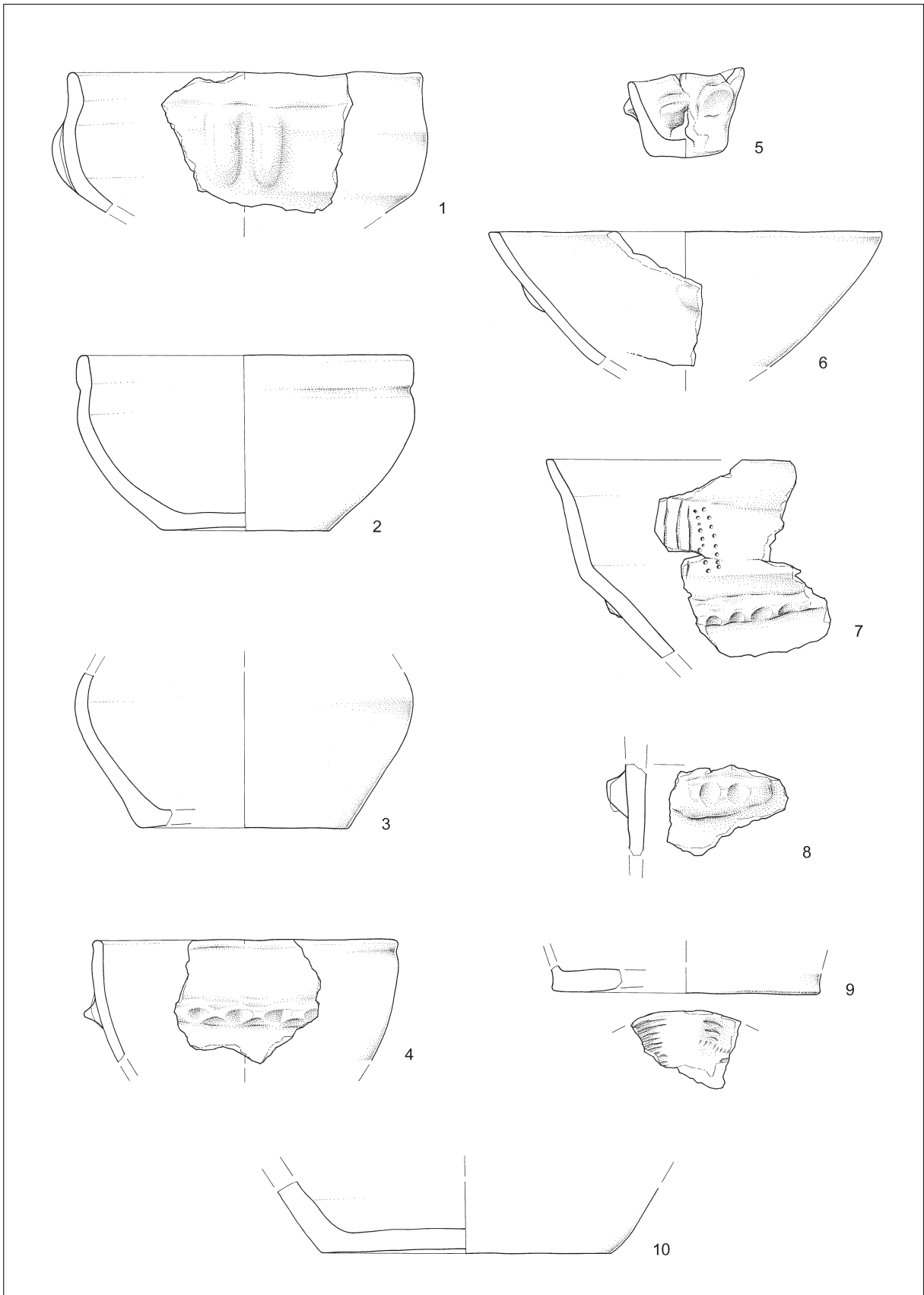
*T. 3.30:* Stare gmajne. Keramika. Risbe: T. Korošec. M = 1 : 3.

*Pl. 3.30:* Stare gmajne. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.



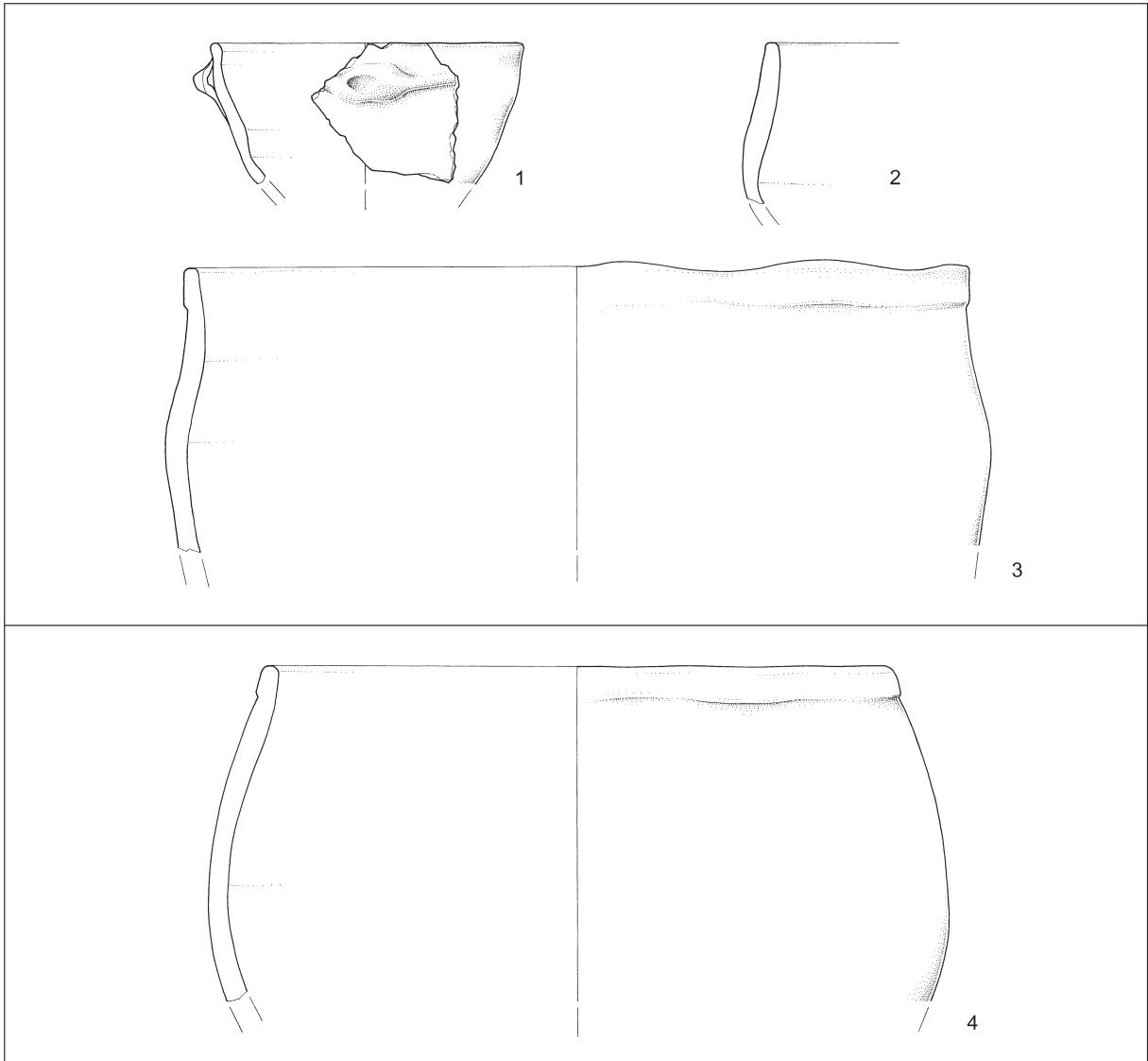
*T. 3.31:* Stare gmajne. Keramika. Risbe: T. Korošec. M = 1 : 3.

*Pl. 3.31:* Stare gmajne. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.



T. 3.32: Stare gmajne. Keramika. Risbe: T. Korošec. M = 1 : 3.

Pl. 3.32: Stare gmajne. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.



*T. 3.33:* Stare gmajne. Keramika. Risbe: T. Korošec. M = 1 : 3.

*Pl. 3.33:* Stare gmajne. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.





# 4. SEDIMENTOLOŠKA ANALIZA PROFILA Z NAJDIŠČA BLATNA BREZOVICA

Janez TURK & Aleksander HORVAT

# 4. SEDIMETOLOGICAL ANALYSIS OF THE PROFILE FROM THE SITE BLATNA BREZOVICA

Janez TURK & Aleksander HORVAT

## Izvleček

Sedimentno zaporedje vertikalnega profila na Blatni Brezovici smo razdelili na 9 vzorcev. Te smo najprej preučili glede na njihovo kvantitativno sestavo in vsem določili tudi granulometrično sestavo. V najglobljem vzorcu smo preučili tudi diatomeje, ki so poglavitni kazalnik sedimentacijskega okolja. Zanimale so nas značilnosti sedimentov oz. okolje, v katerem so se ti odlagali. Ugotovili smo tri faze odlaganja. Spodnji vzorci pripadajo prehodnim jezersko-močvirskim sedimentom (oz. gyttji), navzgor sledijo tipični močvirski sedimenti (oz. šota) in humus. Primerjava z vrtino "Na mahu 1" kaže, da so vsi obravnavani sedimenti mlajši od 7000 let.

**Ključne besede:** granulometrija, jezerska kreda, šota, diatomeje, Blatna Brezovica, Ljubljansko barje, Slovenija.

## Abstract

Sedimentary sequence of the vertical profile at Blatna Brezovica was distributed to 9 samples. Quantitatively composition of samples was studied first. We also determined granulometric composition of all samples. In the deepest sample we also examined diatoms, which are the main indicator of sedimentation conditions. We were interested in characteristics of sediments and conditions in which they were depositing. We found three phases of deposition. The bottom samples belong to transitional lake-marsh sediment (the gyttia) with typical marsh sediments (peat) and humus following upwards. Comparison with "Na mahu 1" borehole indicates that all treated sediments are less than 7000 years old.

**Keywords:** granulometry, lake marl, peat, diatoms, Blatna Brezovica, the Ljubljansko barje, Slovenia.

## 4.1 UVOD

Arheološko najdišče Blatna Brezovica leži na jugozahodnem delu Ljubljanskega barja med istoimenskim krajem in reko Ljubljanico.

Stratigrafijo vrhnjega dela sedimentov najdišča pri Blatni Brezovici, v katerih so arheološke najdbe, je že leta 1963 predstavil J. Korošec in kasneje povzel Z. Harej.<sup>1</sup> Ruši v debelini 7–15 cm sledi 8–29 cm subhumusa. Pod njim leži šotna plast, ki je debela od 10 do 46 cm. Sledi kulturna plast z najdbami v debelini od 32 do 95 cm, pod njo je jezerska kreda. Višina jezerskega dna se je po Korošču gibala na absolutni višini med 288,2 in 288,4 m.

Na območju najdišča Blatna Brezovica prevladujejo glinene in šotne plasti. Prodnati nanosi se vsaj v vrhnjem delu sedimentnega zaporedja ne pojavljajo, saj v bližini ni nobenega hudourniškega potoka, ki bi prinašal prod in oblikoval sedimentni vršaj. Ljubljanica (in tudi Bistra)

<sup>1</sup> Korošec 1963; Harej 1986.

## 4.1 INTRODUCTION

The archaeological site Blatna Brezovica lies on the southwestern part of the Ljubljansko barje, between homonymous village and the Ljubljanica River.

Stratigraphy of the top part of sediments of the site Blatna Brezovica, in which archaeological finds have been found, was already introduced by J. Korošec in 1963 and later summarised by Z. Harej.<sup>1</sup> 7–15 cm thick Turf is followed by 8–29 cm thick layer of sub-humus. 10–46 cm thick peat layer lies underneath. A cultural layer lies below, containing finds, with thickness of 32–95 cm, which lies on lake marl. Lake bottom was at absolute heights between 288.2 and 288.4 m, after Korošec.

Clay and peat layers prevail at the site Blatna Brezovica. Gravelly alluvia are absent at least in the top part of the sedimentary sequence, as there is no torrential stream nearby, which would be carrying a load of gravel and formed a sediment fan. The Ljubljanica (also the

<sup>1</sup> Korošec 1963; Harej 1986.

je prinašala le drobnozrnate sedimente, kajti zaradi majhnega padca je njen tok počasen.<sup>2</sup>

Natančneje je kvartarne sedimente Ljubljanskega barja opisal Tancik.<sup>3</sup>

Jezerska kreča, lokalno imenovana tudi *polžarica*, je sediment, ki se je odlagal na jezerskem dnu. Po sestavi jo gradijo apnenčasto blato, glen ali mulj, ostanki apnenčastih skeletov jezerskih polžkov in deloma organske sestavine jezerskih alg, planktona, ostanki cvetnega peloda ter drugi v jezeru živeči organizmi. Po zrnavosti predstavlja karbonatni (kalcitni) glinasti melj ali karbonatno (kalcitno) glino z drobnozrnatim peskom. Barva polžarice je različna in je odvisna od množine organskih sestavin. Predvsem v zgornji plasti je lahko sivkasta z zelenkastim ali modrikastim odtenkom, medtem ko so nižje plasti bolj belkaste in sivkaste. Na barvo gornje plasti polžarice vplivajo primesi nanešenega materiala ter ferikarbonat, organske sestavine in huminske kisline iz površinske organske plasti. Te sestavine dajejo rjavo barvo in različne odtenke sive barve, od modrikasto do zelenkasto in rumenkasto sive.<sup>4</sup>

Šota se je začela odlagati v zadnjem stadiju jezera, ko je to počasi prehajalo v močvirno območje.<sup>5</sup> Tancik<sup>6</sup> je šotne plasti na Ljubljanskem barju razvrstil v več skupin.

Spodnja šotna plast predstavlja jezersko oz. šotno usedlino, imenovano tudi gyttja. To je mešanica jezerskega blata (krede) in humusnih sestavin, kot so listje, alge, pelod itd. Gytja navzdol postopno prehaja v čisto jezersko krečo.

Navzgor sledi plast zelo razkrojene šote iz listnatih mahov. V šoti se pojavlja tudi vodno travje in trsje. Sledi tretja šotna plast, nastala iz listnatih mahov (*Hypnum*), kjer se pojavljajo bolj ali manj razkrojeni ostanki močvirskih trav in grmičevja. Vrhnja šotna plast je sestavljena iz šotnih mahov (*Sphagnum*), značilnih za visoko barje.

Krovnino vsega predstavlja humus, katerega značilnosti tu ne opisujemo, saj ni pomemben za našo raziskavo.

## 4.2 SEDIMENTNA ANALIZA IN REZULTATI

Iz zahodnega profila izkopane sonde smo odvzeli sedimentološki vzorec med absolutnimi višinami 287,77 in 288,67 m (sl. 4.1, 4.2). Površje je na absolutni višini 289,1 m, torej 0,43 m nad zgornjim robom sedimentološkega vzorca. Celotni sedimentološki vzorec globine 0,9 m smo razdelili na 9 podvzorcev. Vsak je predstavljal 10 cm sedimentnega zaporedja. Vseh 9 podvzorcev smo obdelali po že uveljavljeni metodi mokrega sejanja in

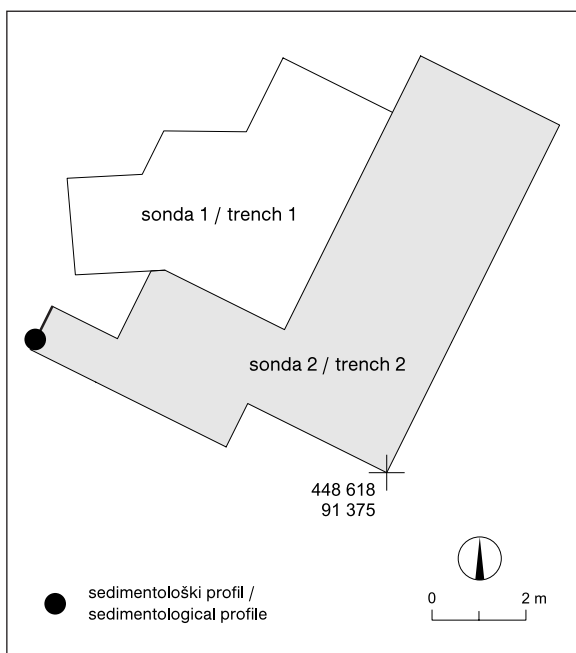
<sup>2</sup> Pavšič 1989.

<sup>3</sup> 1965.

<sup>4</sup> Tancik 1965.

<sup>5</sup> Pavšič 1989.

<sup>6</sup> 1965.



Sl. 4.1: Blatna Brezovica, načrt izkopavanj leta 2003 z označeno lego sedimentološkega profila. Pripravila: T. Korošec.

Fig. 4.1: Blatna Brezovica, plan of excavations done in 2003 with marked position of sedimentological profile. Prepared by: T. Korošec.

Bistra) was, due to its mild inclination and slow current, carrying only a load of fine-grained sediments.<sup>2</sup>

Tancik described Quaternary sediments of the Ljubljansko barje in more detail.<sup>3</sup>

Lake marl, the so-called *polžarica*, is sediment that was depositing on lake bottom. It is composed of limestone mud, silt and mud, remains of limestone skeletons of lake snails and partly of organic element of lake algae, planktons, remains of pollen and of other organisms living in lakes. Granularity-wise, it consists of a carbonated (calcite) clayey silt or carbonated (calcite) clay with fine-grained sand. Many colours of the lake marl exist as the colour depends on the amount of organic elements within. It can be greyish with greenish or bluish tone in top layer, while the bottom layers are whitish and greyish. The colour of the top layer of the lake marl depends on the additions of deposited material, the impact of ferric carbonate, organic elements and humic acids from the organic surface layer. These elements provide brown colour and different shades grey, from bluish to greenish and yellow grey.<sup>4</sup>

Peat started deposit in the last phase of the lake, when the lake slowly transformed to marsh.<sup>5</sup> Tancik<sup>6</sup>

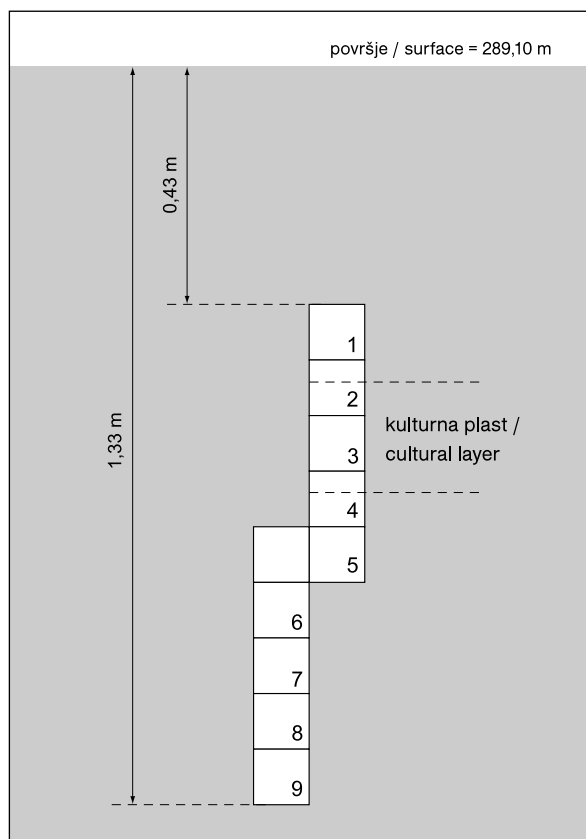
<sup>2</sup> Pavšič 1989.

<sup>3</sup> 1965.

<sup>4</sup> Tancik 1965.

<sup>5</sup> Pavšič 1989.

<sup>6</sup> 1965.



Sl. 4.2: Blatna Brezovica. Shematiziran prikaz vzorčenja v jugozahodnem profilu sonde 2 (glej sl. 4.1). Risba: T. Korošec.

Fig. 4.2: Blatna Brezovica. Stylised display of sampling in southwestern profile of trench 2 (see Fig. 4.1). Drawn by: T. Korošec.

tako iz vsakega dobili dve frakciji. Debelejša frakcija 0,2 do 2 mm je bila pregledana pod lupo, drobnejša, debeline pod 0,2 mm, pa pod optičnim mikroskopom. Hkrati je bila frakcijam določena tudi granulometrija, s katero smo za vsak podvzorec ugotovili delež gline, melja in peska.<sup>7</sup>

Čeprav sedimenti niso bili datirani, zanesljivo vemo, da so holocenske starosti. To dokazuje splošna kronologija plasti Ljubljanskega barja. Jezerska kreda se je namreč odlagala v borealu, atlantiku in v prvi polovici subboreala, torej v času med približno 10.000 in 4000 let pred sedanostjo,<sup>8</sup> medtem ko T. Verbič na primeru Zaloga pri Verdu ugotavlja, da se je na Ljubljanskem barju do odlaganja polžarice lahko prišlo že nekoliko pred tem, v pleistocenu. Verbič nadalje meni, da utegne biti napačna ocena za podnebje, da se je šele v borealu otoplilo do te mere, da je bilo omogočeno izločanje kalcijevega karbonata iz jezerske vode.<sup>9</sup> Kakor koli že, v jezerski kredi in krovnih šotnih plasteh se hkrati nahajajo

categorized peaty layers of the Ljubljansko barje to several groups.

The bottom peat layer is lake/peaty sediment, so-called gyttia. It is a mixture of lake mud (marl) and humus elements, such as leaves, algae, pollen etc. The gyttia downwards slowly transforms to pure lake marl.

Layer of badly decomposed peat mosses follows upwards. Also water grass and reeds are present in peat. The third peaty layer, composed of mosses (*Hypnum*) and more or less decomposed remains of marsh grasses and scrub follows. The top peaty layer is composed of peat mosses (*Sphagnum*) that are characteristic for peat bogs.

Atop lies humus; we are not describing its characteristics here as it is insignificant for this research.

## 4.2 SEDIMENT ANALYSIS AND RESULTS

We took sedimentological sample between absolute heights 287.77 and 288.67 m (Fig. 4.2) from the western profile of the trench (Fig. 4.1). Surface is levelled on absolute height of 289.1 m, that is 0.43 m above the upper edge of the sedimentological sample. We divided the entire, 0.9 m deep sedimentological sample into 9 sub-samples. Every sub-sample presented 10 cm of the entire sedimentary sequence. All 9 sub-samples were examined by well-established procedure of wet sieving, with two fractions deriving from each sub-sample. Thicker fraction 0.2 to 2 mm was investigated under stereo microscope. Thinner fraction of under 0.2 mm was examined with optical microscope. At the same time, this fraction was also analysed with granulometry; consequently we identified amount of clay, silt and sand in every sub-sample.<sup>7</sup>

Although sediments were not dated, we know for sure that they date to the Holocene. General chronology of layers of the Ljubljansko barje confirms this. To be precise, lake marl was depositing during the Boreal, Atlantic and in the first half of the Sub-Boreala, i.e. in time between c. 10,000 and 4000 BP.<sup>8</sup> Based on the data from Zalog near Verd, Verbič assumes, that depositing of the lake marl at the Ljubljansko barje could occur earlier, in Pleistocene. Verbič also presumes that the assessment of climate may be wrong, i.e. the climate warmed up to the degree that secretion of calcium carbonate from lake water was possible as late as the Boreal.<sup>9</sup> Anyway, the lake marl and peaty layers atop contain finds from the time of pile-dwelling settlements, dating to the 4<sup>th</sup> millennium BC.<sup>10</sup>

<sup>7</sup> Turk 2006.

<sup>8</sup> Šercelj 1965.

<sup>9</sup> Verbič 2006; see also Stevanović, Marović, Dimitrijević 1992.

<sup>10</sup> See Chapters 5 and 7 in this monograph.

<sup>7</sup> Turk 2006.

<sup>8</sup> Šercelj 1965.

<sup>9</sup> Verbič 2006; glej še Stevanović, Marović, Dimitrijević 1992.

tudi najdbe iz časa koliščarskih naselbin, ki segajo v 4. tisočletje pred Kristusom.<sup>10</sup>

#### 4.2.1 REZULTATI, DOLOČENI S POMOČJO LUPE (FRAKCIJA 0,2 DO 2 mm)

Spodaj ležeči sedimenti imajo značilnosti jezerskih sedimentov. Analiza s pomočjo lupe je pokazala, da so ti sedimenti pretežno iz belih agregatnih zrn. Ta se pojavljajo od najnižjega vzorca št. 9 in navzgor do vzorca št. 6. Delež agregatov navzgor upada, v vzorcih 9 in 8 njihov delež znaša okoli 90 %, v vzorcu 6 pa le še okoli 40 %. V vseh teh vzorcih se pojavljajo tudi fosilni ostanki rastlinskih in živalskih organizmov. Med živalskimi lupinicami so najpogostejše tiste, ki pripadajo ostrakodom, v najglobljih dveh vzorcih so pogosti tudi oogoniji haracej. V teh dveh vzorcih živalski ostanki prevladujejo nad rastlinskimi, kar je v nasprotju z ostalimi vzorci jezerske krede. Opisane značilnosti nakazujejo jezersko sedimentacijsko okolje.

Drugačnega izvora so vzorci 5 do 1. Ti so pretežno iz organskih snovi. Vzorec 1 vsebuje kar 99 % organske snovi in le okoli 1 % mineralnih zrn, v ostalih vzorcih pa se odstotek mineralnih zrn giblje okoli 10 %. Poleg rastlinskih ostankov se v vseh vzorcih pojavljajo tudi posamezni fragmenti živalskih lupinic. Nekaj oogonijev haracej smo našli celo v vzorcu 1.

#### 4.2.2 REZULTATI, DOLOČENI S POMOČJO OPTIČNEGA MIKROSKOPA (FRAKCIJA POD 0,2 mm)

Značilnost sedimentnega zaporedja je konstantno in neprekinjeno naraščanje deleža zrn organskega izvora navzgor proti površju (*sl. 4.3*).

V najgloblje odvzetih vzorcih 9 in 8 prevladuje delež karbonata (> 60 %), pojavljajo se številne diatomeje. Glede na kvantitativno mineralno sestavo bi lahko sklepali, da so se sedimenti odlagali na obrobju jezera, v močvirskem priobalnem pasu. Sedimentacija tam ni bila več tipično jezerska, marveč predstavlja prehod jezerskih sedimentov v močvirske. V vzorcu 6 kremen že prevladuje nad karbonatom, kar kaže na nadaljnjo krčenje jezerske površine oz. na postopen prehod iz jezersko-močvirskega okolja v tipično močvirsko. Izliv Ljubljanice v jezero se je zaradi njegovega krčenja postopoma približeval najdišču, s čimer se je večal dotok terigenega materiala.

Odlaganje netipičnih jezerskih sedimentov je nadomestila močvirska sedimentacija (vzorci 5, 4 in 3). Ti vzorci so po svojih lastnostih podobni šoti. Odstotek organskih zrn hitro narašča po profilu navzgor, kar nakazuje nadaljnje krčenje jezera in prehod iz močvirja

#### 4.2.1 RESULTS APPOINTED WITH STEREO MICROSCOPE (FRACTION 0.2 TO 2 mm)

The lowest sediments have characteristics of lake sediments. Analysis with the stereo microscope showed that these sediments are mostly of white aggregate grains. These are present between (and including) the lowest sample 9 and sample 6. Amount of aggregates declines upwards, in samples 9 and 8 the percent of them is c. 90 %, in sample 6 only c. 40 %. Fossil remains of vegetal and animal organisms are present in all these samples. The most often among animal "shells" are ostracods, in the lowest two samples also oogonia of Haracea. As opposed to the other samples of lake marl, where vegetal remains prevail, these two samples contain mostly animal remains. Characteristics described remit lake sedimental environment.

Samples 5 to 1 are of a different origin. They are composed mostly of organic material. Sample 1 contains 99 % of organic material and only c. 1 % of mineral grains; percent of mineral grains is c. 10 % in the remaining samples. Still, individual fragments of animal valves are present beside vegetal remains in all samples. Some oogonia of Haracea were found even in sample 1.

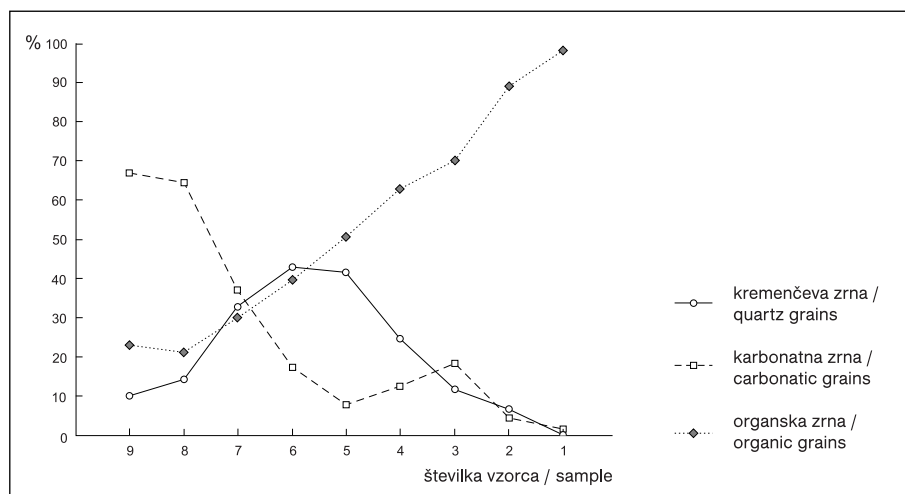
#### 4.2.2 RESULTS APPOINTED WITH THE OPTICAL MICROSCOPE (FRACTION BELOW 0.2 mm)

The main characteristic of sedimentary sequence is constant and continual increasing of organic grains upwards towards surface (*Fig. 4.3*).

Percentage of carbonate prevails (> 60 %) in the deepest samples 9 and 8 where also numerous diatoms occur. Considering quantitative mineral composition, we could assume that sediments were depositing on the edges of the lake, in marshy band near the shore. In that area, sedimentation was not typical of a lake any more, but it presented transition from lake to marshy sediments. Quartz already prevails above carbonate in sample 6, which indicates further contraction of the lake area or on a graduate transition from lake-marshy to typically marshy environment. The outflow of the Ljubljanica to the lake was, because of the gradual contraction of the lake, approaching the prehistoric settlement; consequently the discharge of terigen material was increasing.

Atypical lake sediments altered to marshes sedimentation (samples 5, 4 and 3). These samples have characteristics similar to peat. Percent of organic grains quickly increases upwards in profile, which indicates further contraction of the lake and transition from marsh on the periphery, to moor environment. Vegetation was becoming lush; moor probably transformed from low to high. Carbonate was still being deposited in marshy

<sup>10</sup> Poglavlji 5 in 7 v tem zborniku.



Sl. 4.3: Blatna Brezovica. Kvantitativna mineralna sestava vzorcev.  
Fig. 4.3: Blatna Brezovica. Quantitative mineral composition of samples.

na obrobju v barjansko okolje. Rastje je postajalo vedno bolj bujno, barje je verjetno prešlo iz nizkega v visoko. V močvirnatem okolju se je še vedno odlagal karbonat, vendar v precej manjšem deležu kot v jezerski fazi. V prehodnih vzorcih 6 in 5 je delež kremenovih zrn relativno visok. Diatomeje se navzgor pojavljajo vse do vzorca 3. Delež karbonata v vzorcu 3 je razmeroma visok (18 %), vendar organska zrna vedno bolj prevladujejo nad mineralnimi.

V vzorcu 5 se razmerje med organskimi in mineralnimi zrn praktično izenači. Odstotek kremenja je značilno večji od odstotka karbonata, ki dosega tu presenetljivo nizek delež (7,7 %). V času odlaganja sedimentov vzorcev 5 in 4 je bilo okolje zagotovo še zamočvirjeno, saj je pojavljanje diatomej še vedno značilno.

Značilno humusna sta le vzorca 2 in 1. Sestavljajo ju skoraj izključno organska zrna, ki v prvem vzorcu predstavljajo 98 %, v drugem pa 89 % vseh snovi. Delež kremenovih in karbonatnih zrn je praktično zanemarljiv (sl. 4.3). Sedimentacija teh dveh vzorcev je potekala v drugačnem okolju. Jezera v tem času ni bilo več, tudi močvirje je bilo verjetno v veliki meri izsušeno. Kaže, da sedimentacija ni bila prekinjena s poplavnimi nanosi, ki bi povzročili odlaganje mineralnih zrn.

#### 4.2.3 GRANULOMETRIJA (FRAKCIJA POD 0,2 mm)

Granulometrična analiza potrjuje rezultate mikroskopske. V splošnem velja, da se delež glinene frakcije zelo malo spreminja navzgor po sedimentnem zaporedju (sl. 4.4). Deleži gline se gibljejo od 8,5 % (vzorec 7) do 12,5 % (vzorec 5). Spremembe so tako majhne, da niso statistično značilne. Nekoliko bolj so spremenljivi deleži peščene in deloma meljaste frakcije. Delež meljaste

environment, however, in much smaller quantities as in time of lake. The amount of quartz grains is relatively high in transitional samples 6 and 5. Diatoms occur all the way up to sample 3. The amount of carbonate in sample 3 is comparatively high (18 %), however, organic grains prevail increasingly above the mineral ones.

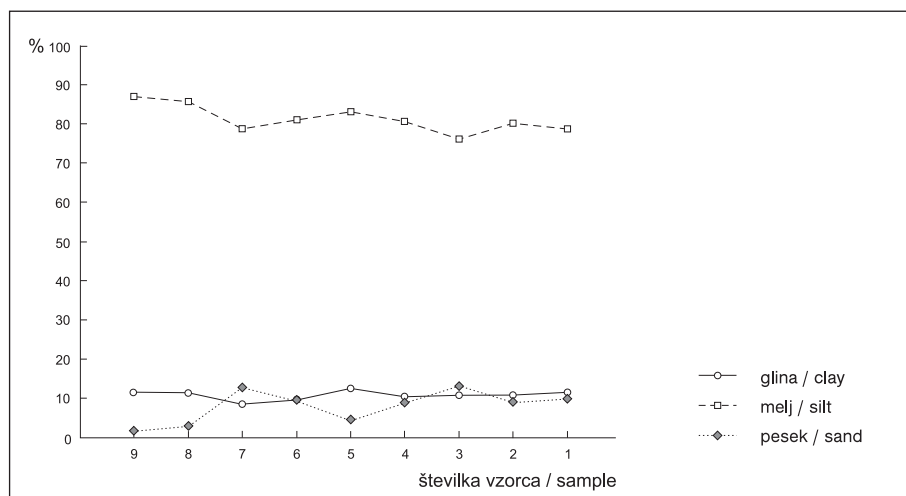
The amount of organic and mineral grains practically equalizes in sample 5. Percent of quartz is considerably larger as percent of carbonate, which achieves surprisingly low percent here (7.7 %). When sediments of samples 5 and 4 were depositing, the environment was definitely still marshy, as diatoms are still present in large numbers.

Samples 2 and 1 are the only characteristic humus samples. These samples are composed almost solely of organic grains, which present 98 % of the whole sample in the first and 89 % in the second sample. Percent of quartz and carbonate grains is practically negligible (Fig. 4.3). Sedimentation of these two of samples was taking place in a different environment. Lake did not exist in this time any more and marsh was probably mostly dried out. It appears that sedimentation was not interrupted with flood deposits, which would cause deposition of mineral grains.

#### 4.2.3 GRANULOMETRY (FRACTION BELOW 0.2 mm)

Granulometric analysis confirms the results of microscopic analysis. Percent of clayey fraction hardly changes upwards in sedimentary sequence (Fig. 4.4). Percentage of clay varies from 8.5 % (sample 7) to 12.5 % (sample 5). Changes are so minute, that they are not statistically characteristic. Percents of sandy and, partly, silty fraction change a bit more. Percentage of silty fraction is somewhat different in basal samples 9 and 8, where it approaches 90 %, but it represents c. 80 %





Sl. 4.4: Blatna Brezovica. Granulometrična sestava vzorcev.

Fig. 4.4: Blatna Brezovica. Granulometric composition of samples.

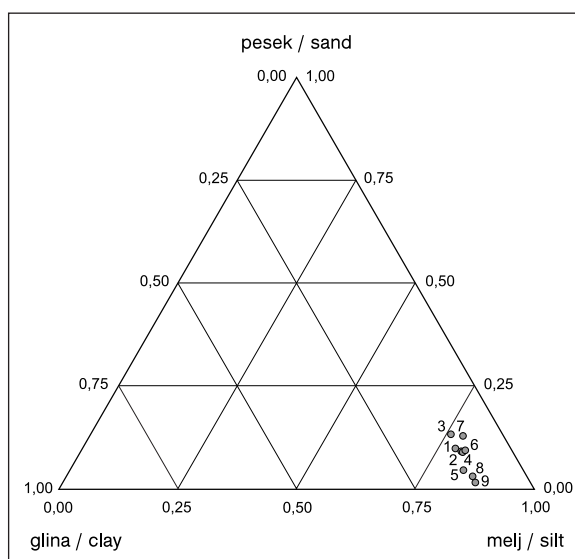
frakcije nekoliko odstopa v talninskih vzorcih 9 in 8, kjer se približa 90 %, v vseh ostalih vzorcih pa se giblje okoli 80 % (sl. 4.4 in 4.5). Splošna interpretacija paleoekoloških razmer v času odlaganja sedimentov na podlagi granulometrične metode ni možna, saj temelji predvsem na spreminjanju deleža peščene frakcije. Lahko pa nam služi kot primerjava z drugima metodama (mikroskopijo frakcije pod 0,2 mm in analizo frakcije nad 0,2 mm).

Najgloblja vzorca 9 in 8 predstavljata močvirsko jezerski sediment z zelo visokim deležem melja (okoli 86 %) in skoraj zanemarljivim deležem peska (< 3 %) (sl. 4.4 in 4.5). Delež peska se izrazito poveča v jezerskih vzorcih 7 in 6, kjer se giblje okoli 10 %, in to predvsem na račun deleža melja. Povečanje deleža peščene frakcije verjetno potrjuje tezo o preraščanju jezera z vodnim rastlinjem oz. njegovem prehajanju v močvirje. Močvirsko rastlinje je bilo past za peščeno frakcijo, ki jo je v bazen prinašala Ljubljaniča. Če bi bilo območje izliva Ljubljaniče v bazen neporaščeno z vodnim rastlinjem, bi se pesek in ostali drobnozrnati sedimenti transportirali proti središču jezera. Tako pa je močvirsko rastje prestreglo drobnozrnat nanose, ki so se odlagali na močvirskem obrobju jezera.

### 4.3 KVANTITATIVNA DIATOMEJSKA ANALIZA

Analiziran je bil le en preparat, ki pripada skrajno talninskemu vzorcu št. 9. Vzorec ni bil pripravljen po standardnih tehnikah za tovrstne analize, saj je bil preiskan preparat, ki je bil narejen za sedimentološko analizo. Za kvantitativne analize relativne zastopanosti posameznih rodov smo pri 500-kratni povečavi prešteli prvih 400 primerkov v vzorcu po metodologiji, ki jo navaja Horvat.<sup>11</sup>

<sup>11</sup> 2004.

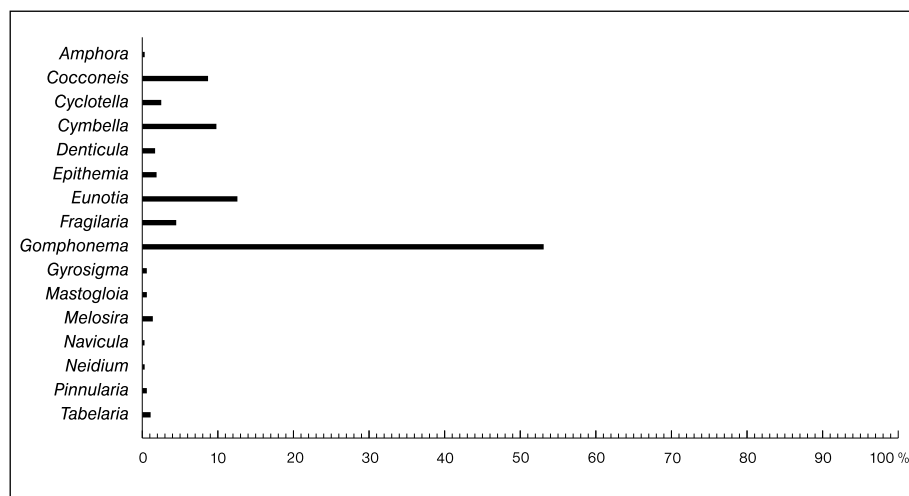


Sl. 4.5: Blatna Brezovica. Trikotni diagram.

Fig. 4.5: Blatna Brezovica. Triangular diagram.

in all the remaining samples (Figs. 4.4 and 4.5). General interpretation of palaeoenvironmental circumstances in the time of deposition of sediments is not possible based on granulometric method, as it depends mostly upon changing of percentage of sandy fractions. However, the results of the granulometry can serve us as a comparison with other methods (microscopy of the fraction below 0.2 mm and analysis of the fraction above 0.2 mm).

The deepest samples 9 and 8 represent marsh-lake sediment with very high percentage of silt (c. 86 %) and almost negligible percentage of sand (< 3 %) (Figs. 4.4 and 4.5). Percentage of sand significantly increases in lake samples 7 and 6, where it represents c. 10 %. Percentage of sand increases mainly because percentage of silt decreases.



Sl. 4.6: Blatna Brezovica. Relativna pogostnost diatomejskih rodov v vzorcu 9.

Fig. 4.6: Blatna Brezovica. Relative frequency of diatom species in sample 9.

Za vzorec je značilen zelo majhen delež planktonskih oblik (*Cyclotella*, *Aulacoseira*, *Melosira*), ki so značilne za jezerska okolja z dobro razvitim profundalom. Več kot 90 % določenih rodov iz obravnavanega vzorca pripada bentoškimi rodovom, kar kaže na sedimentacijo v plitvodnem okolju. Za natančnejše paleoekološke analize bi bilo treba narediti analizo na nivoju vrst, saj imajo rodovi, najdeni v sedimentih v vrtnah Blatna Brezovica in Stare gmajne, preširok razpon ekoloških parametrov.

V vzorcu močno prevladuje rod *Gomphonema*, katerega delež presega 50 %. Razmeroma pogosti rodovi so še *Eunotia* (12,6 %), *Cymbella* (9,8 %), *Cocconeis* (8,7 %) in *Fragilaria* (4,5 %) (sl. 4.6).

Prevladujoči rod *Gomphonema* je značilen za nevtralne in alkalofilne vode.

Nasprotno je *Eunotia* acidofilen rod, značilen za kisle vode z malo karbonata. Rod živi kot epifit v oligotrofnih vodah<sup>12</sup> in je danes pogost v višjih geografskih širinah,<sup>13</sup> kar nakazuje na sedimentacijo za časa hladnejše klime od današnje.

Rod *Cymbella* je značilen za sladkovodne stoječe vode, kjer živi kot epifit ali epilit.<sup>14</sup> Večina oblik rodu živi v oligotrofnih vodah.<sup>15</sup>

*Cocconeis* (sl. 4.7) je perifitonski rod, pogost tako v sladkih kot morskih vodah.<sup>16</sup>

*Fragilaria* je rod, pogost v stoječih vodah v bentosu, redkeje v planktonu.<sup>17</sup> Rod ima široko ekološko toleranco, za natančnejše podatke bi bila potrebna analiza na nivoju vrste.

Increasing trend of sandy fraction probably confirms a thesis about outgrowing of lake with water vegetation, i.e. transition to marsh. Marsh vegetation represented "a trap" for sandy fraction that the Ljubljanica was discharging to the basin. If the area of the outflow of the Ljubljanica to the basin would not be overgrown with water vegetation, sand and the remaining fine-grained sediments would be transported towards the centre of lake. Instead, marsh vegetation intercepted fine-grained deposits, which than deposited in the marshy fringe of the lake.

### 4.3 DIATOM ANALYSIS

Only one slide that belongs to the lowest basal layer sample 9, was analysed. The sample was not prepared according to standard techniques in such analyses, because we analysed slide that was initially made for the purpose of sedimentological analysis. In quantitative analysis of relative abundance of diatom genera we used 500-times enlargement and counted the first 400 specimens in sample, after the methodology, described by Horvat.<sup>11</sup>

Insignificant percentage of planktonic forms (*Cyclotella*, *Aulacoseira*, *Melosira*) that are characteristic for lake environments with well developed profundal, is characteristic for the sample. Over 90 % of identified species are benthos genera, which indicates sedimentation in shallow-water environment. More detailed palaeoecological analysis would require an analysis on the species level while genera found in sediments in boreholes from Blatna Brezovica and Stare gmajne have a too wide span of ecological parameters.

*Gomphonema*, whose relative abundance surpasses 50 %, strongly prevails in the sample. Comparatively

<sup>12</sup> Round, Crawford, Mann 1990.

<sup>13</sup> Hustedt 1959; Lowe 1974; Krammer, Lange-Bertalot 1991.

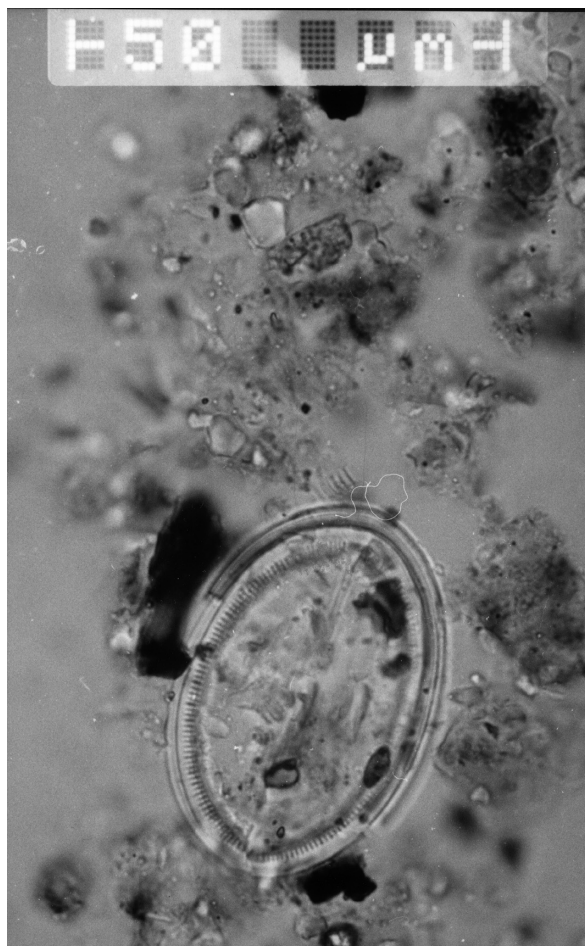
<sup>14</sup> Round, Crawford, Mann 1990.

<sup>15</sup> Krammer, Lange-Bertalot 1986.

<sup>16</sup> Round, Crawford, Mann 1990.

<sup>17</sup> Hustedt 1959; Round, Crawford, Mann 1990.

<sup>11</sup> 2004.



Sl. 4.7: Blatna Brezovica. Diatomeja *Cocconeis placentula*. Foto: J. Turk.

Fig. 4.7: Diatom *Cocconeis placentula* from Blatna Brezovica. Photo: J. Turk.

Vzorec z Blatne Brezovice lahko glede na razmerje zastopanosti rodov *Gomphonema/Fragilaria* in prisotnost rodu *Eunotia* koreliramo s fazo N-4 v vrtini "Na mahu 1".<sup>18</sup> Prav tako v vrtini "Na mahu 1" rod *Cymbella* naraste na okoli 10 %. Faza N-4 v vrtini "Na mahu 1" ustreza starosti približno 6700–5500 let pred sedanostjo oz. globini 230–50 cm. Diatomska združba v fazi N-4 je opredeljena kot plitvovodna in oligotrofna. Nekatere vrste nakazujejo tudi na pogoje, primerne za nastajanje barja in akumulacijo šote.

#### 4.4 SKLEP

Diatomska analiza vzorca 9 potrjuje tezo, da se sedimenti niso odlagali v glavni jezerski fazi razvoja osrednjega dela Ljubljanskega barja. Takšen sklep potrujeta izrazita prevlada perifitonskih rodov in izredno majhen delež planktonskih oblik (4 %), ki so značilne za globljevodna jezerska okolja. Zanimiv je visok delež acidofilnega rodu *Eunotia*, ki običajno nastopa v barjanskih, močvirnatih in vlažnih tleh, skratka v kislih vodnih okoljih. Vendar pa glede na prevlado alkalofitskih rodov sklepamo, da so bile *Eunotie* presedimentirane iz ob-

<sup>18</sup> Andrič et al. 2008.

frequent are also *Eunotia* (12.6 %), *Cymbella* (9.8 %), *Cocconeis* (8.7 %) and *Fragilaria* (4.5 %) (Fig. 4.6).

The dominant genus *Gomphonema* is distinctive for neutral and alkalophilic waters.

On the contrary, *Eunotia* is acidophilic genus, usually found in acidic waters with low pH sparse in carbonates. Genus lives as an epiphyte in oligotrophic waters<sup>12</sup> and is frequent in higher altitudes today,<sup>13</sup> which indicates sedimentation in a colder climate as the climate of today.

*Cymbella* is distinctive for freshwater stagnant water, where it lives as an epiphyte or an epilithic.<sup>14</sup> Majority of the species of the genus are characteristic for oligotrophic waters.<sup>15</sup>

*Cocconeis* (Fig. 4.7) is characteristic for periphyton and is frequent in fresh- as well as sea-waters.<sup>16</sup>

*Fragilaria* is a species frequent in stagnant waters in benthos, more rarely in plankton.<sup>17</sup> The species has extensive ecological tolerance; more accurate data would require analysis on species level.

Sample from Blatna Brezovica can be correlated with phase of development N-4 in the "Na mahu 1" borehole,<sup>18</sup> based on the relationship of the *Gomphonema/Fragilaria* abundance and presence of *Eunotia*. In the "Na mahu 1" borehole the abundance of *Cymbella* also increases to c. 10 %. Phase N-4 from the "Na mahu 1" borehole dates to c. 6700–5500 BP, i.e. to depth of 230–50 cm. Diatom-assemblage in phase N-4 is characteristic for shallow water and oligotrophic conditions. Some species also indicate conditions suitable for development of marsh and accumulation of peat.

#### 4.4 CONCLUSION

Diatom analysis of sample 9 confirms the hypothesis that sediments were not depositing during the main phase of lake development. This is verified by prominent dominance of peryphyton genera and extraordinarily small percent of plankton forms (4 %), distinctive for deep-water lake environments. High percent of acidophilic species *Eunotia*, that is usually present in moors, marshes and waterlogged ground, i.e. in acidic water environments, is interesting. However, considering the

<sup>12</sup> Round, Crawford, Mann 1990.

<sup>13</sup> Hustedt 1959; Lowe 1974; Krammer, Lange-Bertalot 1991.

<sup>14</sup> Round, Crawford, Mann 1990.

<sup>15</sup> Krammer, Lange-Bertalot 1991.

<sup>16</sup> Round, Crawford, Mann 1990.

<sup>17</sup> Hustedt 1959; Round, Crawford, Mann 1990.

<sup>18</sup> Andrič et al. 2008.

robnih močvirskih predelov proti osrednjemu, nekoliko globljevodnemu delu sedimentacijskega bazena. Na to kaže tudi rodova *Cymbella* in *Gomphonema*, katerih predstavniki so značilni tudi za tekoče vode.<sup>19</sup>

Mikroskopska analiza vzorcev iz sedimentnega zaporedja nakazuje tri različne faze odlaganja sedimentov. V prvi, najstarejši fazi se je v skladu z diatomejsko analizo na dnu jezera odlagal prehodni jezersko-močvirski sediment (oz. gyttja) z značilnostmi jezerske krede kot tudi šote. Navzgor se med sedimenti povečuje delež organskih in drugih primesi, kar nakazuje na prehod v tipično močvirsko okolje. Ti močvirski sedimenti so po svojih značilnostih podobni predvsem šoti, v spodnjem delu tudi gyttji. V njih se pojavljajo posamezne diatomeje, nasprotno pa vsebujejo tudi veliko kremenčevih primesi. Krovina je iz humusa.

Granulometrična analiza kaže premajhno variabilnost posamezne frakcije za zanesljivejšo interpretacijo. Kljub temu nakazuje teorijo o počasnem nižanju jezerske gladine in preraščanju nekdanjih jezerskih površin z močvirskim rastjem. Takšno sedimentacijsko okolje naj bi bilo mirno, spremembe pa postopne. "Delta" Ljubljaniče, ki naj bi po naši teoriji nekoč segala neposredno v jezero, je bila pozneje zamočvirjena. Sedimenti, ki jih je prinašala Ljubljaniča, niso več prodrli z vodnim tokom v širše območje umikajočega se jezera, ampak jih je prestreglo bujno močvirsko rastje na obrobju. Sedimentacija je potekala na razmeroma ozkem območju, kar se kaže v nekoliko povečanem deležu peščene frakcije v primerjavi s talninskimi sedimenti.

Mikroskopska analiza frakcije pod 0,2 mm in analiza frakcije, večje od 0,2 mm, nam dajeta razmeroma zanesljive rezultate. Vendar ti podatki bolj kot o drugih dogodkih govorijo o spremembah paleokoljskih razmer oz. o okolju v času odlaganja sedimentov. O dejavnikih, ki so povzročili sedimentološke oz. paleokoljske spremembe, pa na podlagi opisanih analiz ne moremo sklepati.

Prav tako ne moremo podati nobene interpretacije o morebitnem akumulacijsko-erozijskem vplivu Ljubljaniče na spremembo paleokoljskih razmer, ki se je odrazila s krčenjem jezerskega okolja in prehodom v močvirje ter pozneje v barje. V obravnavanem profilu sedimentov so zapisane le postopne in počasne spremembe. Morebitnih sedimentacijskih vrzeli ne moremo popolnoma izključiti, čeprav predvidevamo, da je sedimentacija potekala v mirnem okolju. Sedimenti niso datirani, tako da ne moremo sklepati, ali je sedimentno zaporedje ohranjeno v celoti ali pa morebiti del sedimentnega zapisa manjka.<sup>20</sup>

#### Zahvala

Prvo podpisani avtor se za nemoteno delo z optičnim mikroskopom zahvaljujem prof. dr. Jerneju Pavšiču z Oddelka za geologijo. Zahvala za izdelavo fotografije gre gospodu Marjanu Grmu, prav tako z Oddelka za geologijo.

<sup>19</sup> Krammer, Lange-Bertalot 1986.

<sup>20</sup> Prim. z Verbič 2006.

dominance of alkalophilic species, we assume that they were redeposited from marginal parts of the marsh towards the central, a bit deepwater part of the basin. This can also be confirmed by species *Cymbella* and *Gomphonema*, which are distinct also for running water.<sup>19</sup>

Microscopic analysis of samples from sedimentary sequence indicates three different phases of deposition of sediments. During the first, the oldest phase of development, transitional lake-marsh sediment (gyttia), with characteristics of both, lake marl and peat, was depositing at the bottom of the lake. It is confirmed also by diatom analysis. Observing the sediments upwards, percent of organic and other components increases, which indicates a transition to typical marsh environment. These marshy sediments are similar to peat and also to the gyttia in the bottom part. Individual diatoms occur in them, but they also contain many quartz components. The most upper part of the sequence belongs to the humus.

Granulometric analysis shows restricted variability of individual fraction to make more reliable interpretation. Despite this, the granulometric analysis indicates that water table of the lake was gradually lowering and that former water areas were becoming overgrown with marsh vegetation. Such sedimentation environment was gradual and the changes slow. "The delta" of the Ljubljaniča that would, according to our theory, reach directly into the lake once, later became marshy. Sediments, discharged by the Ljubljaniča, did not deposit within the lake anymore (which was contracting), as lush marsh vegetation on the margin intercepted them. Sedimentation was occurring on a comparatively narrow area, which is reflected in somewhat increased percent of sandy fraction in comparison to the basal layer sediments.

Results of the microscopic analysis of the fraction below 0.2 mm and the analysis of the fraction above 0.2 mm are relatively reliable. However, these data tell us more about changes of palaeoenvironmental circumstances, i.e. about environment in time of deposition of sediments, as opposed to particular events. Based on the analyses described, we cannot discuss factors that caused sedimentological or palaeoenvironmental changes.

Moreover, we cannot pass any interpretation about possible accumulation-erosion impact of the Ljubljaniča on the alteration of the palaeoenvironmental circumstances that reflected in contraction of the lake environment and transition to a swamp and afterward to marsh. Only gradual and slow changes can be seen in the profile of sediments studied above. We cannot completely rule out eventual sedimentation gaps, although we foresee that sedimentation was happening in steady environment. Sediments are not dated; consequently, we cannot assume if the sediment sequence is entirely preserved or perhaps part of the sediment evidence is missing.<sup>20</sup>

<sup>19</sup> Krammer, Lange-Bertalot 1986.

<sup>20</sup> E.g. Verbič 2006.





## 5. KOLIŠČARSKA NASELBINA BLATNA BREZOVICA

Anton VELUŠČEK

## 5. BLATNA BREZOVICA PILE-DWELLING SETTLEMENT

Anton VELUŠČEK

### Izveček

V prispevku so predstavljeni rezultati arheoloških raziskav na koliščarski naselbini Blatna Brezovica, ki jih je Inštitut za arheologijo ZRC SAZU izvedel v letu 2003.

Podana je tudi tipološka preglednica keramike in ostalega gradiva, ki temelji na najdbah, pridobljenih med letoma 1953 in 2003.

**Ključne besede:** najdbe, tipologija keramike, kolišče, Blatna Brezovica, eneolitik.

### Abstract

This chapter introduces results of archaeological research on the pile-dwelling settlement Blatna Brezovica, carried out by the Institute of Archaeology of the Scientific Research Centre of the Slovenian Academy of Sciences and Arts (ZRC SAZU) in 2003.

It also presents a typological determination of pottery and other finds, gained between 1953 and 2003.

**Keywords:** finds, typology of pottery, pile-dwelling, Blatna Brezovica, Eneolithic.

### 5.1 LEGA NAJDIŠČA

**Koda najdišča:** 084303.03<sup>1</sup>

**Lega:** Koliščarska naselbina leži na jugozahodu Ljubljanskega barja ob Lipovskem jarku (tudi Lipavski jarek), približno 700 m jugozahodno od osamelca Blatna Brezovica in približno 200 m severno od Ljubljane.

**Koordinate po karti 1 : 5000:** E 448 616, N 91 380, nadmorska višina = pribl. 289 m.

### 5.1 LOCATION OF THE SITE

**Site code:** 084303.03<sup>1</sup>

**Location:** The pile-dwelling settlement stood on the south-western part of the Ljubljansko barje, next to the Lipovski ditch (also the Lipavski ditch), c. 700 m to the Southwest from the isolated knoll Blatna Brezovica and c. 200 m to the North of the Ljubljana.

**Coordinate on a map to a scale of 1 : 5000:** E 448 616, N 91 380, c. 289 m a.s.l.

### 5.2 ZGODOVINA TERENSKIH RAZISKAV

Arheološko najdišče oz. koliščarsko naselbino Blatna Brezovica so odkrili domačini leta 1942, ko so kopali Lipovski jarek na delu, ki ga imenujejo Dniško. Ob tem so našli številne arheološke artefakte, ki jih je pobral domačin z Blatne Brezovice.<sup>2</sup>

Kmalu zatem je o odkritju poročal časnik *Slovenec* (sl. 5.1). Že leta 1946 pa je koliščarsko naselbino omenil

### 5.2 HISTORY OF RESEARCH

In 1942, while digging the Lipovski ditch, the locals discovered archaeological site/pile-dwelling settlement Blatna Brezovica. It was found on location called Dniško. They came across numerous archaeological artefacts that were collected by a local from Blatna Brezovica.<sup>2</sup>

Soon after, the newspaper *Slovenec* reported about the discovery (Fig. 5.1). Moreover, as soon as 1946, A.

<sup>1</sup> Najdišče je katalogizirano po programu ARKAS (glej Tecco Hvala 1992; Modrijan 1994).

<sup>2</sup> Velušček 1997b, 193–194; prim. s Korošec 1963, 9.

<sup>1</sup> After ARKAS (see Tecco Hvala 1992; Modrijan 1994).

<sup>2</sup> Velušček 1997b, 193–194; compare with Korošec 1963, 9.

## Naselbina barjanskih mostiščarjev pri Vrhniki

Vrhnika in njena okolica skrivata pod svojo ilovnato in maško zemljo ogromno nemih prič tisočletja starih človeških naselbin od neolitika do vdora divjih vzhodnjakov v rimsko provinco. Trgovski Nauportus, poznorimski castrum sta znanstvenemu svetu že znana. Izkopani so že nekateri keltski grobovi in tudi naša via Appia, Stara cesta na Vrhniki, daje malemu krajevemu muzeju vedno nove razstavne predmete; ni še dolgo, ko je delavec Mihevc prinesel vsebino rimskega groba, ki ga je izkopal poleg Naceteve gostilne. To dni pa je g. Franc Gostiša iz Blatne Brezovice rezal jarek svojemu sosedu Lenarčiču. Pri tem je našel na vrsto v zemljo zabitih kolov, debeline 20–30 cm, ki so oddaljeni med seboj nekako za premer svoje debeline. Poleg kolov je bilo dosti črepinj črne keramike in izdelkov iz jelenjega rogova, tako sekira, debela nit, pa tudi več manjših obdelanih kamnov. Veliko zanimanje, ki ga je zlasti na Barju vzbudila najnovejša Jal-

nova knjiga iz dobe mostiščarjev, je tudi g. Gostiša vsililo misel, da je našel novo stavbo na kolih in to domnevo je tudi že potrdil ravnatelj dr. Ložar, ki je nekaj najdb dobil na vpogled. Nova postaja leži južno od vasi Blatna Brezovica kakšnih 160 m severno od Ljubljaničine struge nasproti verdeskem Logu in je od sedaj znanih mostišč najbližja izviru Ljubljaniče. Svet je tam nekoliko zvišen, tako da povodnji ne pridejo do njega. Vsa čast g. Gostiši, ki je o najdbi takoj obvesil strokovnjake, ki se drugače pri nas le prerado zgodijo, da si najditelji izkopanine prisvajajo ali prodajajo v tujino, kot se je to zgodilo še pred kratkim z rimsko vazo, najdeno v strugi Ljubljaniče pri Bevkah, ki jo je neki Ljubljančan spravil čez mejo. Ljubljanski muzej pripravlja strokovno odkopavanje celotne naselbine, ki obeta odkriti še marsikaj zanimivega iz življenja na naših tleh pred davnimi tisočletji.

Sl. 5.1: Izrezek iz dnevnika *Slovenec*, leto LXXI, štev. 45a, 25. februar 1943, 4.

Fig. 5.1: Cutting from a daily newspaper *Slovenec*, year LXXI, no. 45a, 25<sup>th</sup> February 1943, 4.

A. Melik v znamenitem delu o Ljubljanskem barju.<sup>3</sup> Dne 5. maja 1948 je strokovna ekipa v sestavi R. Berce in S. Gabrovec opravila ogled najdišča in geodetsko izmero.<sup>4</sup>

Najpomembnejše in najboljše je bilo raziskovalno izkopavanje, ki je leta 1953 pod vodstvom J. Korošca potekalo na desnem bregu Lipovskega jarka na parc. št. 408 k. o. Blatna Brezovica, kar je bilo deset let pozneje monografsko objavljeno v zbirki *Dela 1. razreda SAZU*.<sup>5</sup>

Po besedah S. Petriča naj bi v istem letu Korošec izkopaval tudi na bližnji Varškovi parc. št. 406, ki pa je bila negativna. Iz dokumentacije, ki jo hrani Inštitut za arheologijo ZRC SAZU, je razvidno, da je Korošec dejansko nameraval zastaviti še eno sondo na levem bregu Lipovskega jarka, na parc. št. 407. Ker je v rokopisu ob št. parc. 407 postavljen vprašaj, se zdi mogoče, da gre za parc. št. 406. Kakor koli že, iz vira ni razvidno, ali je Korošec na parc. št. 406 oz. 407 izkop tudi opravil.<sup>6</sup>

S koncem izkopavanja v letu 1953 je zanimanje za kolišče kot arheološko območje skoraj utonilo v pozabo. V literaturi je sicer zabeleženih nekaj krajših topografskih notic o najdišču, pomembnejših raziskav pa ni bilo več.<sup>7</sup>

Šele leta 2003 je ekipa Inštituta za arheologijo ZRC SAZU na območju Koroščevega izkopavališča zastavila dve večji sondi, kjer smo pridobili vzorce lesa za dendrokronološke raziskave, ob tem pa z roba še nedotaknjenih plasti pobrali vzorce za sedimentološke,<sup>8</sup> palinološke in druge naravoslovne analize.

Melik mentioned the pile-dwelling settlement in his famous publication about the Ljubljansko barje.<sup>3</sup> On 5<sup>th</sup> May 1948, a professional team (R. Berce and S. Gabrovec) completed site-walking and made geodesic measurements.<sup>4</sup>

The most extensive research and excavation was done in 1953, under management of J. Korošec, on the right bank of the Lipovski ditch on plot no. 408 in the Blatna Brezovica cadastral registry. The results were published ten years later as a monograph in periodical *Dela 1. razreda SAZU*.<sup>5</sup>

S. Petrič notes that Korošec was also digging on a nearby Varšek's plot no. 406 in the same year, but the plot was archaeologically negative. Documentation, held by the Institute of Archaeology ZRC SAZU, shows that Korošec intended to open another trench on the left bank of the Lipovski ditch, plot no. 407. There is a question mark next to the plot no. 407 in a handwritten report, and it looks possible that this is actually plot no. 406. Nonetheless, even the handwritten report does not state whether the excavation on the plot no. 406 or 407 was done or not.<sup>6</sup>

With conclusion of excavation in 1953, there was no interest for the pile-dwelling as an archaeological site. Some shorter topographic notes exist, but there have been no important researches.<sup>7</sup>

In 2003, a team of the Institute of Archaeology, opened two large trenches on the area excavated by Korošec. We gained samples of wood for dendrochronological research and picked up samples for sedimentological,<sup>8</sup> palynological and other natural history analyses from the edge of the intact layers.

<sup>3</sup> Melik 1946, 81.

<sup>4</sup> Glej Velušček 1997b, 193–194.

<sup>5</sup> Korošec 1963.

<sup>6</sup> Velušček 1997b, 193–194.

<sup>7</sup> Vuga 1979, 258; Velušček 1997b, 194.

<sup>8</sup> Glej poglavje 4 v tem zborniku.

<sup>3</sup> Melik 1946.

<sup>4</sup> See Velušček 1997b, 193–194.

<sup>5</sup> Korošec 1963.

<sup>6</sup> Velušček 1997b, 193–194.

<sup>7</sup> Vuga 1979, 258; Velušček 1997b, 194.

<sup>8</sup> See Chapter 4 in this monograph.



Sl. 5.2: Izkopavališče iz leta 1953 (po Korošec 1963, priloga 10).

Fig. 5.2: Excavation in 1953 (after Korošec 1963, Appendix 10).

## 5.2.1 RAZISKOVANJE LETA 1953

## 5.2.1 RESEARCH IN 1953

### 5.2.1.1 IZKOPAVALIŠČE (sl. 5.2)

### 5.2.1.1 EXCAVATION SITE (Fig. 5.2)

Na Blatni Brezovici je Korošec raziskoval od 1. do 30. julija 1953. Izkopavališče je zastavil na parc. št. 408 k. o. Blatna Brezovica in je obsegalo 304 m<sup>2</sup>, tj. 19 kvadrantov po 4 × 4 m.<sup>9</sup>

Po mnenju izkopavalca<sup>10</sup> so pri izkopavanju zadeli na kolišče površine približno 170 m<sup>2</sup>. Kolišče naj bi bilo štirioglatno, grajeno pravilno s popolnoma ravnimi

From 1<sup>st</sup> to 30<sup>th</sup> July 1953, Korošec carried out excavations at Blatna Brezovica. He located the site plot no. 408 in the Blatna Brezovica cadastral registry. The excavation area encompassed 304 m<sup>2</sup>, i.e. 19 quadrants of 4 × 4 m each.<sup>9</sup>

According to Korošec, they dug c. 170 m<sup>2</sup> of the pile-dwelling.<sup>10</sup> The pile-dwelling was thought to be

<sup>9</sup> Velušček 1997b, 193–195.

<sup>10</sup> Korošec 1963, 9–16.

<sup>9</sup> Velušček 1997b, 193–195.

<sup>10</sup> Korošec 1963, 9–16.

stranicami. Usmerjeno je bilo od severa proti jugu oz. od severovzhoda proti jugozahodu.

Izkopavalec je odkril 332 vertikalnih ter 9 horizontalnih kolov. Vertikalni koli so bili v 11 oz. 12 vrstah, ki so stale vzporedno z ožjo stranjo kolišča in so potekale pravilno od zahoda proti vzhodu.

Vrst niso sestavljali le posamezni koli, temveč mestoma tudi skupine po nekaj kolov, razmeščenih na razne načine. Oddaljenost ene vrste kolov od druge je bila zelo različna: največ približno 2 do 2,3 m, najmanj pa približno 1 m. Tudi debelina kolov je bila različna, od 4 do 21 cm, povprečno od 7 do 10 cm.

Koli, ki so stali v vrstah, naj bi predstavljali glavno oporo, na kateri so ležala prečna bruna, na teh šele pod kolišča. Načina, kako so bila bruna položena na oporo, izkopavalcu sicer ni uspelo dognati. Na podlagi dobre ohranjenosti pa je sklepal, da kolišča ni prizadel požar.

Poleg 9 horizontalnih kolov sta bili ob južnem robu kolišča odkriti tudi 2 debli, ki sta ležali vzporedno s koliščem, ter nekoliko južneje še 2 debli. Šlo je za od 2 do 4 m dolge kose, debeline od približno 20 do 35 cm. Odkritje debel naj bi dokazovalo, da so bila po vodi privlečena h kolišču in da so jih nameravali uporabiti kot gradivo, malo verjetno, da v funkciji valobrana.

Na severozahodnem robu kolišča so našli tudi vejevje, ki je bilo skupaj s horizontalnimi koli verjetno ostanek hišnih sten oz. opleta, kar naj bi dokazovala tudi tanka plast gline, ki so jo našli tako nad opletom kot pod njim in tudi med koli ter vejevjem.

Med koli so naleteli tudi na večje število kamnov. Ležali so tako v polzarici kot tudi višje v kulturni plasti. Med njimi jih je bilo največ iz peščenca in apnenca. Po mnenju Korošca so kamni verjetno služili kot gradbeni material za obteževanje predvsem strehe. Poleg neobdelanih kamnov so naleteli tudi na ostanke žrmelj, ki so jih našli v raznih kvadrantih: kv. X – 5 fragmentov; kv. XIII – 3 fragmente; kv. 1 – 1 fragment; kv. XI – 4 fragmente; kv. I – 2 fragmenta itd.

V kvadrantu XIV so v globini 1,15 m naleteli tudi na večjo koncentracijo semen maline in drugih makrorastlinskih ostankov ter na ribje luske. Teh so v večji količini našli v kvadrantu X.

#### 5.2.1.2 VERTIKALNA STRATIGRAFIJA

Zanimiva je tudi vertikalna stratigrafija. Korošec je opisal in slikovno predstavil 9 profilov.<sup>11</sup> Najglobljo plast je predstavljala svetlosiva peščena ilovica oz. jezersko dno. V kv. I, III, IV, VI, XVII–XIX je na njej ležala temnosiva ilovica, v kateri je bilo najti kulturne ostanke. T. i. kulturno plast je po celotni površini prekrivala temnorjava šotna plast, na nekaterih mestih tudi črnorjava šotna glina, nad njo pa sta ležali še dve plasti: črnorjav subhumus in ruša.

<sup>11</sup> Korošec 1963, 16–21, pril. I–IX.

quadrangular, built accurately, with completely straight sides. It was positioned in the south-north, or, southeast-northwest direction.

Korošec discovered 332 vertical and 9 horizontal piles. Vertical piles formed 11 or 12 rows, running parallel with the narrower side of the pile-dwelling, in the west-east direction.

Rows were not formed only by individual piles, but also clusters of piles, which were arranged in several different ways. Distance between pile rows was c. 2 to 2.3 m at its widest and c. 1 m at its narrowest part. Moreover, thickness of piles was not uniform; they measured 4 to 21 cm, with an average of 7 to 10 cm.

Rows of piles formed foundations, on which transverse base-planks were placed and, on top of these, the pile-dwelling platform was constructed. Korošec did not manage to find out how the horizontal constructional elements were fastened onto the vertical piles. He presumed, based on good preservation, that the pile-dwelling was not destroyed by fire.

Apart from 9 horizontal piles, 2 logs were found next to the southern edge of the pile-dwelling, laying parallel with the pile-dwelling and 2 more logs were discovered a bit more towards the south. Logs were 2 to 4 m long and c. 20 to 35 cm thick. Discovery of these logs is perhaps proving that they were dragged to the pile-dwelling across the water and were intended to be used as building material. It is unlikely that they would serve as a breakwater.

In addition, branches were discovered on the northwestern edge of the pile-dwelling. They, together with horizontal piles, probably form remains of house walls or whitys. This can furthermore be confirmed by a thin layer of clay, found above and under withys and also on piles and branches.

A large number of stones were found between piles. They were present on lake marl as well as higher, in cultural layer. They were mostly sandstone and limestone. According to Korošec, stones most probably served as roof weighting material. Apart from unworked stones, they also came across quern remains, which were found in several quadrants: quadrant X – 5 fragments; quadrant XIII – 3 fragments; quadrant 1 – 1 fragment; quadrant XI – 4 fragments; quadrant I – 2 fragments etc.

In quadrant XIV, in depth of 1.15 m, a larger concentration of raspberry seeds, other macro-vegetal remains and fish scales were found. The latter were most frequent in quadrant X.

#### 5.2.1.2 VERTICAL STRATIGRAPHY

Vertical stratigraphy is also interesting. Korošec described and illustrated 9 cross-sections.<sup>11</sup> The deepest layer was a light grey sandy loam or lake bottom. It was

<sup>11</sup> Korošec 1963, 16–21, app. I–IX.

Nekoliko drugačna je bila stratigrafija, odkrita v kv. VIII in X. Najglobljo plast sta predstavljali siva peščena ilovica (kv. VIII) ali temnosiva ilovica z ostanki oglja in kulturnimi ostalinami (kv. X). Sledila je kulturna plast, ki se je pokazala za kompleksnejšo kot v ostalih kvadrantih:

1. v črnojavi plasti z organskimi in kulturnimi ostanki so naleteli na vložke sivorumenkaste gline s peskom, organskimi in kulturnimi ostanki ter vložke sivorjave ilovice, pomešane s šoto in organskimi ostanki (severni profil kv. X);

2. v sivočrni humozni plasti s kulturnimi ostanki so naleteli na vložke svetlosive ilovice, delno pomešane z ogljem, in na vložke črne oglene plasti, ki jo je delno prekrivala črnojava plast z vejami in kulturnimi ostanki (severni profil kv. VIII).

Nad kulturno plastjo so sledile plasti temnorjave šote, temno- oz. črnojavega subhumusa in ruše.

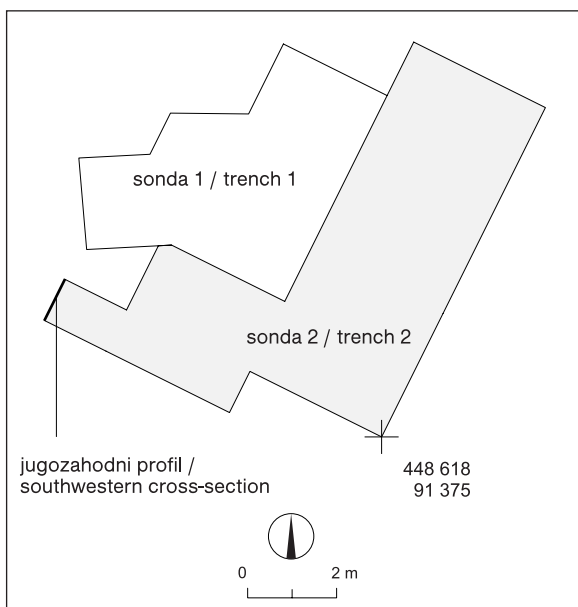
### 5.2.2 RAZISKOVANJE INŠTITUTA ZA ARHEOLOGIJO ZRC SAZU LETA 2003

V letu 2003 je v dveh časovno ločenih etapah na območju koliščarske naselbine Blatna Brezovica potekalo terensko raziskovanje Inštituta za arheologijo ZRC SAZU:

1. etapa: med 20. in 30. majem
2. etapa: med 21. oktobrom in 11. novembrom.

Na leta 1953 raziskanem območju sta bili zastavljene dve sorazmerno veliki sondi<sup>12</sup> (sl. 5.3). Ob tem smo na robu izkopavališča dosegli tudi nedotaknjene plasti, kjer smo dokumentirali profil in vzeli vzorce za naravoslovne raziskave. Tako smo z malo stroški najprej pridobili les za

<sup>12</sup> Sondi sta bili sorazmerno veliki, če ju primerjamo s površinami sond na Hočevarici (8 m<sup>2</sup>) in Starih gmajnah (do 15 m<sup>2</sup>).



overlain by a dark grey loam with cultural remains in quadrants I, III, IV, VI, XVII-XIX. A dark brown peaty layer, also black/brown peaty clay on some spots, overlay a so-called cultural layer over the entire surface. Two layers were laying on top: black/brown subhumus and turf.

Somewhat different stratigraphy can be seen in quadrants VIII and X. Grey sandy loam (quadrant VIII) or dark grey loam with remains of charcoal and cultural remains (quadrant X) form the deepest layers. These are overlain by a cultural layer, which is more complex as in others quadrants:

1. black/brown layer with organic and cultural remains was interlaced with greyey yellow clay with sand, organic and cultural remains and with greyey brown loam mixed with peat and organic remains (northern cross-section of quadrant X)

2. greyey brown humus layer with cultural remains was interlaced with light grey loam, partly mixed with charcoal and with charcoal layer, which is partly overlapped with black/brown layer with branches and cultural remains (northern cross-section of quadrant VIII).

Dark brown peats, dark or black/brown subhumus and turf overlay the cultural layer.

### 5.2.2 RESEARCH OF THE INSTITUTE OF ARCHAEOLOGY ZRC SAZU IN 2003

In 2003, a field research of the Institute of Archaeology on the pile-dwelling settlement Blatna Brezovica was carried out in two stages:

- 1<sup>st</sup> stage: 20<sup>th</sup>-30<sup>th</sup> May;
- 2<sup>nd</sup> stage: 21<sup>st</sup> October-11<sup>th</sup> November.

Two rather large trenches were opened<sup>12</sup> on the area dug in 1953 (Fig. 5.3). We have also investigated previously intact layers on the edge of the excavation site, where we documented cross-sections and took samples for natural history researches. Consequently, we gained wood for dendrochronological researches and samples for interdisciplinary research with almost no cost.

#### 5.2.2.1 THE EXCAVATION SITE (Fig. 5.3)

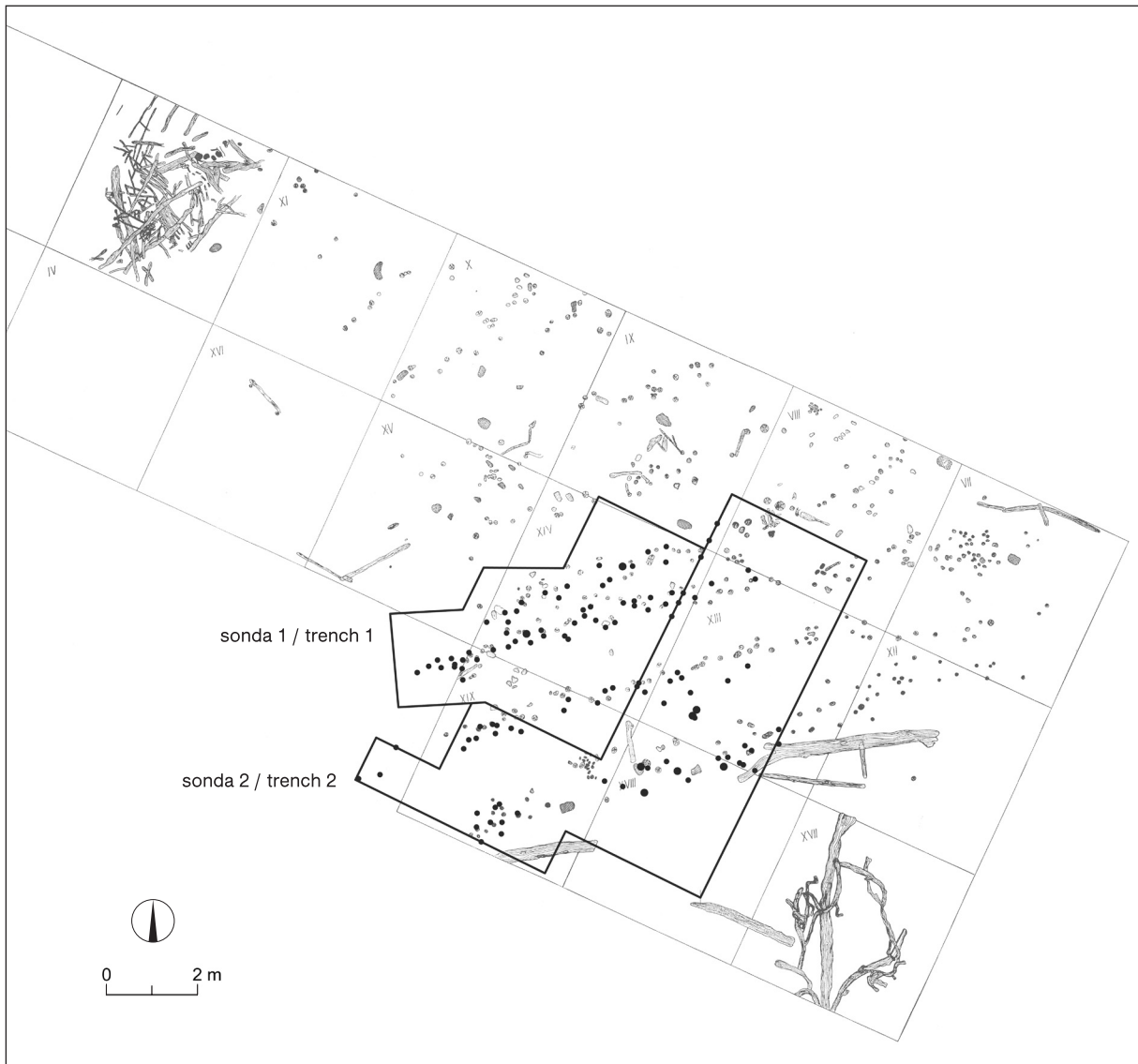
In May, trench 1 was opened on the south-eastern part of the 1953 excavations. Based on field observation and Korošec's documentation, the trench was excavated in the range of quadrants X and XVIII (see Fig. 5.4). At first, we widened the trench northwards, in the direction

<sup>12</sup> Trenches were large if compared to the ones at Hočevarica (8 m<sup>2</sup>) and Stare gmajne (15 m<sup>2</sup>).

Sl. 5.3: Sondi 1 in 2 iz leta 2003. Risba: T. Korošec.

Fig. 5.3: Trenches 1 and 2 from 2003. Drawn by: T. Korošec.





Sl. 5.4: Poskus uskladitve načrtov izkopavanj iz let 1953 in 2003. Risba: T. Korošec.

Fig. 5.4: An attempt of synchronization of excavations plans from 1953 and 2003. Drawn by: T. Korošec.

dendrokronološke raziskave, pa tudi že omenjene vzorce za interdisciplinarno raziskovanje.

#### 5.2.2.1 IZKOPAVALIŠČE (sl. 5.3)

Majska sonda 1 je bila zastavljena na jugovzhodnem delu izkopavališča iz leta 1953. Na podlagi terenskega opazovanja in Koroščeve dokumentacije smo sondo zastavili na območju med kv. X in XVIII (glej sl. 5.4). Sprva smo se usmerili proti severu, v smeri proti Lipovskemu jarku, kasneje pa smo sledili vertikalnim kolom v smeri proti jugozahodu. Na skrajnem jugozahodnem delu izkopnega polja smo naleteli na nedotaknjene plasti ter na tem mestu zastavili manjšo sondo, da bi pridobili manjše, leta 1953 večinoma prezrte artefakte in makrorastlinske ostanke.

towards the Lipovski ditch. Later, we followed vertical piles in the direction towards the southwest. We came across intact layers on the utmost south-western part of excavation. We opened a smaller trench on this area, to gain artefacts, overlooked in 1953, and macro-vegetal remains.

In autumn, trench 2 was opened eastwards from the trench, dug in May. The excavation site was widened towards the north at first, in the Lipovski ditch direction, where we came across a continuation of vertical piles, which were documented in May. It soon turned out that the ground near the ditch was so dried out, that piles were disintegrated and therefore inappropriate for dendrochronological research. The excavation area was then widened towards the south or southwest, where we, similarly as in May, came across intact layers and took

Sl. 5.5: M. Andrič pri zajemanju vzorcev za palinološke raziskave iz profila na jugozahodnem delu sonde 2. Foto: M. Dirjec.

Fig. 5.5: M. Andrič taking samples for a palynological research. Cross-section on the south-western part of trench 2. Photo: M. Dirjec.

Jesenska sonda 2 je bila zastavljena vzhodno od majskega izkopavališča. Izkopavališče se je sprva širilo proti severu, v smeri proti Lipovskemu jarku, kjer smo naleteli na nadaljevanje skupine vertikalnih kolov, dokumentiranih v maju. Kmalu se je izkazalo, da je na območju v bližini jarka teren izsušen že do takšne mere, da so koli zelo prepereli in neprimerni za dendrokronologijo. Izkopavališče smo nato širili proti jugu oz. jugozahodu, kjer smo podobno kot maja na skrajnem robu naleteli na nedotaknjene plasti in odvzeli vzorce sedimenta za interdisciplinarne raziskave.<sup>13</sup>



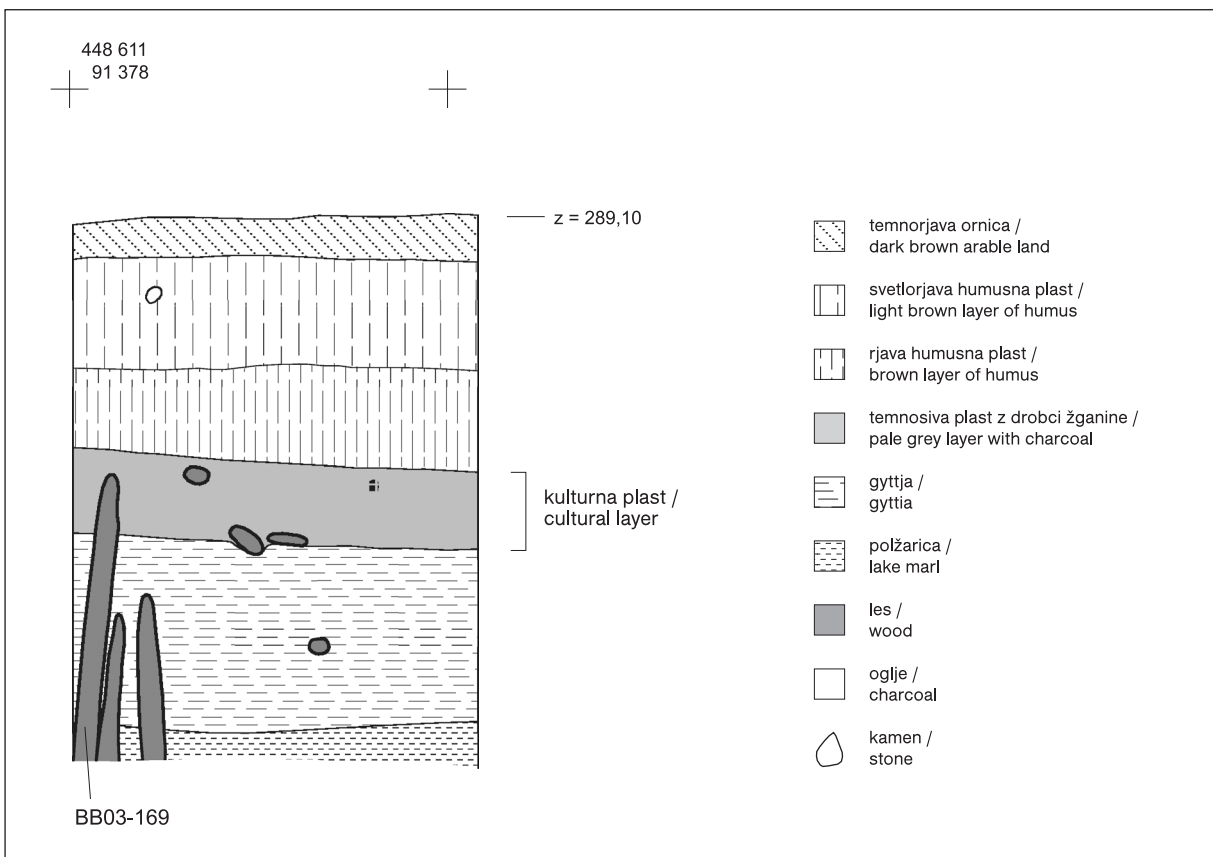
samples of sediment on the utmost edge of the trench for interdisciplinary researches.<sup>13</sup>

#### 5.2.2.2 VERTIKALNA STRATIGRAFIJA (sl. 5.6)

#### 5.2.2.2 VERTICAL STRATIGRAPHY (Fig. 5.6)

<sup>13</sup> Analizo sedimentološkega profila objavljamo v poglavju 4 v tem zborniku, medtem ko so rezultati drugih naravoslovnih analiz v fazi priprave za objavo.

<sup>13</sup> See Chapter 4 in this monograph for the analysis of the sedimentological profile. Results of other natural science analyses are being prepared for publication.



Sl. 5.6: Profil v jugozahodnem delu sonde 2. Risba: T. Korošec. M = 1 : 20.

Fig. 5.6: Cross-section of south-western part of trench 2. Drawn by: T. Korošec. Scale = 1 : 20.



V nadaljevanju predstavljamo vertikalno stratigrafijo na podlagi profila na skrajno jugozahodnem delu sonde 2 (sl. 5.3).

Na dnu sonde smo prišli do svetlosivega blata oz. jezerske krede, ki skoraj neopazno preide v plast 5, t. i. gytijo temnosive barve, v kateri se že pojavljajo posamezne arheološke najdbe. Na plasti 5 leži slabo prepoznavna plast 4. Gre za t. i. kulturno plast temnosive barve, v kateri je bilo najti detritus, kamne in večino arheoloških najdb. Analiza je pokazala, da je v času tvorjenja te plasti na tem območju prevladovalo močvirsko oz. barjansko okolje.<sup>14</sup>

Na plasti 4 leži humusna plast 3 temnorjave barve, v kateri je najti znatno količino organskih ostankov: npr. zrn.

Plast 3 prekrivata še dve humusni plasti, svetlorjava plast 2 in plast 1 – ruša.

### 5.3 NAJDBE

Korošec je izpostavil pomen drobnih (arheoloških) najdb za datacijo in kulturno opredelitev. V to skupino je uvrstil kamnite, koščene, lesene in keramične artefakte.<sup>15</sup> Najti jih je bilo razmeroma veliko. Tako se glede na njihovo številčnost koliščarska naselbina Blatna Brezovica bistveno ne razlikuje od nekaterih drugih koliščarskih naselbin Ljubljanskega barja, kot so npr. Notranje Gorice,<sup>16</sup> Maharski prekop,<sup>17</sup> Hočevarica<sup>18</sup> itd.

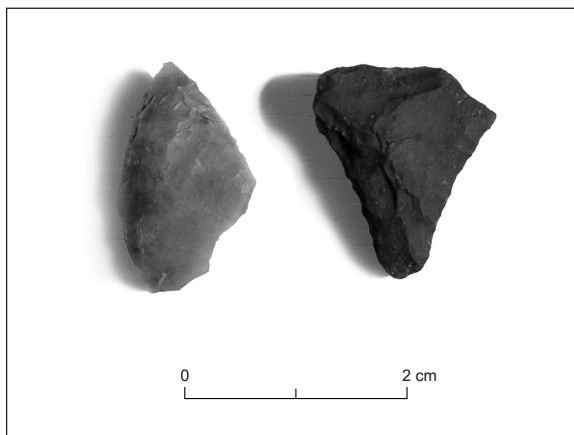
<sup>14</sup> Glej poglavje 4 v tem zborniku.

<sup>15</sup> Korošec 1963, 21.

<sup>16</sup> Schmid 1910.

<sup>17</sup> Bregant 1996.

<sup>18</sup> Velušček 2004a.



Sl. 5.8: Kamniti pušični osti. Foto: T. Korošec.

Fig. 5.8: Stone arrowheads. Photo: T. Korošec.



Sl. 5.7: Profil v jugozahodnem delu sonde 2. Foto: M. Dirjec.

Fig. 5.7: Cross-section of south-western part of trench 2. Photo: M. Dirjec.

Vertically stratigraphy, based on the cross-section from the far south-western part of trench 2 (Fig. 5.3) is described below.

We came across light grey mud or lake marl at the bottom of the trench. This layer almost imperceptibly transforms to layer 5, so-called gytia, dark grey in colour, containing some individual archaeological finds. A hardly recognizable layer 4, a so-called cultural layer, dark grey in colour, containing detritus, stones and the majority of archaeological finds, overlies layer 5. Analysis showed that moor or marshy environment existed on this area in time of formation of this layer.<sup>14</sup>

Humus layer 3, dark brown in colour, lies on top of layer 4. It contains a considerable amount of organic remains: e.g. grains.

Layer 3 is overlapped by two humus layers, light brown layer 2 and layer 1 – turf.

### 5.3 FINDS

Korošec emphasised the importance of small (archaeological) finds for dating and cultural definition of a site. He placed stone, bone, wooden and pottery artefacts to this group.<sup>15</sup> They were numerous. Their quantity in the pile-dwelling settlement Blatna Brezovica is similar to other pile-dwelling settlements of the Ljubljansko barje, such as Notranje Gorice,<sup>16</sup> Maharski prekop,<sup>17</sup> Hočevarica<sup>18</sup> etc.

<sup>14</sup> See Chapter 4 in this monograph.

<sup>15</sup> Korošec 1963, 21.

<sup>16</sup> Schmid 1910.

<sup>17</sup> Bregant 1996.

<sup>18</sup> Velušček 2004a.

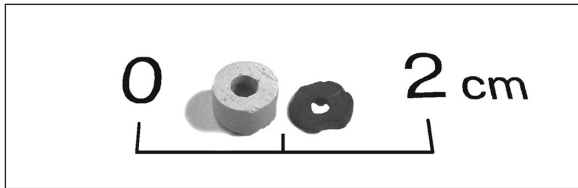
### 5.3.1 NEKERAMIČNE NAJDBE

#### 5.3.1.1 KAMNITE NAJDBE

Med nekeramičnimi najdbami naj najprej navedemo kamnite, to so: žrmlje, puščične osti (*t. 5.9: 3; sl. 5.8*), konice,<sup>19</sup> noži,<sup>20</sup> kladivaste sekire<sup>21</sup> in brusi na uho (*t. 5.1: 5*)<sup>22</sup> ali brez ušesa.<sup>23</sup>

Natančna petrografska analiza je bila opravljena samo za brus na uho (*t. 5.1: 5*). Razkriva, da je bil narejen iz surovine, ki se nahaja v bližnji okolici Ljubljanskega barja,<sup>24</sup> podobno kot velja za žrmlje, ki jih je makroskopsko preučil J. Turk.<sup>25</sup>

Čeprav Korošec o kamnitih jagodah ne poroča,<sup>26</sup> smo leta 2003 odkrili dve jagodi. V bistvu gre za ogrlična obročka. Prvi je iz bele, drugi iz črne kamnine (*sl. 5.9*). Na pogled sta najdbi podobni majhnim ogrličnim obročkom z ostalih najdišč Ljubljanskega barja, med katerimi naj omenimo npr. obročke s Hočevarice<sup>27</sup> in Starih gmajn.<sup>28</sup>



#### 5.3.1.2 KOŠČENE NAJDBE IN NAJDBE IZ ROGOVJA

Podobno kot na drugih koliščih Ljubljanskega barja smo tudi na Blatni Brezovici našli najdbe iz kosti: šila, dleta itd.,<sup>29</sup> in rogovja.<sup>30</sup>

#### 5.3.1.3 LESENI OZ. DRUGI RASTLINSKI ARTEFAKTI

V mokrih tleh Ljubljanskega barja se zelo dobro ohranijo tudi najdbe iz lesa in drugih manj odpornih organskih materialov. Najprej omenimo lesene artefakte. Tako je leta 1953 Korošec odkril lesen korec<sup>31</sup> in več fra-

<sup>19</sup> Korošec 1963, t. 12: 7.

<sup>20</sup> Korošec 1963, t. 12: 6; 13: 1,2; 14: 1.

<sup>21</sup> Korošec 1963, t. 15: 4-7.

<sup>22</sup> Glej še Korošec 1963, t. 15: 2.

<sup>23</sup> Korošec 1963, t. 15: 1, 3.

<sup>24</sup> Glej poglavje 12 v tem zborniku.

<sup>25</sup> Poglavje 13 v tem zborniku.

<sup>26</sup> Glej Korošec 1963, 25.

<sup>27</sup> Velušček 2004b, sl. 3.1.20; Skaberene, Mladenovič 2004, 65-68.

<sup>28</sup> Poglavje 3.2.2.2 v tem zborniku.

<sup>29</sup> Korošec 1963, t. 16; 17: 1-12; glej še poglavje 14 v tem zborniku.

<sup>30</sup> Korošec 1963, t. 20: 9-13.

<sup>31</sup> Korošec 1963, t. 19: 1.

### 5.3.1 NON-CERAMIC FINDS

#### 5.3.1.1 STONE FINDS

The following stone finds were discovered: quern stones, arrowheads (*Pl. 5.9: 3; Fig. 5.8*), points,<sup>19</sup> knives,<sup>20</sup> shaft-hole axes<sup>21</sup> and whetstones with (*Pl. 5.1: 5*)<sup>22</sup> or without holes.<sup>23</sup>

Detailed petrographical analysis was done only on a whetstone with a hole (*Pl. 5.1: 5*). It was made of raw material, originating from the immediate environs of the Ljubljansko barje.<sup>24</sup> Similar can be claimed for querns, which were macroscopically analysed by J. Turk.<sup>25</sup>

Although Korošec did not mention stone beads,<sup>26</sup> we discovered two in 2003. They are actually necklace ringlets. One is made of white, and the other of black rock (*Fig. 5.9*). Finds are similar to small necklace ringlets, which were found on the other sites of the Ljubljansko barje, e.g. ringlets from Hočevarica<sup>27</sup> and Stare gmajne.<sup>28</sup>

*Sl. 5.9: Kamnita ogrlična obročka. Foto: T. Korošec.  
Fig. 5.9: Stone necklace ringlets. Photo: T. Korošec.*

#### 5.3.1.2 BONE AND ANTLER FINDS

Similarly as other pile-dwellings of the Ljubljansko barje, also Blatna Brezovica yielded some bone: awl, chisel etc.<sup>29</sup> and antler finds.<sup>30</sup>

#### 5.3.1.3 WOODEN OR REMAINING VEGETABLE ARTEFACTS

Wooden finds and objects from other less resistant organic materials are well preserved in wet ground of the Ljubljansko barje. We first have to mention wooden artefacts. In 1953, Korošec discovered a wooden dipper<sup>31</sup>

<sup>19</sup> Korošec 1963, Pl. 12:7.

<sup>20</sup> Korošec 1963, Pls. 12: 6; 13: 1,2; 14: 1.

<sup>21</sup> Korošec 1963, Pl. 15: 4-7.

<sup>22</sup> See also Korošec 1963, Pl. 15: 2.

<sup>23</sup> Korošec 1963, Pl. 15: 1,3.

<sup>24</sup> See Chapter 12 in this monograph.

<sup>25</sup> Chapter 13 in this monograph.

<sup>26</sup> See Korošec 1963, 25.

<sup>27</sup> Velušček 2004b, Fig. 3.1.20; Skaberene, Mladenovič 2004, 65-68.

<sup>28</sup> Chapter 3.2.2.2 in this monograph.

<sup>29</sup> Korošec 1963, Pls. 16; 17: 1-12; see also Chapter 14 in this monograph.

<sup>30</sup> Korošec 1963, Pl. 20: 9-13.

<sup>31</sup> Korošec 1963, Pl. 19: 1.



gmentov neidentificiranih lesenih posod.<sup>32</sup> Našli so tudi odlomke vesel<sup>33</sup> in morda tudi kopje.<sup>34</sup> Gre za 2,20 m dolg lesen predmet, na eni strani priostren, na drugi s krilcem trikotnega preseka.

Med pomembne lesene najdbe z Blatne Brezovice lahko uvrstimo tudi nakit, ki je bil narejen iz lesa oz. drevesne skorje. Tako je Korošec našel tri jagode,<sup>35</sup> h katerim moramo prišteti tudi jagode, najdene leta 2003.

Jagode pa so bile narejene tudi iz drugih delov rastlin: npr. koščic itd. Podobne kot na Blatni Brezovici smo v precej večjem številu našli v sondi 2 na Starih gmajnah.<sup>36</sup>

Korošec tudi omenja, da so pri izkopavanju na Blatni Brezovici naleteli na večje kose tkanine, tkane v ožjih, pribl. 2 cm širokih trakovih. Analiza je pokazala, da so vlakna rastlinskega izvora in da pripadajo konoplji ali lanu.<sup>37</sup> Ker pa konoplje v obdobju Blatne Brezovice na Ljubljanskem barju še niso poznali,<sup>38</sup> se zdi verjetneje, da gre za ostanke tkanine iz lanu.

### 5.3.2 KERAMIČNE NAJDBe

Kot že omenjeno, je med arheološkimi najdbami ali artefakti z Blatne Brezovice daleč največ keramike. Veliko večino je leta 1953 pridobil Korošec pri raziskovalnem izkopavanju in gradivo o tem deset let kasneje tudi objavil.<sup>39</sup> Objava je bila izhodišče za dve modernejši tipološki analizi keramike. Prvo je leta 1984 opravil H. Parzinger,<sup>40</sup> drugo pa A. Velušček leta 2001 oz. 2004.<sup>41</sup>

Slednji sledimo tudi v tej monografiji. Pri vrednotenju smo se podobno kot v primeru keramičnih najdb s Starih gmajn<sup>42</sup> oprli na naslednja metodološka izhodišča:

1. V analizo smo vključili vse objavljene oz. narisane keramične najdbe iz let 1953 in 2003.
2. Keramiko smo preučevali makroskopsko.
3. Zaradi prostorskih omejitev in specifične metode pridobivanja najdb (glej zgoraj), fragmentov, pridobljenih leta 2003, razen v redkih primerih, ko je razviden svež prelom, nismo poskušali sestavljati.
4. Oblike leta 2003 pridobljenih posod so bile določene na podlagi risarske rekonstrukcije – v poštev so prišli predvsem večji fragmenti, v glavnem ustja z ostenji.
5. Za objavo so bile pripravljene vse najdbe iz leta 2003, ki smo jih subjektivno označili za izpovedne in se zdi,

<sup>32</sup> Npr. Korošec 1963, 24, t. 20: 3.

<sup>33</sup> Korošec 1963, 24, t. 20: 1,2,7.

<sup>34</sup> Korošec 1963, 24, t. 20: 8.

<sup>35</sup> Korošec 1963, t. 13: 3–5.

<sup>36</sup> Glej poglavje 3.2.2.1 v tem zborniku: *sl.* 3.32.

<sup>37</sup> Korošec 1953, 260.

<sup>38</sup> T. Tolar, osebna komunikacija.

<sup>39</sup> Korošec 1963.

<sup>40</sup> 1984.

<sup>41</sup> Velušček 2001; 2004d, 222–225.

<sup>42</sup> Glej poglavje 3.2.1 v tem zborniku.

and several fragments of unidentified wooden vessels.<sup>32</sup> Fragments of oars<sup>33</sup> and perhaps a javelin were also discovered.<sup>34</sup> The latter is a 2.20 m long wooden object, pointed on one side and with a fin of a triangular intersection on the other.

Jewellery, made of wood and bark, can also be placed among important wooden finds from Blatna Brezovica. Korošec found three beads<sup>35</sup> and some more were discovered in 2003.

Beads were made also from other parts of plants: e.g. kernels. Large quantities of similar beads were also found in trench 2 at Stare gmajne.<sup>36</sup>

Korošec also notes that they came across larger pieces of fabric, woven in narrow, c. 2 cm wide bands, at excavation on Blatna Brezovica. Analysis showed that it is fibres of vegetal origin, hemp or flax.<sup>37</sup> As hemp was not known on the Ljubljansko barje during the existence of Blatna Brezovica,<sup>38</sup> it seems likely that it is flax.

### 5.3.2 POTTERY FINDS

As mentioned above, pottery is dominant among the archaeological finds at Blatna Brezovica. The vast majority of it was found by Korošec at 1953 excavation, which was published ten years later.<sup>39</sup> This publication was a starting point for two modern typological analyses of pottery. The first one was carried out by H. Parzinger in 1984<sup>40</sup> and the second one by A. Velušček in 2001 and 2004.<sup>41</sup>

We follow Velušček's typology in this monograph.

The following starting points were, similarly as in case of pottery from Stare gmajne,<sup>42</sup> followed by the evaluation:

1. All published or drawn pottery finds from 1953 and 2003 were included in the analysis.
2. Macroscopic analysis was performed on pottery.
3. Because of spatial restraints and specific method of discovering the finds (see above), we did not try to reassemble the fragments found in 2003; the latter only occurred when fresh fractures were visible.
4. Shapes of vessels, gained in 2003, were determined based on drawing reconstructions – we mostly used larger fragments, usually rims with walls.
5. All finds from 2003 that were subjectively marked as diagnostic, were prepared for publication: rims with walls,<sup>43</sup> ornamented fragments<sup>44</sup> etc.

<sup>32</sup> E.g. Korošec 1963, 24, Pl. 20: 3.

<sup>33</sup> Korošec 1963, 24, Pl. 20: 1,2,7.

<sup>34</sup> Korošec 1963, 24, Pl. 20: 8.

<sup>35</sup> Korošec 1963, Pl. 13: 3–5.

<sup>36</sup> See Chapter 3.2.2.1 in this monograph: *Fig.* 3.32.

<sup>37</sup> Korošec 1953, 260.

<sup>38</sup> T. Tolar, pers.comm.

<sup>39</sup> Korošec 1963.

<sup>40</sup> 1984.

<sup>41</sup> Velušček 2001; 2004d, 222–225.

<sup>42</sup> See Chapter 3.2.1 in this monograph.

<sup>43</sup> All types of vessels are included.

<sup>44</sup> All types of decoration are included.



da so reprezentativne: ustja z ostenjem,<sup>43</sup> ornamentirani fragmenti<sup>44</sup> itd.

6. Število objavljenih primerkov posameznega tipa posode ne odraža dejanskega deleža teh posod na Blatni Brezovici, čeprav je umestno pričakovati, da je pogostejša oblika dejansko tudi številčnejša.

7. Število objavljenih primerkov določenega tipa ornamenta odseva vsaj približno realen delež tako ornamentiranih posod.

8. Analiza količinskega pojavljanja keramike na izkopavališču zaradi pomanjkljivih podatkov s Koroščevih izkopavanj ni bila opravljena.

9. Tipološko označevanje posodja in ornamenta temelji na rahlo modificirani tipologiji keramičnega gradiva s Hočevarice in Maharskega prekopa.<sup>45</sup>

Na Blatni Brezovici prevladuje keramika temnosivih barvnih tonov, svetlosive ali barvno svetlejšje keramike je manj. Keramika je krhka, ob dotiku se rada lomi. Celih posod je malo, prevladujejo fragmenti s starimi prelomi.

Po obliki smo keramiko razdelili na posodje (lonci, vrči/amfore, kupe, sklede, skodele in viseče posode) in posebne oblike (zajemalke, vretenca in uteži).

### 5.3.2.1 OBLIKE

#### 5.3.2.1.1 Lonci

Med lonci smo diagnosticirali naslednje tipe: L4 (*sl. 5.10: L4; t. 5.1: 1; 5.2: 5; 5.3: 5*), L5 (*sl. 5.10: L5; t. 5.8: 4*), L8 (*sl. 5.10: L8; t. 5.5: 9*), L9 (*sl. 5.10: L9; t. 5.2: 4*), L11 (*sl. 5.10: L11; t. 5.4: 8; 5.7: 10; 5.10: 6*), L14 (*sl. 5.10: L14; t. 5.2: 6*), L17 (*sl. 5.11: L17; t. 5.4: 2; 5.5: 2,6,7; 5.8: 1,7; 5.9: 1*), L18 (*sl. 5.11: L18; t. 5.1: 6; 5.2: 1,2; 5.3: 2; 5.4: 3; 5.5: 1,4; 5.6: 8; 5.8: 2,5; 5.9: 6; 5.10: 1,5,10*), L19 (*sl. 5.11: L19; t. 5.8: 3,6*), L21 (*sl. 5.11: L21; t. 5.3: 1*) in L24 (*sl. 5.11: L24; t. 5.2: 3; 5.9: 7*).

#### 5.3.2.1.2 Sklede

Pojavljajo se naslednje sklede: S5 (*sl. 5.14: S5; t. 5.4: 6; 5.10: 7; 5.9: 11*), S6 (*sl. 5.14: S6; t. 5.6: 6,7; 5.10: 8*), S7 (*sl. 5.14: S7; t. 5.2: 8; 5.4: 5*), S15 (*sl. 5.14: S15; t. 5.4: 4; 5.6: 1,3*), S17 (*sl. 5.14: S17; t. 5.9: 9*), S18 (*sl. 5.15: S18; t. 5.2: 7*) in S21 (*sl. 5.15: S21; t. 5.6: 2*).

#### 5.3.2.1.3 Krožniki

Krožnik je plitva posoda ravnih sten (*sl. 5.17: KR; t. 5.9: 2*).

<sup>43</sup> Zajeti so vsi diagnosticirani tipi posodja.

<sup>44</sup> Zajeti so vsi diagnosticirani tipi ornamenta.

<sup>45</sup> Velušček 2001; 2004c.

6. Quantity of published specimens of an individual type of vessels is not reflecting the real percentage of vessels of such type, found at Blatna Brezovica. However, we can expect that the percentage of specific types of vessels is at least partly reflected in the publication.

7. Quantity of published specimens with a certain type of ornament reflects at least approximately realistic percentage of ware, ornamented in such way.

8. Analysis of quantitative occurrence of pottery in different parts of the excavation site was not done, due to lack of data gained at the excavation done by Korošec.

9. Typological determination of ware and ornaments is based upon somewhat modified typology of pottery from Hočevarica and Maharski prekop.<sup>45</sup>

Dark grey pottery prevails at Blatna Brezovica. There is only a small amount of light grey and light-coloured pottery. Pottery is fragile and breaks easily. There were hardly any entirely preserved vessels; sherds with old fractures prevail.

Pottery was divided into vessels (pots, pitchers/amphora, goblets, dishes, bowls and hanging vessels) and special forms (ladles, spindle whorls and weights).

### 5.3.2.1 FORMS

#### 5.3.2.1.1 Pots

The following types of pots were determined: L4 (*Fig. 5.10: L4; Pls. 5.1: 1; 5.2: 5; 5.3: 5*), L5 (*Fig. 5.10: L5; Pl. 5.8: 4*), L8 (*Fig. 5.10: L8; Pl. 5.5: 9*), L9 (*Fig. 5.10: L9; Pl. 5.2: 4*), L11 (*Fig. 5.10: L11; Pls. 5.4: 8; 5.7: 10; 5.10: 6*), L14 (*Fig. 5.10: L14; Pl. 5.2: 6*), L17 (*Fig. 5.11: L17; Pls. 5.4: 2; 5.5: 2,6,7; 5.8: 1,7; 5.9: 1*), L18 (*Fig. 5.11: L18; Pls. 5.1: 6; 5.2: 1,2; 5.3: 2; 5.4: 3; 5.5: 1,4; 5.6: 8; 5.8: 2,5; 5.9: 6; 5.10: 1,5,10*), L19 (*Fig. 5.11: L19; Pl. 5.8: 3,6*), L21 (*Fig. 5.11: L21; Pl. 5.3: 1*) and L24 (*Fig. 5.11: L24; Pls. 5.2: 3; 5.9: 7*).

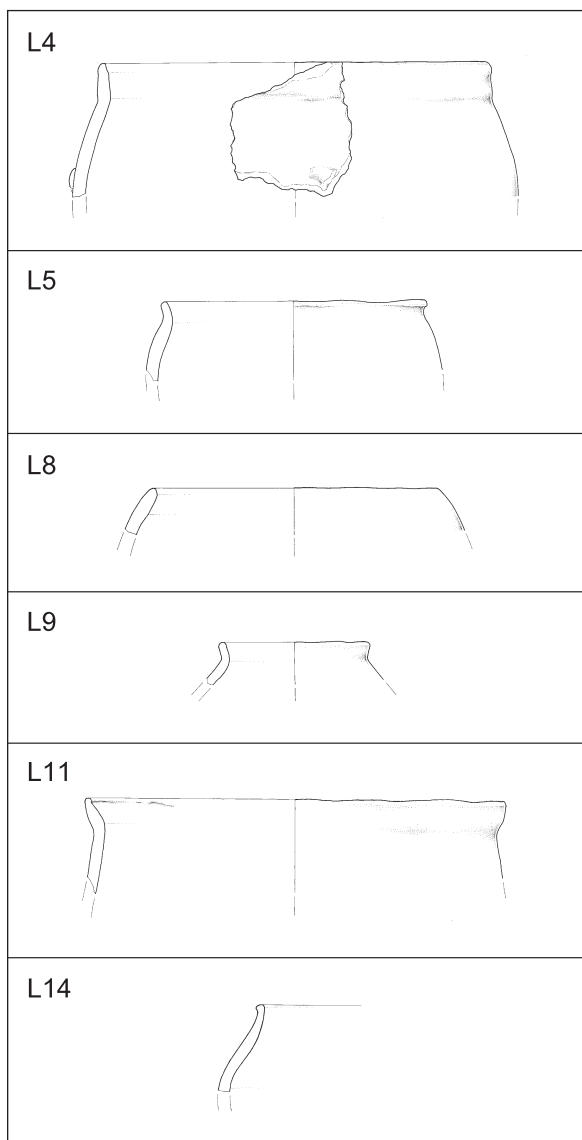
#### 5.3.2.1.2 Dishes

The following types of dishes occur: S5 (*Fig. 5.14: S5; Pls. 5.4: 6; 5.10: 7; 5.9: 11*), S6 (*Fig. 5.14: S6; Pls. 5.6: 6,7; 5.10: 8*), S7 (*Fig. 5.14: S7; Pls. 5.2: 8; 5.4: 5*), S15 (*Fig. 5.14: S15; Pls. 5.4: 4; 5.6: 1,3*), S17 (*Fig. 5.14: S17; Pl. 5.9: 9*), S18 (*Fig. 5.15: S18; Pl. 5.2: 7*) and S21 (*Fig. 5.15: S21; Pl. 5.6: 2*).

#### 5.3.2.1.3 Plates

A plate is a shallow vessel with straight walls (*Fig. 5.17: KR; Pl. 5.9: 2*).

<sup>45</sup> Velušček 2001; 2004c.



Sl. 5.10: Blatna Brezovica, 2003. Lonci po tipih. Risbe: T. Korošec. M = 1 : 5.

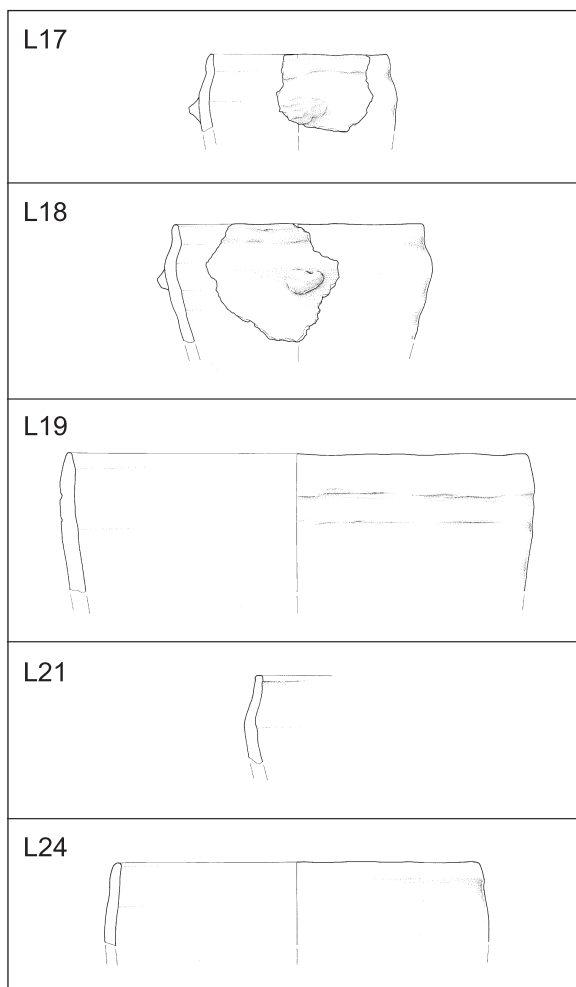
Fig. 5.10: Blatna Brezovica, 2003. Types of pots. Drawn by: T. Korošec. Scale = 1 : 5.

#### 5.3.2.1.4 Viseče posode

V to skupino posodja nedvomno sodi fragment držaja z dvema ušescema (sl. 5.17: VP; t. 5.2: 10). Večje število visečih posod najdemo pri Korošec 1963, npr. t. 24: 7,9; 25: 5; 27: 3; 31: 13,15.

#### 5.3.2.1.5 Miniaturne posode

Leta 2003 miniaturnih posod nismo našli. Poznamo jih z izkopavanj leta 1953 (sl. 5.18: MP).



Sl. 5.11: Blatna Brezovica, 2003. Lonci po tipih. Risbe: T. Korošec. M = 1 : 5.

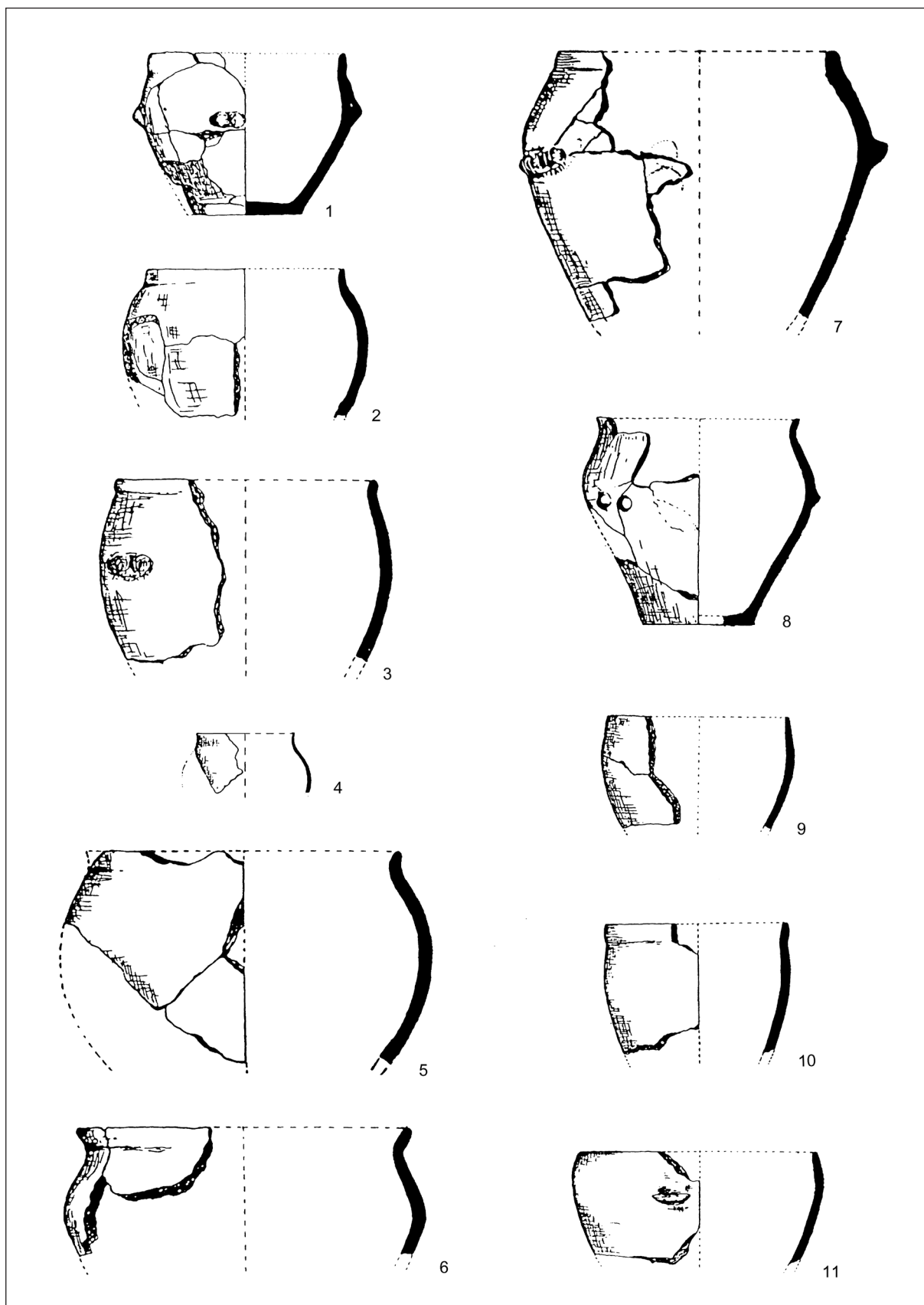
Fig. 5.11: Blatna Brezovica, 2003. Types of pots. Drawn by: T. Korošec. Scale = 1 : 5.

#### 5.3.2.1.4 Hanging vessels

A fragment of a handle with two protrusions (Fig. 5.17: VP; Pl. 5.2: 10) can doubtlessly be categorised as a fragment of a hanging vessel. A larger number of hanging vessels was published by Korošec (1963, e.g. Pls. 24: 7,9; 25: 5; 27: 3; 31: 13,15).

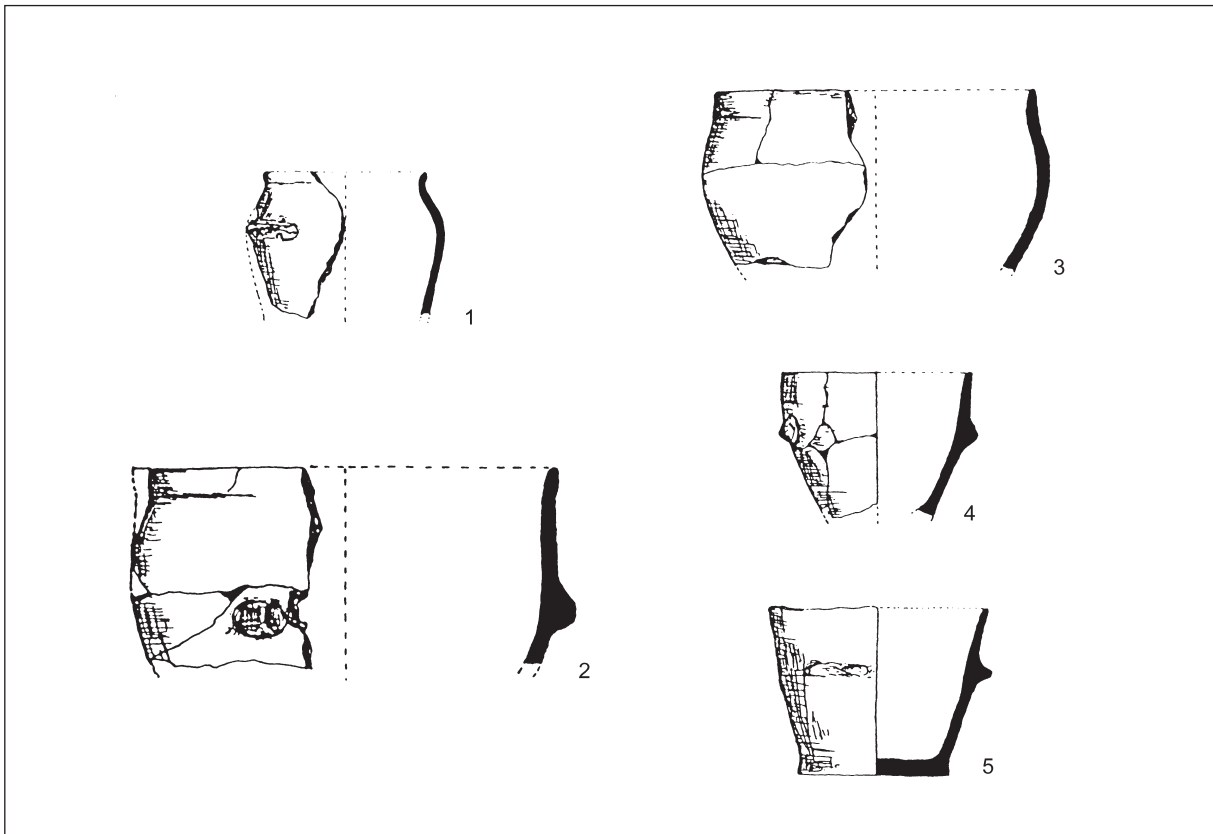
#### 5.3.2.1.5 Miniature vessels

There were not miniature vessels found in 2003. However, some were discovered during the excavations in 1953 (Fig. 5.18: MP).



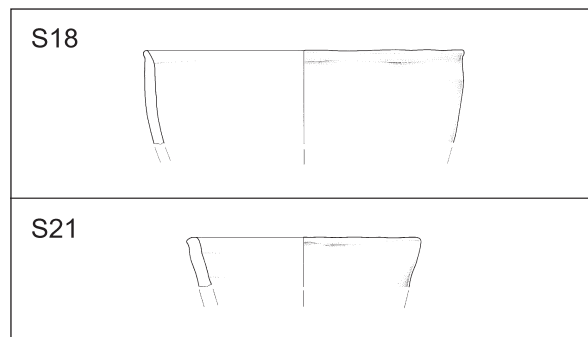
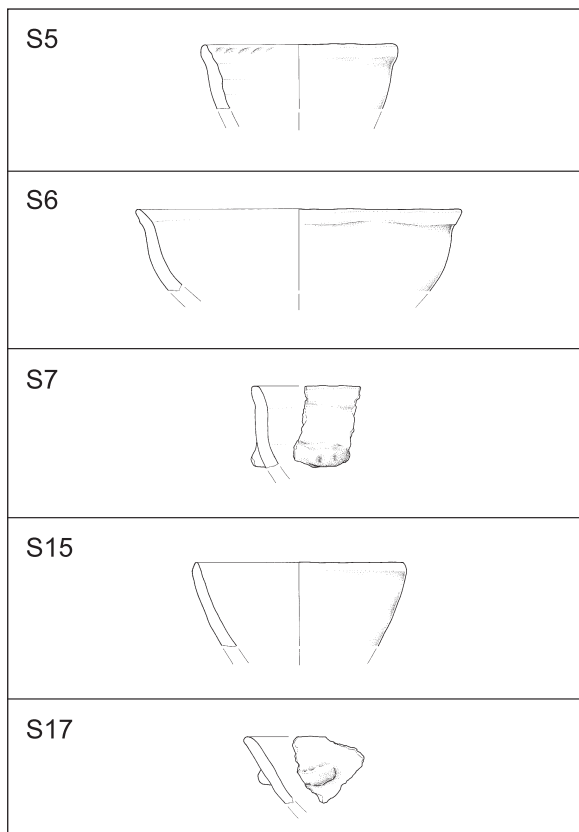
Sl. 5.12: Blatna Brezovica, 1953. Izbor loncev. Risbe: po Korošec 1963. M = 1 : 5.

Fig. 5.12: Blatna Brezovica, 1953. Selection of pots. Drawings: after Korošec 1963. Scale = 1 : 5.



Sl. 5.13: Blatna Brezovica, 1953. Izbor loncev in kup. Risbe: po Korošec 1963. M = 1 : 5.

Fig. 5.13: Blatna Brezovica, 1953. Selection of pots and goblets. Drawings: after Korošec 1963. Scale = 1 : 5.

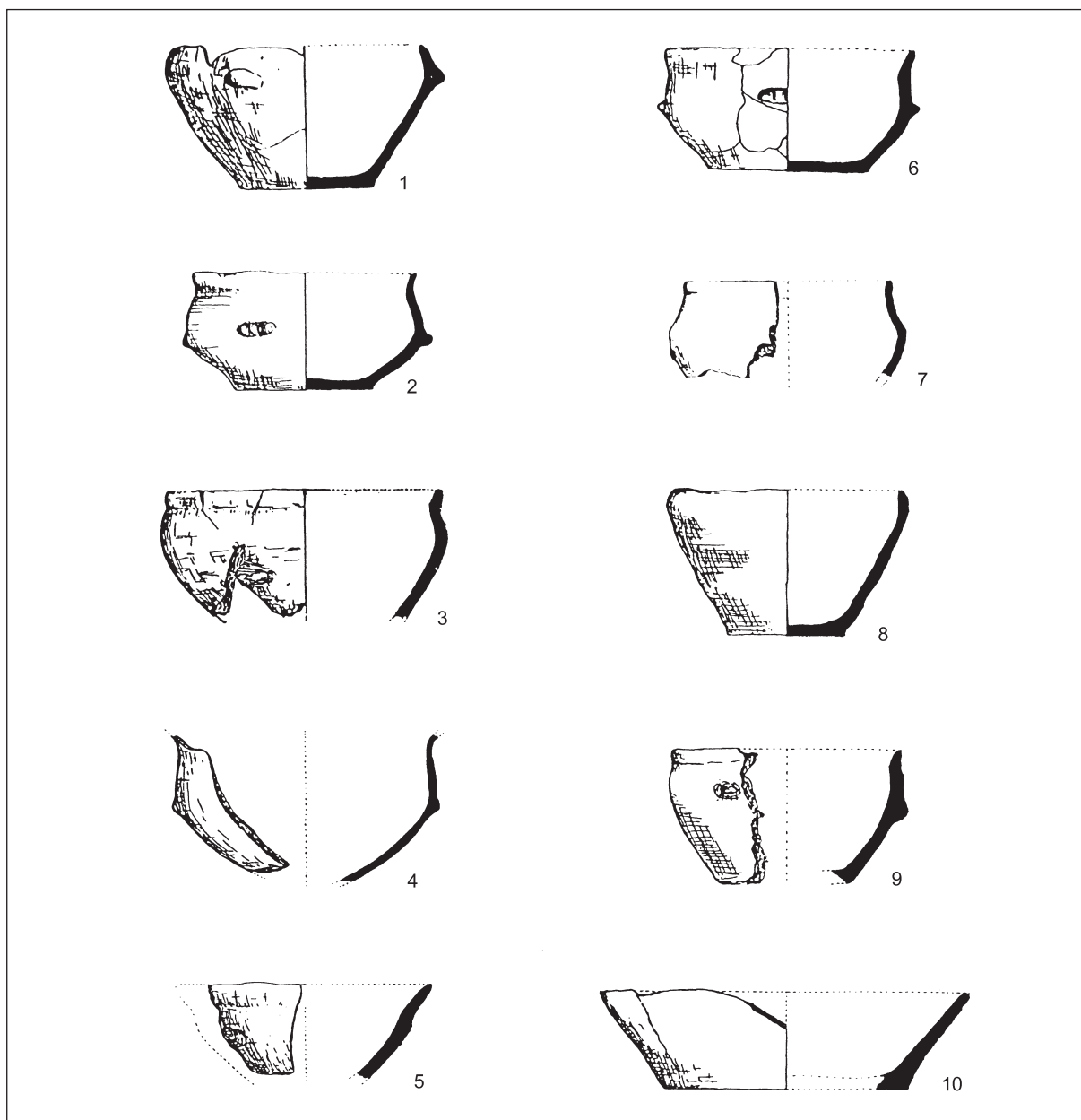


Sl. 5.15: Blatna Brezovica, 2003. Sklede po tipih. Risbi: T. Korošec. M = 1 : 5.

Fig. 5.15: Blatna Brezovica, 2003. Types of dishes. Drawn by: T. Korošec. Scale = 1 : 5.

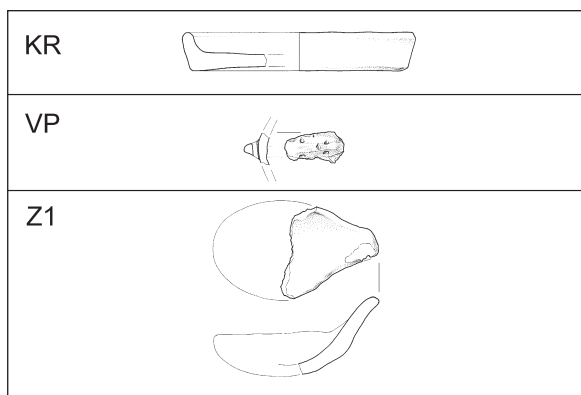
Sl. 5.14: Blatna Brezovica, 2003. Sklede po tipih. Risbe: T. Korošec. M = 1 : 5.

Fig. 5.14: Blatna Brezovica, 2003. Types of dishes. Drawn by: T. Korošec. Scale = 1 : 5.



Sl. 5.16: Blatna Brezovica, 1953. Izbor skled. Risbe: po Korošec 1963. M = 1 : 5.

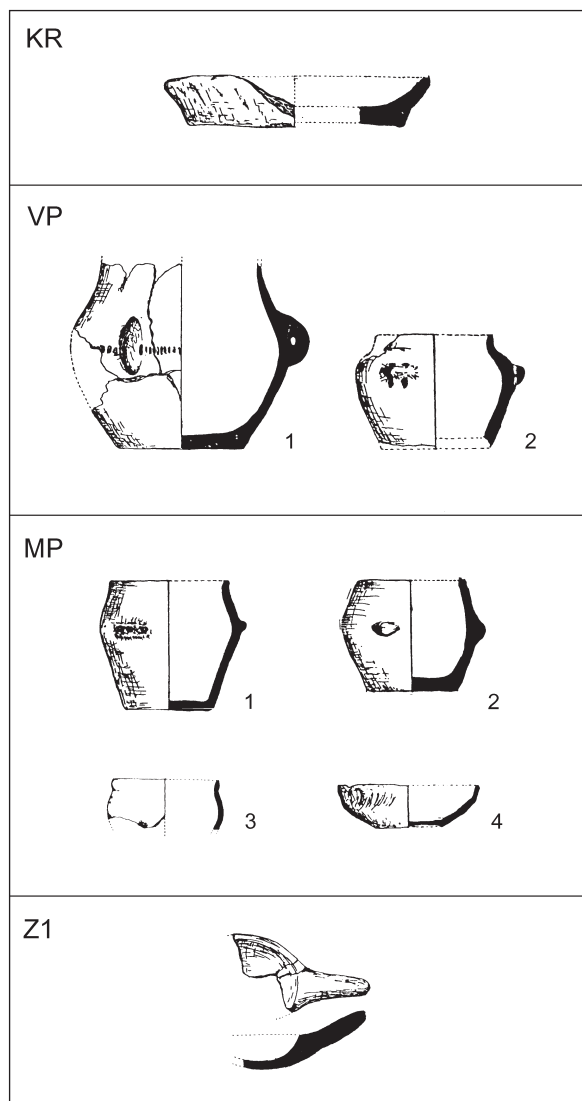
Fig. 5.16: Blatna Brezovica, 1953. A selection of dishes. Drawing: after Korošec 1963. Scale = 1 : 5.



Sl. 5.17: Blatna Brezovica, 2003. Krožniki, viseče posode in zajemalke. Risbe: T. Korošec. M = 1 : 5.

Fig. 5.17: Blatna Brezovica, 2003. Plates, hanging vessels and ladles. Drawn by: T. Korošec. Scale = 1 : 5.





### 5.3.2.1.6 Posebne oblike

#### 5.3.2.1.6.1 Zajemalke

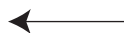
Na Blatni Brezovici se pojavljajo izključno zajemalke s polnim držajem, ki jih uvrščamo v tip Z1 (sl. 5.17: Z1; t. 5.11: 2).

#### 5.3.2.1.6.2 Vretenca

Vretenca so številčno dobro zastopana. Pojavljajo se v dveh tipih: V2 in V3 (sl. 5.19, 5.20: V2, V3); enostavnih bikoničnih vretenc tipa V1 ni bilo najti.

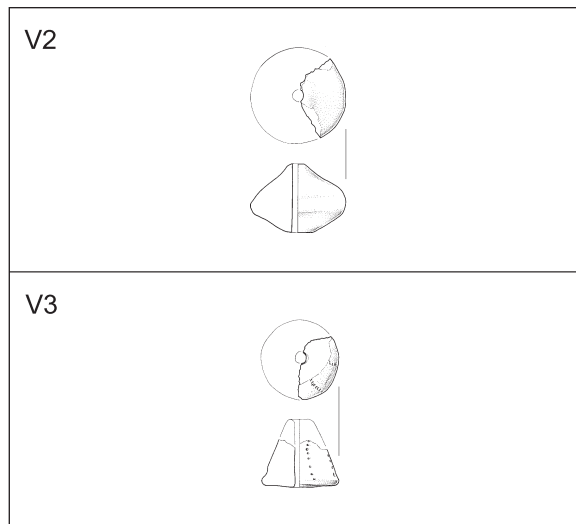
Prisotna so vretenca tipa V2, kamor uvrščamo bikonična vretenca z močno poudarjenim sredinskim delom (npr. t. 5.1: 3). Pri tem tipu je opaziti različne variante, ki se razlikujejo po višini: nizko oz. ploščato (do 3 cm),<sup>46</sup> srednje visoko (od 3 do 5 cm; t. 5.1: 2,3;

<sup>46</sup> Korošec 1963, t. 17: 17.



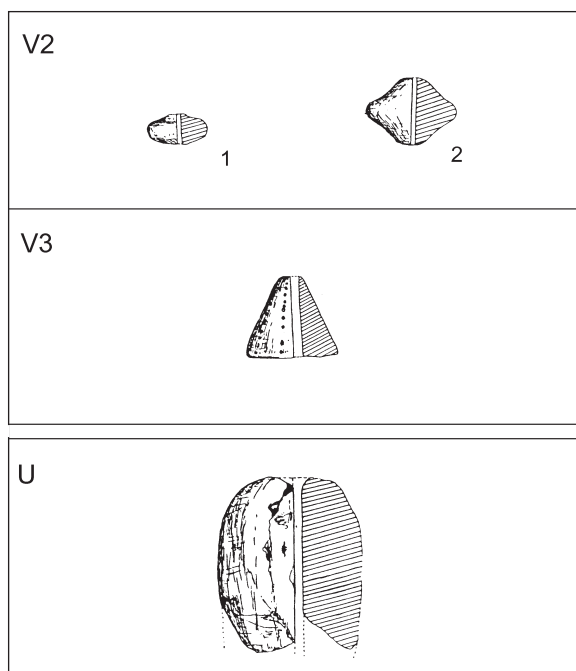
Sl. 5.18: Blatna Brezovica, 1953. Krožniki, viseče in miniaturne posode ter zajemalke. Risbe: po Korošec 1963. M = 1 : 5.

Fig. 5.18: Blatna Brezovica, 1953. Plates, hanging and miniature vessels and ladles. Drawings: after Korošec 1963. Scale = 1 : 5.



Sl. 5.19: Blatna Brezovica, 2003. Vretenca po tipih. Risbi: T. Korošec. M = 1 : 5.

Fig. 5.19: Blatna Brezovica, 2003. Types of spindle whorls. Drawn by: T. Korošec. Scale = 1 : 5.



Sl. 5.20: Blatna Brezovica, 1953. Vretenca po tipih in utež. Risbe: po Korošec 1963. M = 1 : 5.

Fig. 5.20: Blatna Brezovica, 1953. Spindle whorls according to type and a weight. Drawings: after Korošec 1963. Scale = 1 : 5.

5.3: 3), teh je največ, izrazito visokih vretenc, višine nad 5 cm, pa nismo našli.

K tipu V3 uvrščamo vretenca s poudarjeno koničnostjo. Razlikujemo nizko<sup>47</sup> in visoko varianto, ki ima obliko stožca (t. 5.1: 4).<sup>48</sup>

#### 5.3.2.1.6.3 Uteži

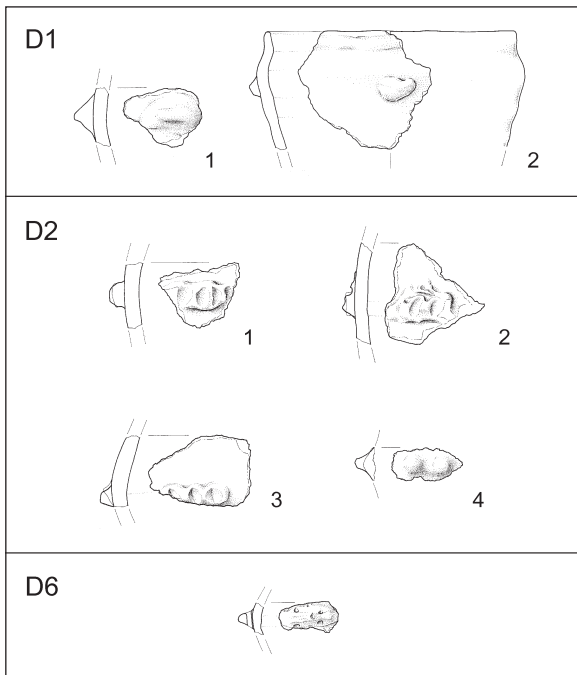
Na Blatni Brezovici je bila najdena ena utež ovalne oblike z navpično odprtino (sl. 5.20: U).

#### 5.3.2.2 DRŽAJI

Na keramiki na Blatni Brezovici je bilo najti samo držaje. Pojavljajo se v petih osnovnih oblikah: D1, D2, D4, D5 in D6. Pogosti so tako imenovani razčlenjeni držaji (sl. 5.21: D2) in tudi jezičasti (sl. 5.21: D1). Veliko manj je vertikalnih masivnih držajev tipa D4 (sl. 5.22: D4) in držajev z enim ali dvema ušescema tipa D6 (sl. 5.21: D6; t. 5.2: 10).

<sup>47</sup> Korošec 1963, t. 18: 7.

<sup>48</sup> Korošec 1963, t. 17: 14,18.



Sl. 5.21: Blatna Brezovica, 2003. Držaji po tipih. Risbe: T. Korošec. M = 1 : 5.

Fig. 5.21: Blatna Brezovica, 2003. Types of lugs. Drawn by: T. Korošec. Scale = 1 : 5.

Sl. 5.22: Blatna Brezovica, 1953. Držaji po tipih. Risbe: po Korošec 1963. M = 1 : 5.

Fig. 5.22: Blatna Brezovica, 1953. Types of lugs. Drawings: after Korošec 1963. Scale = 1 : 5.

#### 5.3.2.1.6 Special forms

##### 5.3.2.1.6.1 Ladles

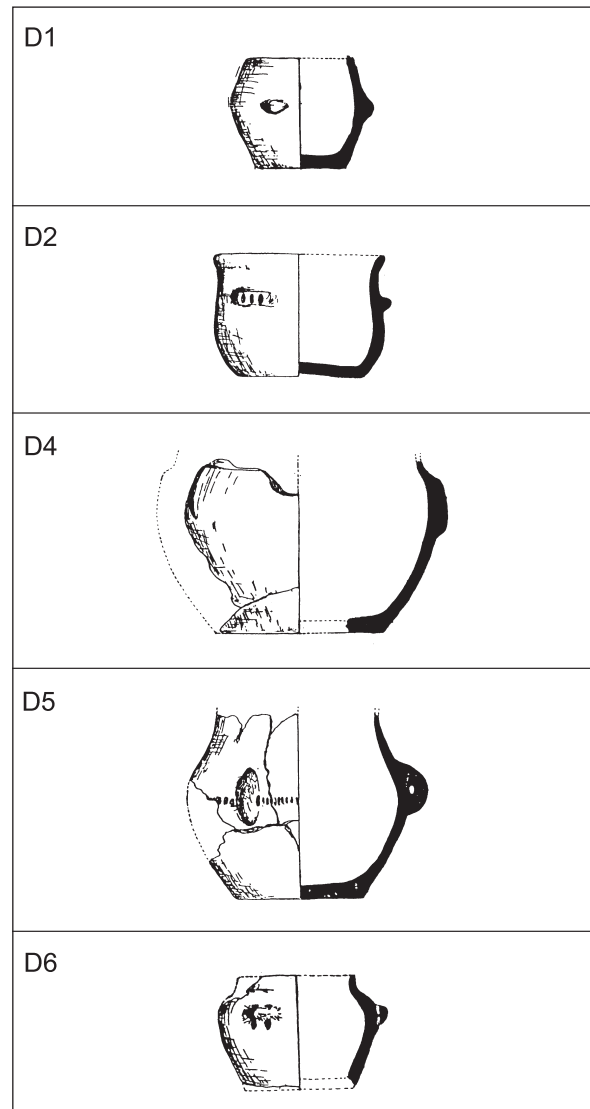
Only ladles with solid handles, representing type Z1, occur at Blatna Brezovica (Fig. 5.17: Z1; Pl. 5.11: 2).

##### 5.3.2.1.6.2 Spindle whorls

Numerous spindle whorls were discovered. Two types were found: V2 and V3 (Figs. 5.19, 5.20: V2,V3); simple biconical whorls of type V1 do not occur.

Biconical spindle whorls with strongly accentuated central part (e.g. Pl. 5.1: 3) present type V2. We can recognize several versions of this type, which were categorised according to height. Low or flat (up to 3 cm)<sup>46</sup> and medium (3 to 5 cm; Pls. 5.1: 2,3; 5.3: 3)

<sup>46</sup> Korošec 1963, Pl. 17: 17.



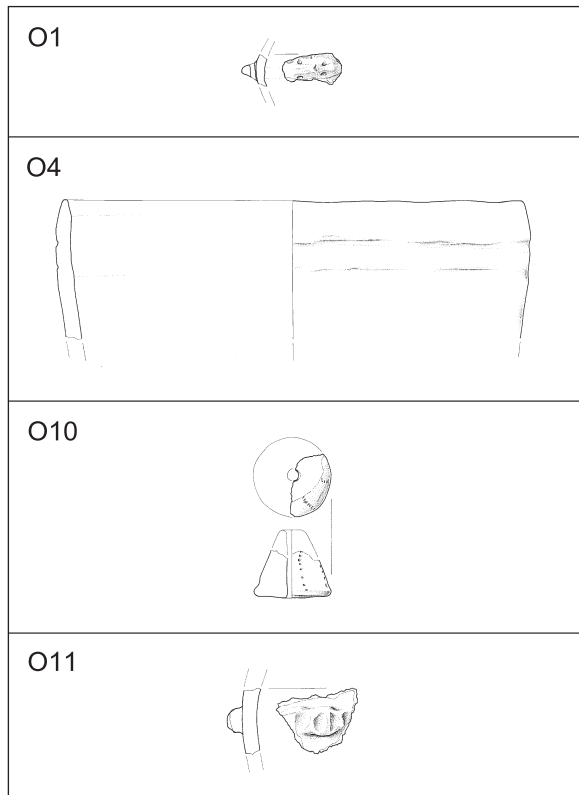
## 5.3.2.3 ORNAMENT

Keramika z Blatne Brezovice je podobno kot na Starih gmajnah razmeroma skromno ornamentirana. Kljub temu je najti več vrst ornamenta, ki ga glede na ornamentalno tehniko lahko ločimo na vrezovanje, vtiskovanje in plastično apliciranje.

Na Blatni Brezovici so s tehniko vrezovanja v stene keramike vrezane linije v obliki navadnega vreza (sl. 5.23: O1). Z vrezovanjem ornamentiranih posod oz. keramičnih oblik ni veliko. Vrezane linije je najti na ostenju,<sup>49</sup> na držajih (npr. t. 5.2: 10) in na vretencih (npr. t. 5.3: 3). Redko se pojavlja tudi žlebljenje (npr. sl. 5.23: O4; t. 5.8: 3).

Zdi pa se, da je bilo vtiskovanje pogostokrat uporabljena ornamentalna tehnika. Rezultati te tehnike so: vbodi (sl. 5.23: O10), odtisi prsta (sl. 5.23: O11), odtisi topega predmeta (sl. 5.24: O12) in odtisi nohta (sl. 5.24: O13; npr. t. 5.7: 4). Značilno je, da se različne variante odtisov pojavljajo v kombinaciji z drugimi ornamenti. Pogosta je predvsem kombinacija odtisov in plastičnih reber, držajev (npr. t. 5.5: 1; 5.7: 4–6 itd.). Odtisi se pojavljajo tudi na obodu ustja (npr. t. 5.6: 1) in tik pod njim v notranjosti posode (t. 5.4: 6).

<sup>49</sup> Korošec 1963, t. 24: 9; isto sl. 5.25: O1.



Sl. 5.23: Blatna Brezovica, 2003. Ornament po tipih. Risbe: T. Korošec. M = 1 : 5.

Fig. 5.23: Blatna Brezovica, 2003. Types of decoration. Drawn by: T. Korošec. Scale = 1 : 5.

height spindle whorls were discovered. The latter ones were the most frequent. Tall-neck spindle whorls (above 5 cm) have not been found.

Spindle whorls of accentuated conical form are categorised as type V3. We distinguish low<sup>47</sup> and tall versions. The latter one is cone-shaped (Pl. 5.1: 4).<sup>48</sup>

## 5.3.2.1.6.3 Weights

One oval-shaped weight with a vertical opening was found on Blatna Brezovica (Fig. 5.20: U).

## 5.3.2.2 LUGS

Only lugs are present on pottery at Blatna Brezovica. Five types occur: D1, D2, D4, D5 and D6. So-called lugs with slashed decoration are frequent (Fig. 5.21: D2). Tongue-shaped lugs are also common (Fig. 5.21: D1). Vertical massive lugs of type D4 (Fig. 5.22: D4) and pierced lugs of type D6 (Fig. 5.21: D6; Pl. 5.2: 10) are rare.

## 5.3.2.3 ORNAMENT

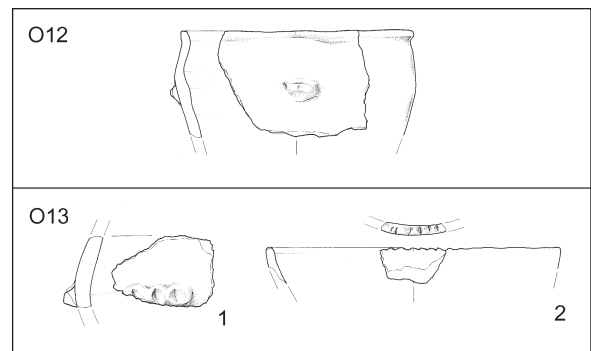
Pottery from Blatna Brezovica is, similarly as the one from Stare gmajne, not richly ornamented. Still, several types of decoration occur; incision, impressing and applied decoration are present.

Incision technique is seen as etched lines in shape of an incised decoration on the pottery walls (Fig. 5.23: O1) at Blatna Brezovica. Only a few vessels and other pottery objects are decorated with incisions. Etched lines are seen on walls,<sup>49</sup> lugs (e.g. Pl. 5.2: 10) and spindle

<sup>47</sup> Korošec 1963, Pl. 18: 7.

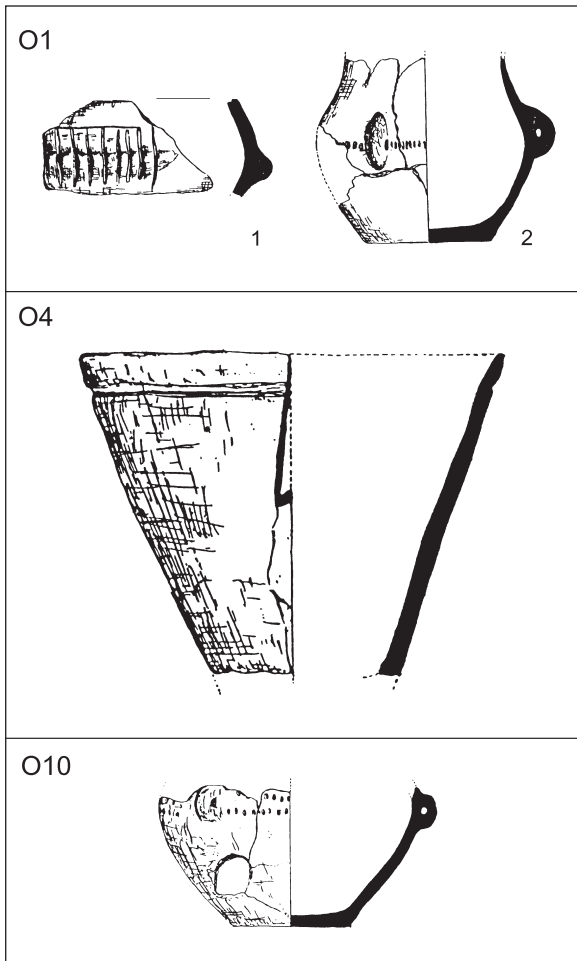
<sup>48</sup> Korošec 1963, Pl. 17: 14,18.

<sup>49</sup> Korošec 1963, Pl. 24: 9; ibid. Fig. 5.25: O1.



Sl. 5.24: Blatna Brezovica, 2003. Ornament po tipih. Risbe: T. Korošec. M = 1 : 5.

Fig. 5.24: Blatna Brezovica, 2003. Types of decoration. Drawn by: T. Korošec. Scale = 1 : 5.



Sl. 5.25: Blatna Brezovica, 1953. Ornament po tipih. Risbe: po Korošec 1963. M = 1 : 5.

Fig. 5.25: Blatna Brezovica, 1953. Types of decoration. Drawings: after Korošec 1963. Scale = 1 : 5.

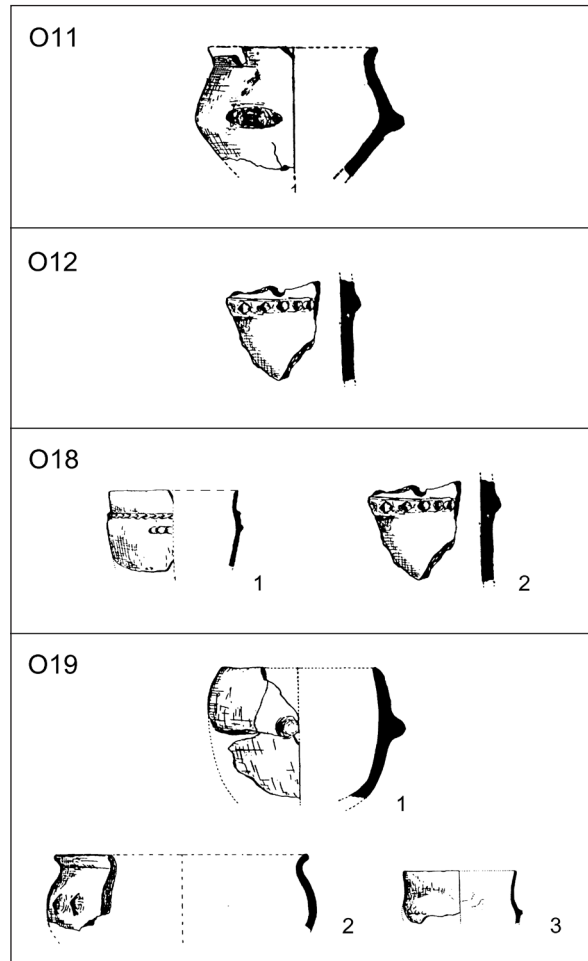
Na keramiki z Blatne Brezovice je bila, sodeč po gradivu, najpogosteje uporabljena ornamentalna tehnika plastično apliciranje (sl. 5.23: O10,O11, 5.24: O12,O13, 5.26: O18,O19). Največkrat naletimo na razčlenjene držaje (npr. t. 5.5: 1 itd.), medtem ko aplicirana razčlenjena rebra niso pogost pojav. Običajno so horizontalna. Najti jih je na zgornji polovici ostenja posod.<sup>50</sup> Med bradavicami prevladujejo enostavne (sl. 5.26: O19). Običajno se pojavljajo v paru (t. 5.7: 2) ali celo v nizu po tri.<sup>51</sup>

### 5.3.3 RECENTNE NAJDBE

Kakor omenjeno, sta bili sondi iz leta 2003 večji del zastavljeni na območju, ki ga je leta 1953 raziskal Korošec (glej sl. 5.4). Kot eden izmed najotipljivejših dokazov za to je zagotovo prisotnost najdb iz novejšje dobe.

<sup>50</sup> Korošec 1963, t. 30: 1; 31: 17.

<sup>51</sup> Npr. Korošec 1963, t. 24: 4.



Sl. 5.26: Blatna Brezovica, 1953. Ornament po tipih. Risbe: po Korošec 1963. M = 1 : 5.

Fig. 5.26: Blatna Brezovica, 1953. Types of decoration. Drawings: after Korošec 1963. Scale = 1 : 5.

whorls (e.g. Pl. 5.3: 3). Grooved lines are also rare (e.g. Fig. 5.23: O4; Pl. 5.8: 3).

Impressing is frequently used decoration technique. It can be seen as: furrowed incisions (Fig. 5.23: O10), fingertip impressions (Fig. 5.23: O11), impressions of blunt objects (Fig. 5.24: O12) and fingernail impressions (Fig. 5.24: O13; e.g. Pl. 5.7: 4). It is characteristic that different types of impressed decoration occur in combination with other ornaments. Combination of impressing and plastic cordons or lugs is frequent (e.g. Pls. 5.5: 1; 5.7: 4-6). Impressions also occur on rims (e.g. Pl. 5.6: 1) and just below rims in vessel's interior (Pl. 5.4: 6).

Applied decoration is the most frequently used ornamentation technique at Blatna Brezovica (Figs. 5.23: O10,O11; 5.24: O12,O13; 5.26: O18,O19). Lugs with slashed decoration are most common (e.g. Pl. 5.5: 1), while applied slashed cordons, usually horizontal, are rare. They are usually applied to vessel's upper bodies.<sup>50</sup> Appliqués

<sup>50</sup> Korošec 1963, Pls. 30: 1; 31: 17.

Tovrstnih najdb je sicer malo. Nekatere so v zasutje zašle po naključju, kot je npr. fragment keramike, ki je bila narejena na lončarskem vretenu (*t. 5.6: 4*), druge, kot je pleskarska lopatica (*t. 5.3: 4*), pa ne. Ker je pred dobrimi 50 leti pleskarska lopatica pomenila znatno vrednost, lahko sklepamo, da se je izgubila. V izkopavališču namreč odpadkov iz pedesetih let 20. stoletja nismo našli. Razlogov ni iskati v odnosu do okolja. V "čisti" sondi se verjetneje odslikavajo razmere, ko je v socialistični Jugoslaviji vladalo vsesplošno pomanjkanje. Slednje je dokumentirano v arhivskih virih,<sup>52</sup> pa tudi v spominu danes še živečih ljudi.

Temu lahko pritrdimo tudi z arheološkimi raziskavami. Pri ponovnem izkopu izkopavališča na Maharskem prekopu v letu 2005, naj spomnimo, najdišče je v sedemdesetih letih raziskovala T. Bregant,<sup>53</sup> smo naleteli na steklenice, tetrapake, vrečke itd., skratka na odpadke iz tistega obdobja. V izkopno jamo so jih po končanem izkopavanju odvrgli izkopavalci. Njihovo znatno število oz. že samo njihova prisotnost dokazuje, da se je v Jugoslaviji v sedemdesetih letih standard izboljšal, ni pa še bilo prave zavesti o okolju. V zadnjih letih je namreč običaj, da po končanem sondiranju odpadki romajo v smetnjake in se ne zakopljejo.

Kakor koli že, tudi takšne najdbe veliko povedo o dogajanju na nekem najdišču, pa tudi o razmerah in navadah v obdobju, v katerem so bile odložene.

## 5.4 KATALOG NAJDB / CATALOGUE OF FINDS

Tabla 5.1

1. Frag. ustja z ostenjem; siva; grobozrnata; lega: sonda 1; reženj 2; kulturna plast; datum: 27. 05. 2003.
2. Frag. vretenca; temnosiva; grobozrnata; lega: sonda 1; x = 1,0 m; y = 4,1 m; kulturna plast; datum: 26. 05. 2003.
3. Frag. vretenca; siva; grobozrnata; lega: sonda 1; reženj 6; kulturna plast; datum: 29. 05. 2003.
4. Frag. vretenca; vbodi; siva; grobozrnata; lega: sonda 1; reženj 2; kulturna plast; datum: 27. 05. 2003.
5. Prevrtan kamen/brus; muljevec ali drobnozrnati kremnasto glinasti tuf;<sup>54</sup> siva; lega: sonda 1; reženj 6; kulturna plast; datum: 29. 05. 2003.
6. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 1; datum: 23. 05. 2003.

Tabla 5.2

1. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 1; datum: 26. 05. 2003.
2. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 1; datum: 23. 05. 2003.
3. Frag. ustja z ostenjem; siva; grobozrnata; lega: sonda 1; datum: 23. 05. 2003.

are usually simple (*Fig. 5.26: O19*). They typically occur in pairs (*Pl. 5.7: 2*) or in sets of three.<sup>51</sup>

### 5.3.3 MODERN FINDS

As mentioned above, the 2003 trenches partly encompassed the areas, which were dug by Korošec in 1953 (see *Fig. 5.4*). Presence of modern finds is definitely one of the most palpable evidences.

Such finds are scarce. Some of them were deposited by chance while filling the trenches, such as a fragment of pottery, made on potter's wheel (*Pl. 5.6: 4*), while the others, e.g. a trowel (*Pl. 5.3: 4*), were probably accidentally lost; a trowel was of a considerable value some 50 years ago. No waste from the 50-ies of the 20<sup>th</sup> century was found. Environment friendly attitude is probably not the reason for this. A "clean" trench more probably reflects times of deprivation in socialist Yugoslavia. The latter is documented in archival sources<sup>52</sup> and also in living memory.

Several other archaeological researches can confirm this. The second excavation of the Maharski prekop in 2005; the site was dug by T. Bregant in the 70-ies;<sup>53</sup> yielded bottles, beverage cartons, bags etc., in short, waste from that period. Excavators threw them into the excavation pit when the excavation was completed. A considerable quantity of them, and their presence alone, prove that standard of living had to improve in Yugoslavia during the 70-ies. However, the standard of ecology was low still. Nowadays, waste is collected in bins after sample trenching is completed, and not buried.

Nonetheless, such finds can tell us a lot about activities on a certain excavation site, and also about the circumstances and behaviour of the people during the period, in which they were deposited.

<sup>52</sup> Glej Keršič, Stres 2008.

<sup>53</sup> 1996.

<sup>54</sup> Poglavlje 12 v tem zborniku.

<sup>51</sup> E.g. Korošec 1963, Pl. 24: 4.

<sup>52</sup> See Keršič, Stres 2008.

<sup>53</sup> 1996.



4. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 1; datum: 23. 05. 2003.
5. Frag. ustja z ostenjem; temnosiva; drobnozrnata; lega: sonda 1; datum: 26. 05. 2003.
6. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 1; datum: 26. 05. 2003.
7. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 1; datum: 29. 05. 2003.
8. Frag. ustja z ostenjem; siva; grobozrnata; lega: sonda 1; datum: 26. 05. 2003.
9. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 1; datum: 23. 05. 2003.
10. Frag. ostenja; frag. razčlenjenega držaja; temnosiva; drobnozrnata; lega: sonda 1; datum: 26. 05. 2003.

Tabla 5.3

1. Frag. ustja z ostenjem; temnosiva; drobnozrnata; lega: sonda 2; humus; datum: 21. 10. 2003.
2. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 2; humus; datum: 21. 10. 2003.
3. Frag. vretenca; vrezi (verjetno nastali slučajno); temnosiva; grobozrnata; lega: sonda 2; reženj 3; datum: 22. 10. 2003.
4. Pleskarska lopatica; železo in les; rjava; lega: sonda 2; reženj 3; datum: 22. 10. 2003.
5. Frag. ustja z ostenjem; frag. držaja; temnosiva; grobozrnata; lega: sonda 2; reženj 3; datum: 03. 11. 2003.

Tabla 5.4

1. Frag. ustja z ostenjem; temnosiva; drobnozrnata; lega: sonda 2; reženj 4; datum: 03. 11. 2003.
2. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 2; reženj 3; datum: 03. 11. 2003.
3. Frag. ustja z ostenjem; držaj; temnosiva; grobozrnata; lega: sonda 2; reženj 2; datum: 29. 10. 2003.
4. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 2; reženj 3; datum: 03. 11. 2003.
5. Frag. ustja z ostenjem; frag. razčlenjenega držaja; temnosiva; grobozrnata; lega: sonda 2; reženj 2; datum: 29. 10. 2003.
6. Frag. ustja z ostenjem; odtisi; siva; grobozrnata; lega: sonda 2; reženj 3; datum: 03. 11. 2003.
7. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 2; reženj 4; datum: 03. 11. 2003.
8. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 2; reženj 1; datum: 05. 11. 2003.
9. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 2; reženj 1; datum: 03. 11. 2003.

Tabla 5.5

1. Frag. ustja z ostenjem; frag. razčlenjenega držaja; siva; grobozrnata; lega: sonda 2; reženj 1; datum: 05. 11. 2003.
2. Frag. ustja z ostenjem; siva; grobozrnata; lega: sonda 2; reženj 3; datum: 05. 11. 2003.
3. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 2; reženj 1; datum: 05. 11. 2003.
4. Frag. ustja z ostenjem; siva; grobozrnata; lega: sonda 2; reženj 4; datum: 06. 11. 2003.
5. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 2; reženj 1; datum: 05. 11. 2003.
6. Frag. ustja z ostenjem; siva; grobozrnata; lega: sonda 2; reženj 2; datum: 05. 11. 2003.
7. Frag. ustja z ostenjem; rjava; drobnozrnata; lega: sonda 2; reženj 1; datum: 05. 11. 2003.
8. Frag. ustja z ostenjem; temnosiva; drobnozrnata; lega: sonda 2; reženj 2; datum: 05. 11. 2003.

9. Frag. ustja z ostenjem; rjava; drobnozrnata; lega: sonda 2; reženj 2; datum: 05. 11. 2003.

Tabla 5.6

1. Frag. ustja z ostenjem; odtisi; temnosiva; grobozrnata; lega: sonda 2; reženj 1; datum: 03. 11. 2003.
2. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 2; reženj 1; datum: 03. 11. 2003.
3. Frag. ustja z ostenjem; temnorjava; drobnozrnata; lega: sonda 2; reženj 1; datum: 05. 11. 2003.
4. Frag. dna; oranžna; drobnozrnata; lega: sonda 2; reženj 1; datum: 05. 11. 2003.
5. Frag. dna z ostenjem; siva; grobozrnata; lega: sonda 2; reženj 3; datum: 05. 11. 2003.
6. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 2; reženj 1; datum: 05. 11. 2003.
7. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 2; reženj 1; datum: 05. 11. 2003.
8. Frag. ustja z ostenjem; v notranjosti odtis prsta; temnosiva; grobozrnata; lega: sonda 2; reženj 4; datum: 06. 11. 2003.
9. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 2; reženj 1; datum: 05. 11. 2003.
10. Frag. dna; temnosiva; grobozrnata; lega: sonda 2; reženj 4; datum: 06. 11. 2003.
11. Frag. dna z ostenjem; rjava; drobnozrnata; lega: sonda 2; reženj 1; datum: 03. 11. 2003.

Tabla 5.7

1. Frag. ostenja; frag. razčlenjenega držaja; temnosiva; grobozrnata; lega: sonda 2; reženj 1; datum: 03. 11. 2003.
2. Frag. razčlenjenega držaja; temnosiva; drobnozrnata; lega: sonda 2; reženj 2; datum: 05. 11. 2003.
3. Frag. ostenja; držaj; rjava; drobnozrnata; lega: sonda 2; reženj 1; datum: 05. 11. 2003.
4. Frag. ostenja; frag. razčlenjenega držaja; rjava; grobozrnata; lega: sonda 2; reženj 1; datum: 05. 11. 2003.
5. Frag. ostenja; razčlenjen držaj; temnosiva; grobozrnata; lega: sonda 2; reženj 2; datum: 05. 11. 2003.
6. Frag. ostenja; frag. razčlenjenega držaja; rjava; grobozrnata; lega: sonda 2; reženj 1; datum: 05. 11. 2003.
7. Frag. ostenja; frag. držaja/ročaja; temnosiva; drobnozrnata; lega: sonda 2; reženj 2; datum: 05. 11. 2003.
8. Klina; kamen; siva; lega: sonda 2; reženj 4; datum: 06. 11. 2003.
9. Frag. ostenja; razčlenjen držaj; temnosiva; grobozrnata; lega: sonda 2; reženj 5; kulturna plast; datum: 10. 11. 2003.
10. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 2; reženj 5; kulturna plast; datum: 10. 11. 2003.

Tabla 5.8

1. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 2; reženj 4; kulturna plast; datum: 10. 11. 2003.
2. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 2; reženj 4; kulturna plast; datum: 10. 11. 2003.
3. Frag. ustja z ostenjem; žlebovi; temnosiva; grobozrnata; lega: sonda 2; reženj 4; kulturna plast; datum: 10. 11. 2003.
4. Frag. ustja z ostenjem; siva; grobozrnata; lega: sonda 2; reženj 3; kulturna plast; datum: 10. 11. 2003.
5. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 2; reženj 3; kulturna plast; datum: 10. 11. 2003.
6. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 2; reženj 5; kulturna plast; datum: 10. 11. 2003.
7. Frag. ustja z ostenjem; frag. držaja; temnosiva; grobozrnata; lega: sonda 2; reženj 3; kulturna plast; datum: 10. 11. 2003.

Tabla 5.9

1. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 2; reženj 3; kulturna plast; datum: 10. 11. 2003.
2. Posoda; temnosiva; grobozrnata; lega: sonda 2; reženj 3; kulturna plast; datum: 10. 11. 2003.
3. Frag. kline/osti; kamen; siva; lega: sonda 2; reženj 3; kulturna plast; datum: 10. 11. 2003.
4. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 2; reženj 2; datum: 10. 11. 2003.
5. Frag. ustja z ostenjem; siva; grobozrnata; lega: sonda 2; reženj 2; kulturna plast; datum: 10. 11. 2003.
6. Frag. ustja z ostenjem; siva; grobozrnata; lega: sonda 2; reženj 2; kulturna plast; datum: 10. 11. 2003.
7. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 2; reženj 2; datum: 10. 11. 2003.
8. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 2; reženj 2; kulturna plast; datum: 10. 11. 2003.
9. Frag. ustja z ostenjem; frag. držaja; siva; grobozrnata; lega: sonda 2; reženj 2; kulturna plast; datum: 10. 11. 2003.
10. Frag. ostenja; frag. držaja; rjava; grobozrnata; lega: sonda 2; reženj 2; kulturna plast; datum: 10. 11. 2003.
11. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 2; reženj 2; kulturna plast; datum: 10. 11. 2003.

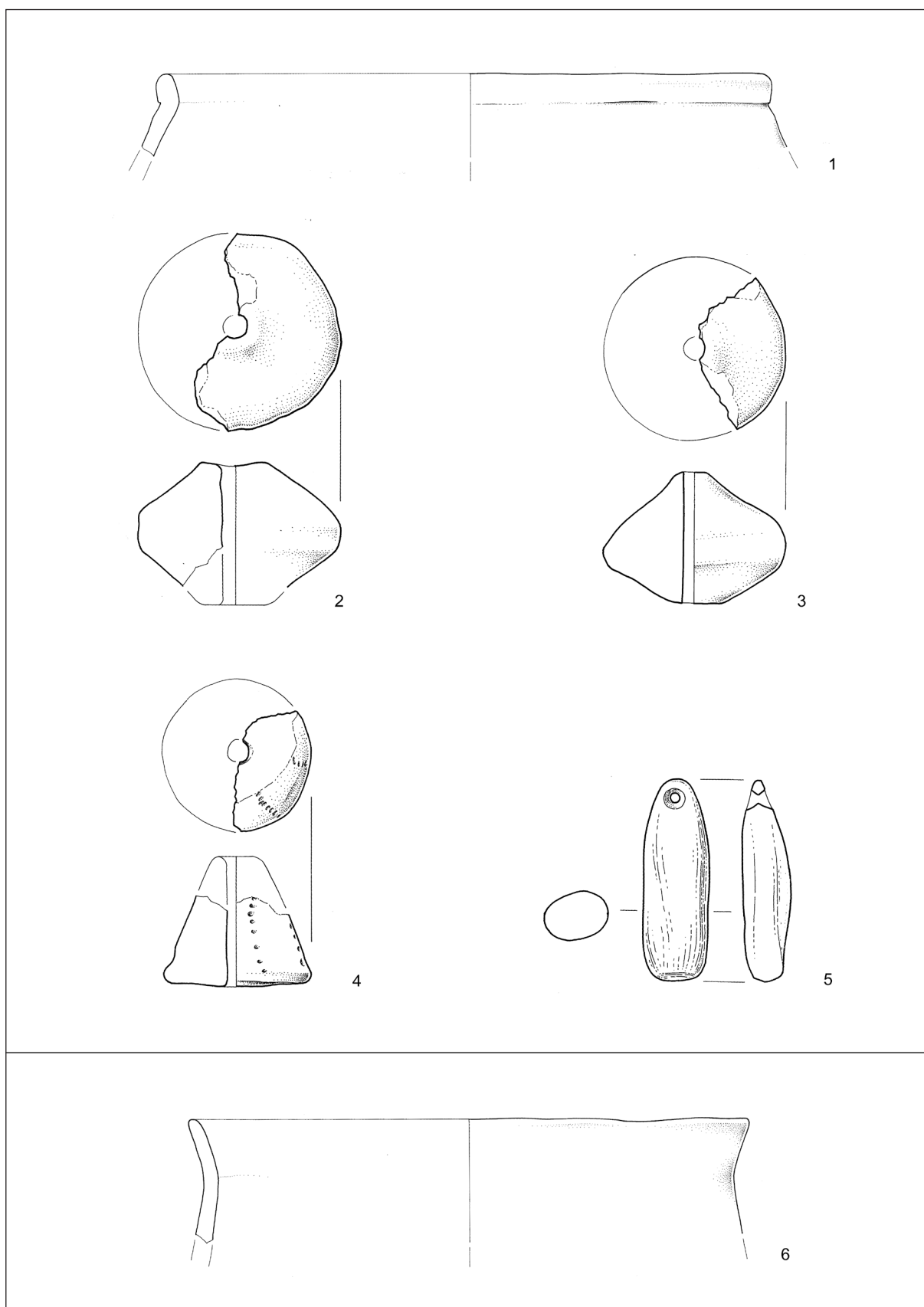
Tabla 5.10

1. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 2; reženj 1; datum: 06. 11. 2003.
2. Frag. ustja z ostenjem; temnorjava; grobozrnata; lega: sonda 2; reženj 1; kulturna plast; datum: 10. 11. 2003.

3. Frag. dna z ostenjem; temnosiva; grobozrnata; lega: sonda 2; reženj 1; datum: 06. 11. 2003.
4. Frag. ustja z ostenjem; siva; drobnozrnata; lega: sonda 2; reženj 1; datum: 06. 11. 2003.
5. Frag. ustja z ostenjem; razčlenjen držaj; siva; grobozrnata; lega: sonda 2; pri čiščenju jugozahodnega profila; datum: 11. 11. 2003.
6. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 2; reženj 3; verjetno že prekopano; datum: 10. 11. 2003.
7. Frag. ustja z ostenjem; temnosiva; grobozrnata; lega: sonda 2; reženj 4; verjetno že prekopano; datum: 10. 11. 2003.
8. Frag. ustja z ostenjem; siva; grobozrnata; lega: sonda 2; reženj 4; verjetno že prekopano; datum: 10. 11. 2003.
9. Frag. ostenja; frag. razčlenjenega držaja; temnosiva; grobozrnata; lega: sonda 2; reženj 3; verjetno že prekopano; datum: 10. 11. 2003.
10. Frag. ustja z ostenjem; siva; grobozrnata; lega: sonda 2; reženj 4; verjetno že prekopano; datum: 10. 11. 2003.
11. Frag. ostenja; frag. razčlenjenega držaja; temnosiva; grobozrnata; lega: sonda 2; reženj 4; verjetno že prekopano; datum: 10. 11. 2003.
12. Frag. dna z ostenjem; siva; grobozrnata; lega: sonda 2; reženj 2; verjetno že prekopano; datum: 10. 11. 2003.
13. Frag. dna z ostenjem; siva; grobozrnata; lega: sonda 2; reženj 3; verjetno že prekopano; datum: 10. 11. 2003.

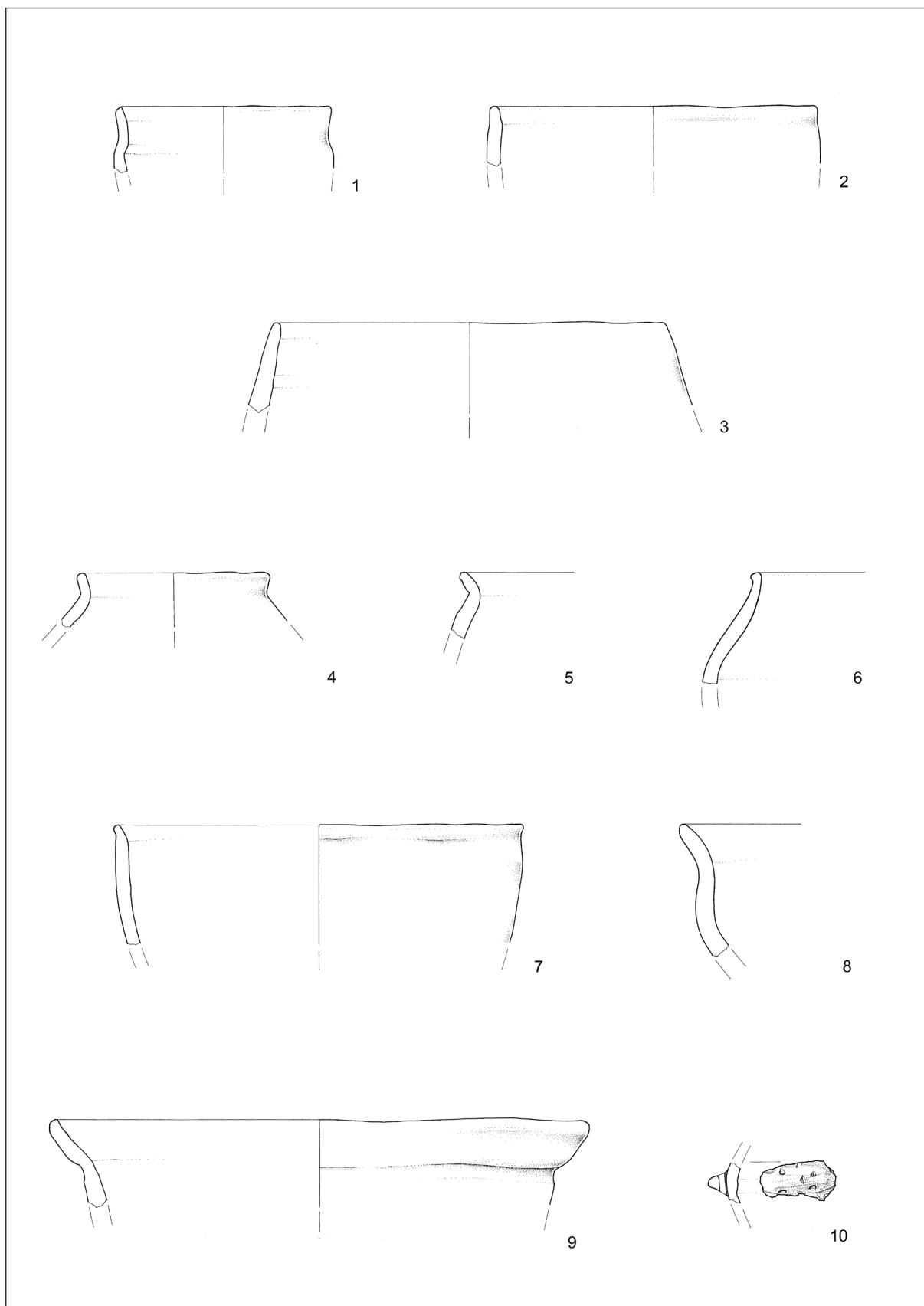
Tabla 5.11

1. Frag. dna z ostenjem; temnosiva; drobnozrnata; lega: sonda 2; reženj 3; verjetno že prekopano; datum: 10. 11. 2003.
2. Frag. zajemalke; temnosiva; grobozrnata; lega: sonda 2; reženj 4; verjetno že prekopano; datum: 10. 11. 2003.



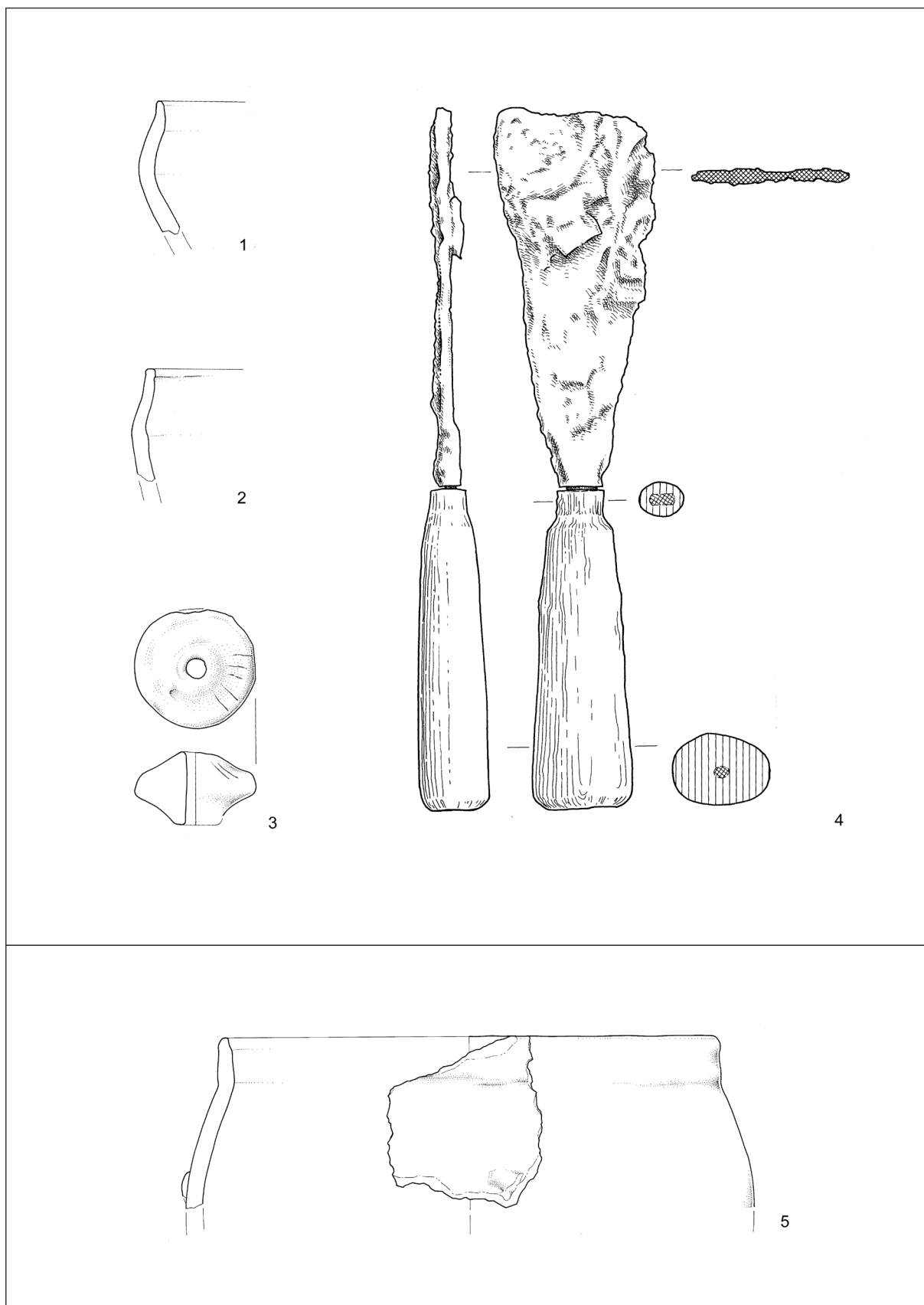
*T. 5.1:* Blatna Brezovica, 2003. 1–4,6, keramika. 5, kamen. Risbe: T. Korošec. Keramika: m = 1 : 3; kamen: m = 1 : 2.

*Pl. 5.1:* Blatna Brezovica, 2003. 1–4,6, pottery. 5, stone. Drawn by: T. Korošec. Pottery: scale = 1 : 3; stone: scale = 1 : 2.



*T. 5.2:* Blatna Brezovica, 2003. Keramika. Risbe: T. Korošec. M = 1 : 3.

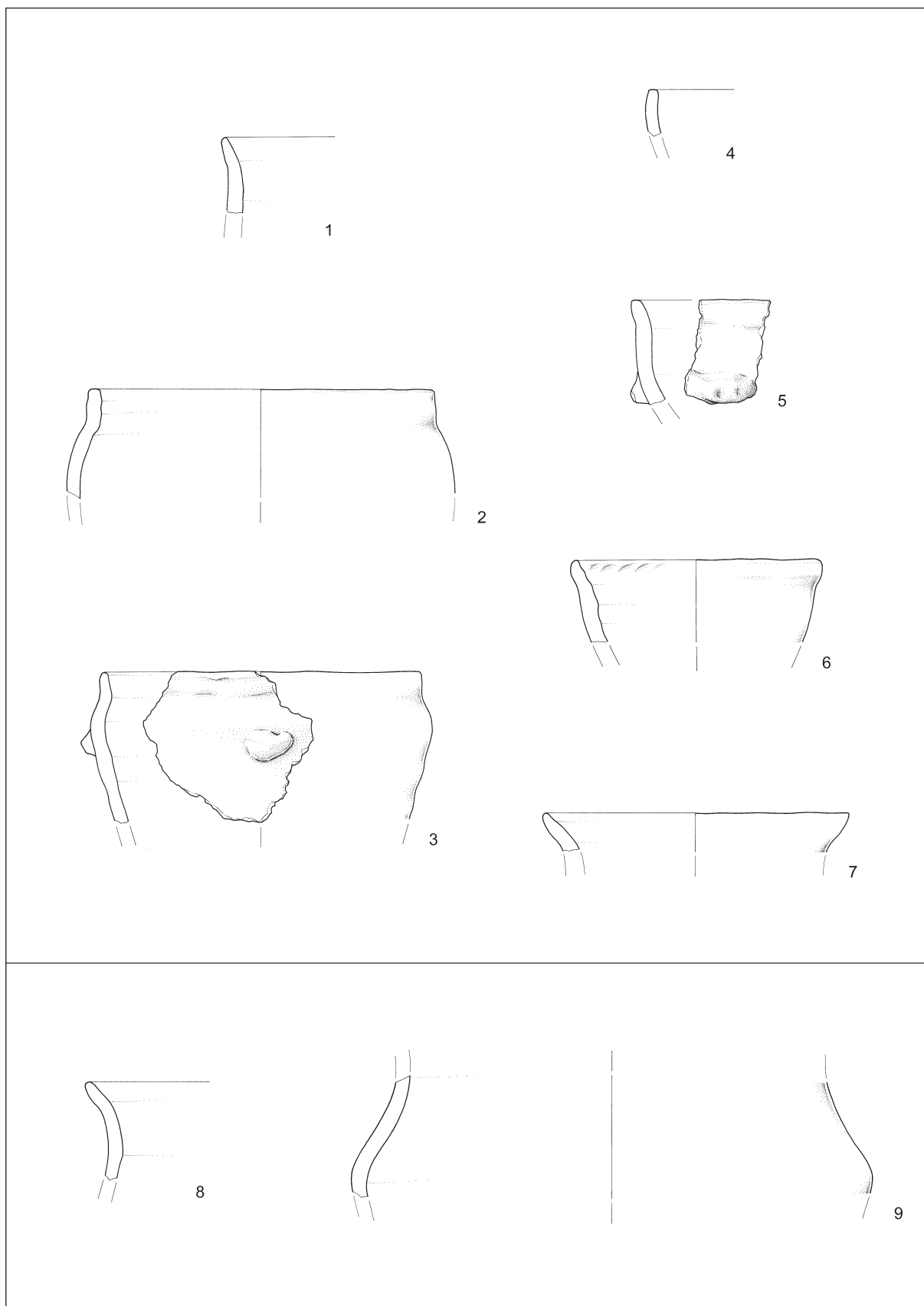
*Pl. 5.2:* Blatna Brezovica, 2003. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.



T. 5.3: Blatna Brezovica, 2003. 1-3,5, keramika. 4, les in jeklo. Risbe: T. Korošec. Keramika: m = 1 : 3; les in jeklo: m = 1 : 2.

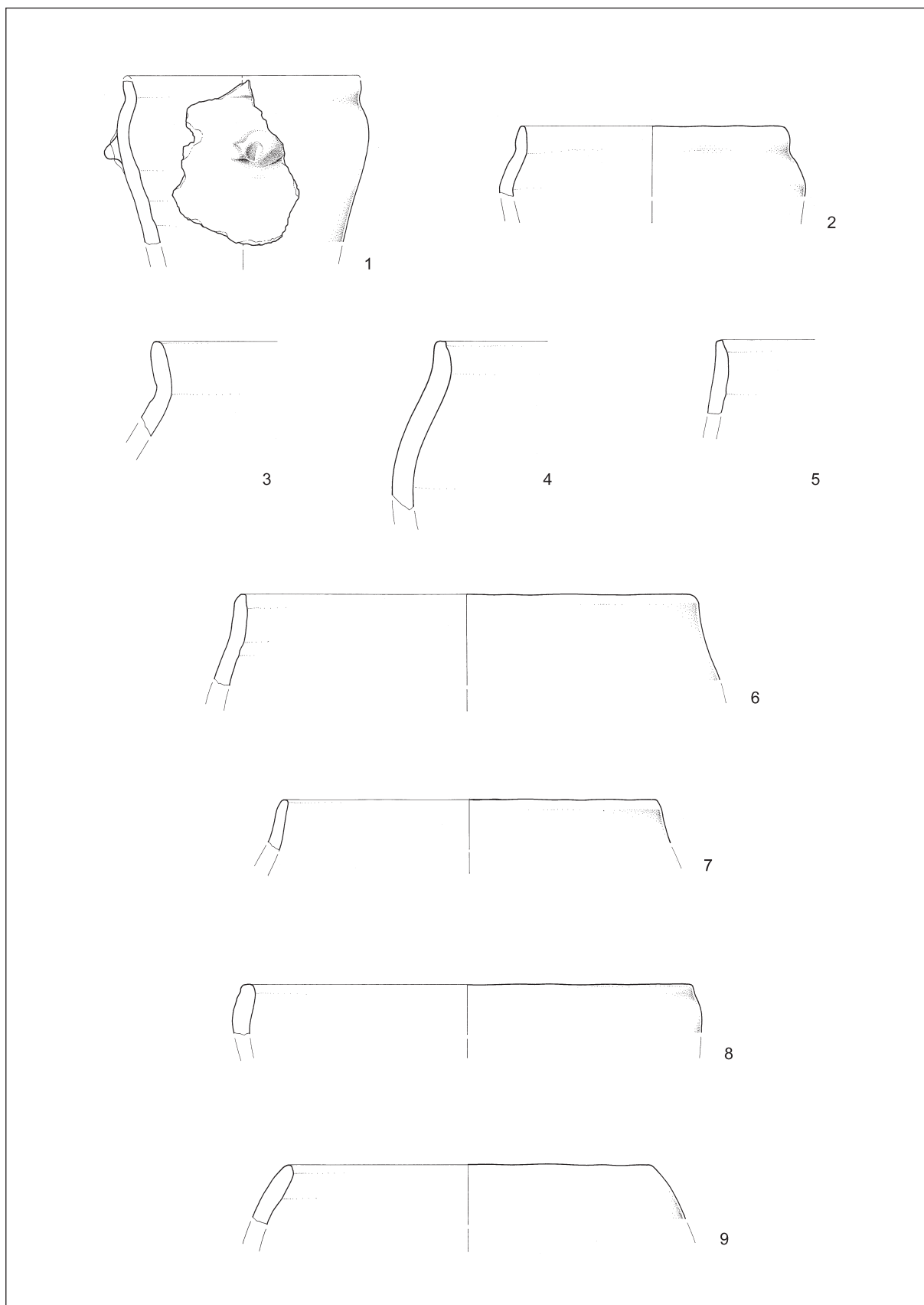
Pl. 5.3: Blatna Brezovica, 2003. 1-3,5, pottery. 4, wood and steel. Drawn by: T. Korošec. Pottery: scale = 1 : 3; wood and steel: scale = 1 : 2.





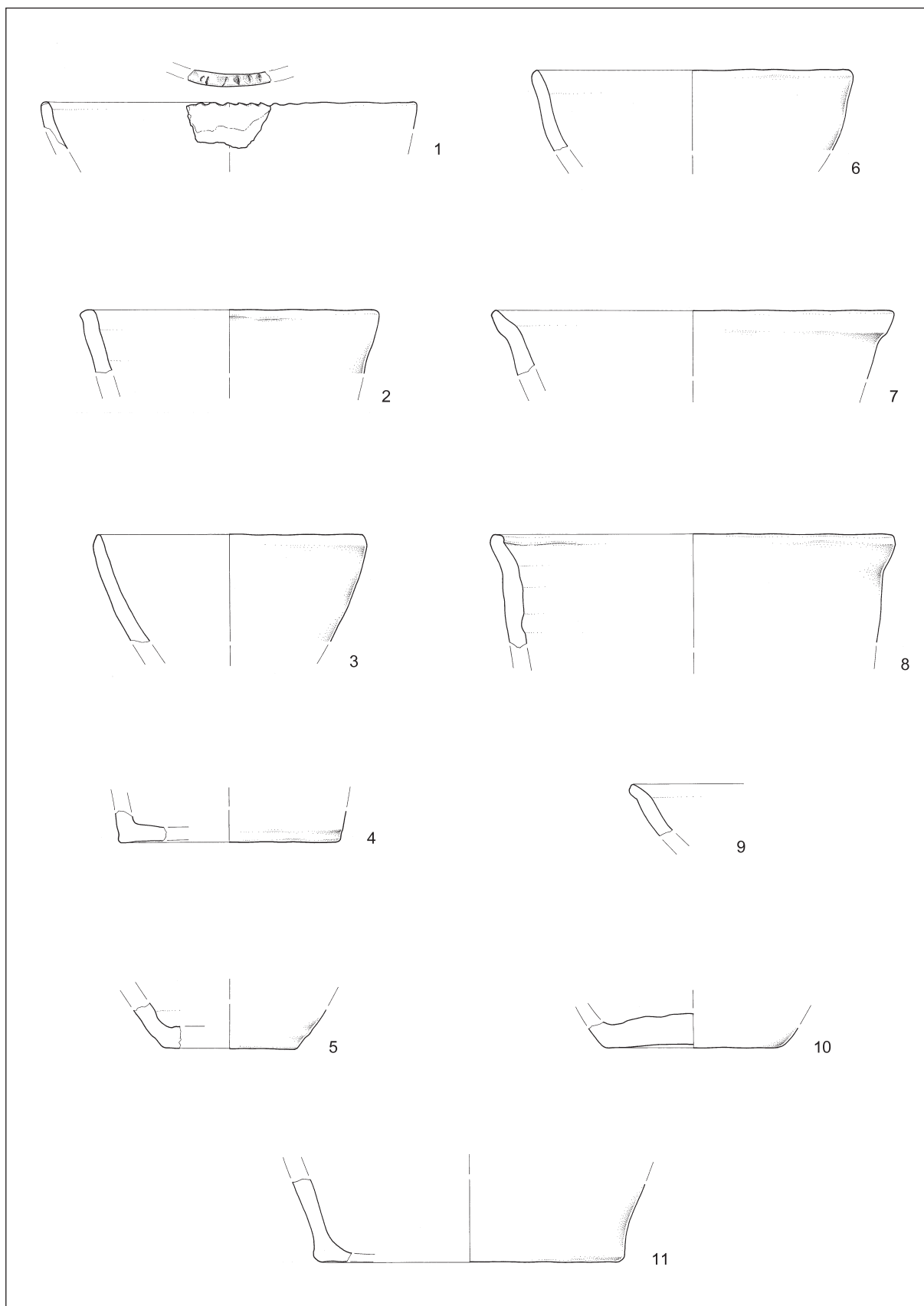
T. 5.4: Blatna Brezovica, 2003. Keramika. Risbe: T. Korošec. M = 1 : 3.

Pl. 5.4: Blatna Brezovica, 2003. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.



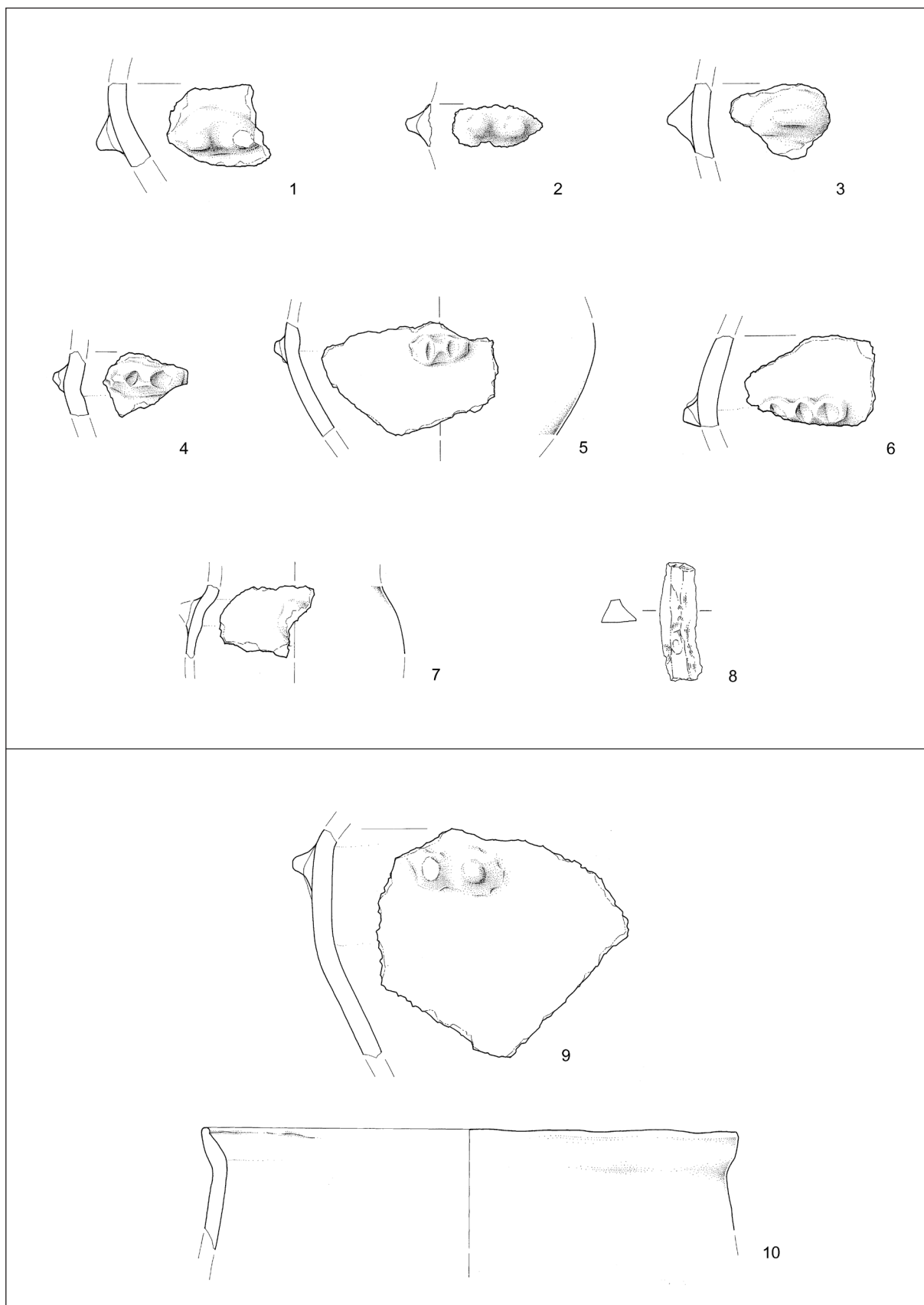
T. 5.5: Blatna Brezovica, 2003. Keramika. Risbe: T. Korošec. M = 1 : 3.

Pl. 5.5: Blatna Brezovica, 2003. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.



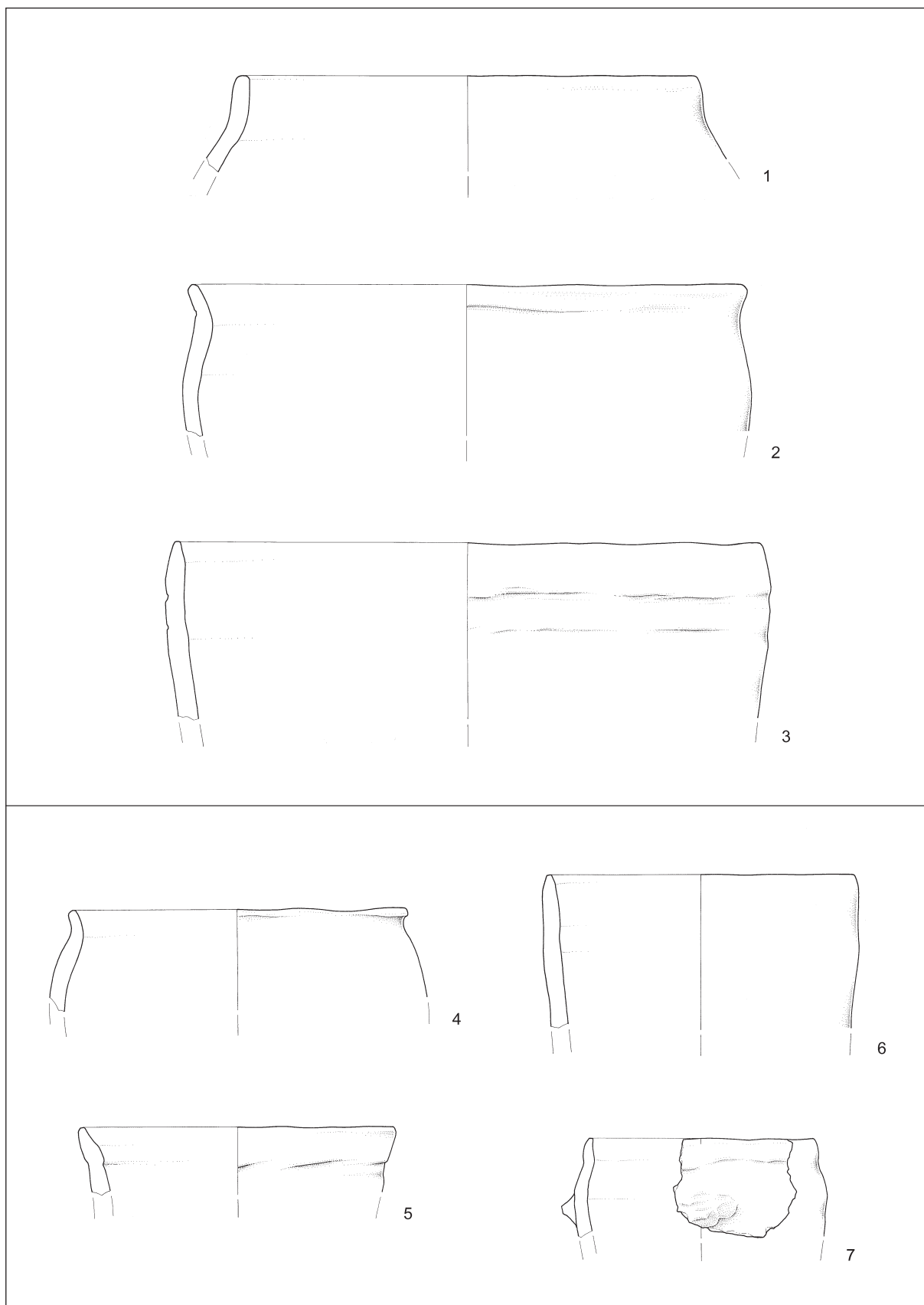
T. 5.6: Blatna Brezovica, 2003. Keramika. Risbe: T. Korošec. M = 1 : 3.

Pl. 5.6: Blatna Brezovica, 2003. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.



*T. 5.7:* Blatna Brezovica, 2003. 1-7,9,10, keramika. 8, kamen. Risbe: T. Korošec. Keramika: m = 1 : 3; kamen: m = 1 : 2.

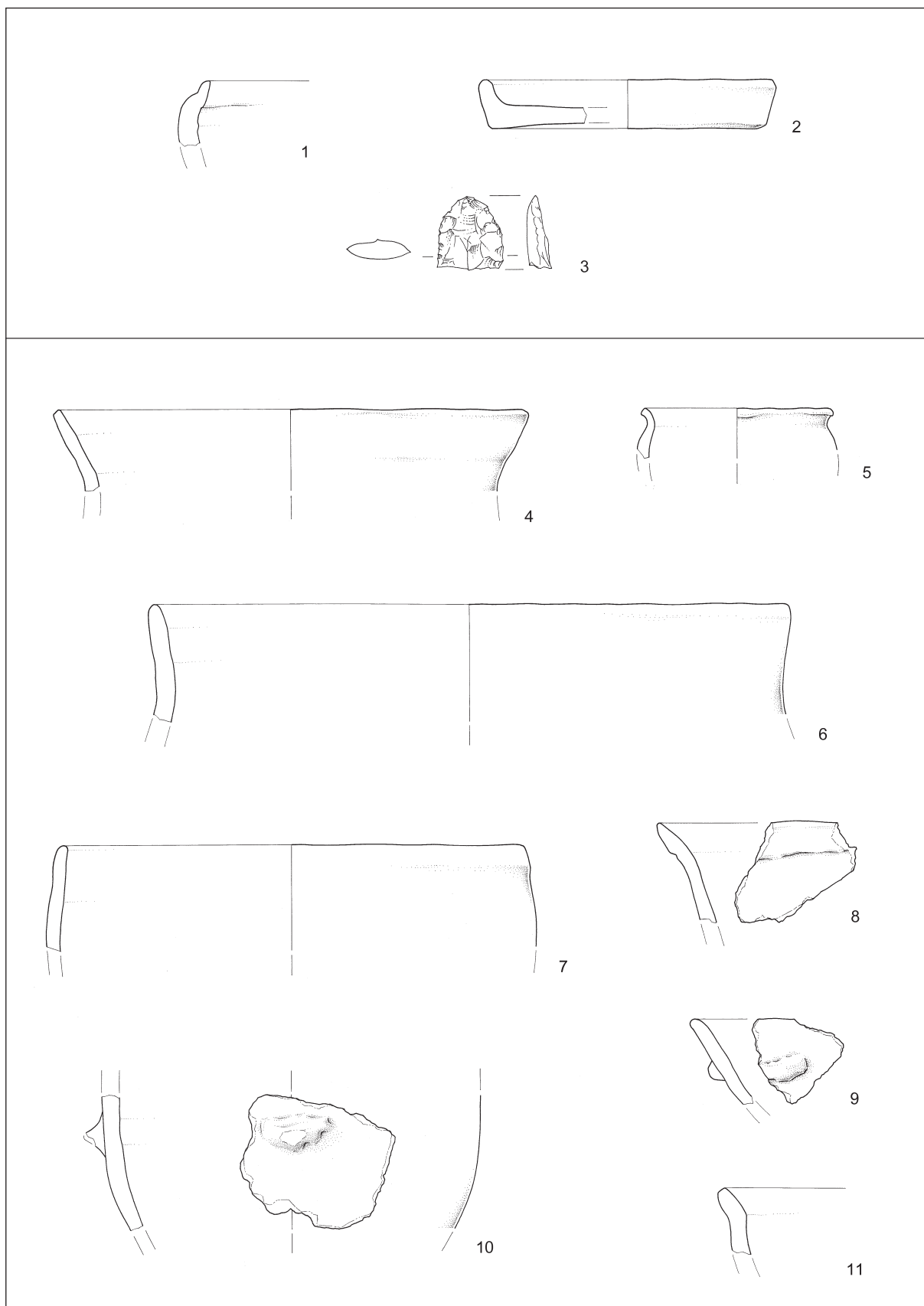
*Pl. 5.7:* Blatna Brezovica, 2003. 1-7,9,10, pottery. 8, stone. Drawn by: T. Korošec. Pottery: scale = 1 : 3; stone: scale = 1 : 2.



T. 5.8: Blatna Brezovica, 2003. Keramika. Risbe: T. Korošec. M = 1 : 3.

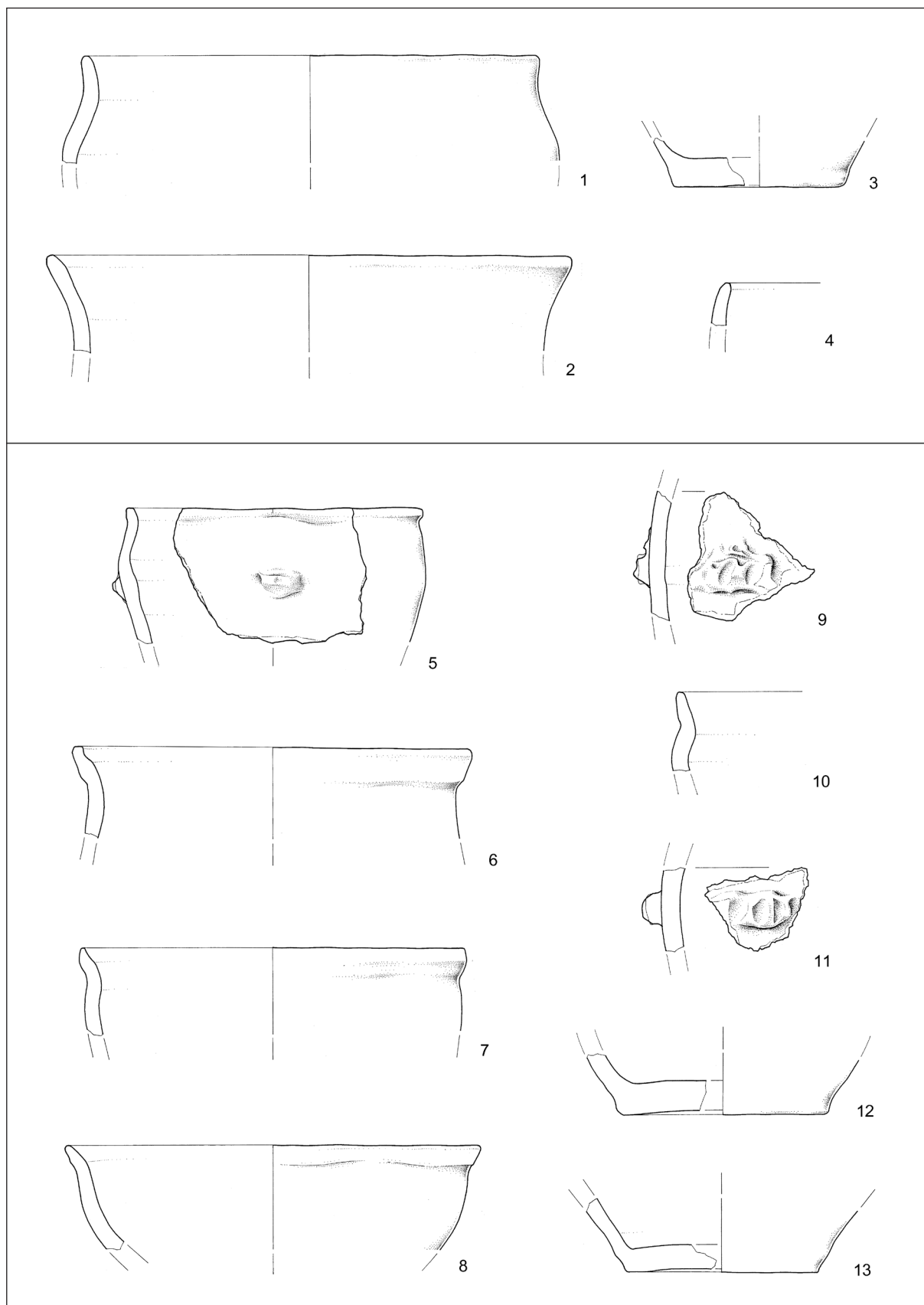
Pl. 5.8: Blatna Brezovica, 2003. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.





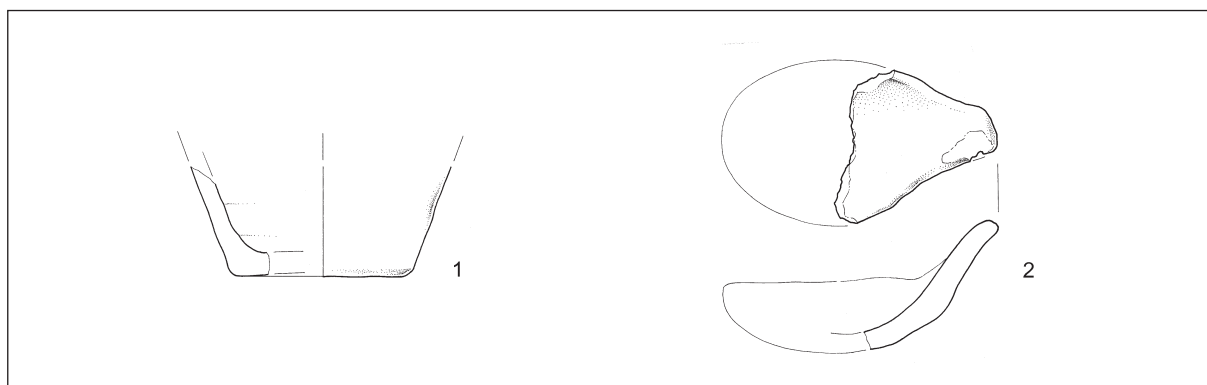
*T. 5.9:* Blatna Brezovica, 2003. 1,2,4-11, keramika. 3, kamen. Risbe: T. Korošec. Keramika: m = 1 : 3; kamen: m = 1 : 2.

*Pl. 5.9:* Blatna Brezovica, 2003. 1,2,4-11, pottery. 3, stone. Drawn by: T. Korošec. Pottery: scale = 1 : 3; stone: scale = 1 : 2.



*T. 5.10:* Blatna Brezovica, 2003. Keramika. Risbe: T. Korošec. M = 1 : 3.

*Pl. 5.10:* Blatna Brezovica, 2003. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.



*T. 5.II:* Blatna Brezovica, 2003. Keramika. Risbe: T. Korošec. M = 1 : 3.

*Pl. 5.II:* Blatna Brezovica, 2003. Pottery. Drawn by: T. Korošec. Scale = 1 : 3.



## 6. PREDHODNE ARHEOLOŠKE IN DENDROKRONOLOŠKE RAZISKAVE NA KOLIŠČARSKI NASELBINI VELIKI OTAVNIK Ib PRI BISTRU

Andrej GASPARI, Katarina ČUFAR,  
Miran ERIČ & Tjaša TOLAR

### Izvleček

Leta 2006 so bili med podvodnim pregledom struge potoka Bistra na Ljubljanskem barju nedaleč od vznožja hribovitega kraškega obrobja odkriti ostanki koliščarske naselbine Veliki Otavnik Ib. Dendrokronološka analiza lesenih nosilnih kolov je pokazala, da naselbina sodi v horizont kolišč 4. tisočletja pr. Kr. in da je sočasna z naselbino Stare gmajne.

**Ključne besede:** arheologija, dendrokronologija, koliščarska naselbina Veliki Otavnik Ib, eneolitik.

### 6.1 UVOD

V okviru delovnega programa Skupine za podvodno arheologijo in pod okriljem ljubljanske območne enote Zavoda za varstvo kulturne dediščine Slovenije je v letih 2005 in 2006 potekalo sistematično rekognosciranje potokov Ljubija in Bistra na Ljubljanskem barju z namenom, da se evidentira, dokumentira in poda preliminarna ocena potenciala arheoloških najdišč v omenjenih desnih pritokih Ljubljanice, ki v okviru arheološkega raziskovanja Ljubljanskega barja do nedavnega nista bila deležna večje pozornosti (*sl. 6.1*). Tako je bil izveden intenziven terenski pregled izpostavljenih delov glinene podlage s kolekcijo značilnih najdb, zaradi močnega erozivnega delovanja potoka pa smo se odločili tudi za preventiven odvzem vzorcev lesenih navpičnih kolov. Lokacije najdb in kolov ter morfološke značilnosti korita z bregovi so bile izmerjene z elektronskim teodolitom in umeščene v državni koordinatni sistem. Arheološke najdbe in terensko dokumentacijo v skladu z Odločbo Ministrstva za kulturo začasno hrani ZVKDS OE Ljubljana, dendrokronološke

## 6. PRELIMINARY ARCHAEOLOGICAL AND DENDROCHRONO- LOGICAL RESEARCHES AT THE PILE-DWELLING SETTLEMENT VELIKI OTAVNIK Ib NEAR BISTRA

Andrej GASPARI, Katarina ČUFAR,  
Miran ERIČ & Tjaša TOLAR

### Abstract

In 2006, we discovered remains of a pile-dwelling settlement Veliki Otavnik Ib during underwater survey of the riverbed of the Bistra stream at the Ljubljansko barje, not far from the foot of the mountainous Karstic fringe. Dendrochronological analysis of wooden foundation piles showed that the settlement dates to the horizon of pile-dwellings from 4<sup>th</sup> millennium BC and that is contemporary with the settlement Stare gmajne.

**Keywords:** archaeology, dendrochronology, pile-dwelling settlement Veliki Otavnik Ib, Eneolithic.

### 6.1 INTRODUCTION

As part of a working programme of the Group for underwater archaeology of the Institute for the Protection of Cultural Heritage of Slovenia a systematic reconnaissance of the Ljubija and Bistra streams at the Ljubljansko barje was carried out in 2005 and 2006. Our intention was to register, document and make a preliminary assessment of potential archaeological sites in the mentioned right tributaries of the Ljubljanica. These have, until recently, not received much attention in frame of archaeological research of the Ljubljansko barje (*Fig. 6.1*). An intense field examination of exposed parts of clayey base with collection of characteristic finds was performed. Due to the stream's strong erosive effects, we also decided to collect wooden vertical pile samples. Positions of finds, piles and morphological features of the riverbed with banks were recorded with total station and projected to the coordinate system of Slovenia. Archaeological finds and field documentation are, according to a decree of the Ministry of Culture,



vzorke pa Oddelek za lesarstvo Biotehniške fakultete Univerze v Ljubljani.

Čeprav je terenska ekipa v strugi Bistre odkrila dve doslej neznani koliščarski naselbini, Mali Otavnik in Veliki Otavnik Ib, ter sledove še štirih potencialnih kolišč Veliki Otavnik Ia, Veliki Otavnik II, Veliki Otavnik III in Bistra I,<sup>1</sup> v prispevku predstavljamo rezultate raziskav na koliščarski naselbini Veliki Otavnik Ib (sl. 6.2), ki izmed omenjenih edina sodi v 4. tisočletje pr. Kr.

## 6.2 OPIS NAJDIŠČA IN LEGA NAJDB

Vode Bistre pritekajo na dan v deltatistih izvirihi pri istoimenskem gradu ob vznožju kraškega masiva Ljubljanskega vrha in se po približno 3 km dolgem vijugavem toku južno od Blatne Brezovice izlivajo v Ljubljanico. Do 4 m globoko in povprečno 10 m široko korito, vrezano v jezerske sedimente in lastne drobnozrnate naplavine, se začne takoj pod sotočjem dveh vzhodnih izvirihih krakov potoka v bližini gradu. Obravnavano najdišče Veliki Otavnik leži okoli 1,1 km po potoku navzdol, nekoliko pod mostom makadamske ceste proti poslopjem Ljubljanskih mlekarn. Pod mostom je Bistra oblikovala 4 m globok podolgovat tolmun, ki se kmalu razcepi v dva, proti severovzhodu potekajoča kraka. Tik pred sotočjem obeh krakov, ki sta vrezana do 1,5 m globoko v polžarico, je

<sup>1</sup> Gaspari, Erič 2007a; 2007b.

Sl. 6.1: Zahodni del Ljubljanskega barja z novoodkritimi arheološkimi najdišči. Izsek s karte 1 : 25.000 (DTK25, © Geodetska uprava RS). Pripravila: T. Korošec.

Fig. 6.1: The western part of the Ljubljansko barje with newly discovered archaeological sites. Section from a map 1 : 25.000 (DTK25, © Geodetska uprava RS). Prepared by: T. Korošec.

temporarily stored at the Institute for the Protection of Cultural Heritage of Slovenia, Regional Unit Ljubljana (ZVKDS OE Ljubljana); dendrochronological samples are stored at the Department of Wood Technology Biotechnical faculty of the University of Ljubljana.

The field team discovered two, so far unknown, pile-dwelling settlements, Mali Otavnik and Veliki Otavnik Ib, and traces of four other potential pile-dwellings Veliki Otavnik Ia, Veliki Otavnik II, Veliki Otavnik III and Bistra I,<sup>1</sup> in bed of the Bistra. However, here we only introduce results of researches on the pile-dwelling settlement Veliki Otavnik Ib (Fig. 6.2), as it is the only pile-dwelling among the newly discovered, which dates to the 4<sup>th</sup> millennium BC.

## 6.2 DESCRIPTION OF THE SITE AND LOCATION OF FINDS

The Bistra emerges as a delta shaped spring system, close to an eponymous castle, next to the foot of the Karstic massif of the Ljubljanski vrh. It outflows into the Ljubljanica just to the South from Blatna Brezovica, after a c. 3 km long meandering course. Up to 4 m deep and on average 10 m wide riverbed, cut into the fine-grained lake sediments and its own alluvia, starts just under the confluence of the two eastern spring channels, near the castle. The site Veliki Otavnik is located c. 1.1 km downstream, not far from a bridge of a road, which runs towards the buildings of the "Ljubljanske mlekarne". The Bistra formed a 4 m deep oblong pool under the mentioned bridge, which soon splits up into two channels, running in the north-eastern direction. Just before the confluence of both watercourses, which are cut c. 1.5 m deep into the lake marl called polžarica, a smaller complex of prehistoric finds was found on the internal side of a bend, denominated Veliki Otavnik Ia (Fig. 6.1). On a shelf, which is an eroded surface of lake marl (286.5 m a.s.l.), is a layer of fine-grained sand. Several pottery sherds with analogies in the Early Bronze Age pile-dwellings Mali Otavnik<sup>2</sup> and Zornica at Blatna Brezovica,<sup>3</sup> animal bones, caprid antlers and stones with round edges were found on its surface, in an area of 1 m<sup>2</sup>. Three pieces of wood and a log with a diameter of 30 cm project horizontally from a profile layer. Downstream, in a deep bed with a rectangular cross-section (285.4 m

<sup>1</sup> Gaspari, Erič 2007a; 2007b.

<sup>2</sup> See Gaspari 2008, 57–89.

<sup>3</sup> Dirjec 1991, Pls. 1: 1; 3; 2; 4: 3.





Sl. 6.2: Območje kolišča med posegom leta 2006. Foto: A. Gaspari.  
 Fig. 6.2: The area of the pile-dwelling during research in 2006. Photo: A. Gaspari.

bil na notranji strani zavoja ugotovljen manjši kompleks prazgodovinskih najdb, poimenovan Veliki Otavnik Ia (sl. 6.1). Na terasi, ki predstavlja erodirano površino polžarice (286,5 m n. m. v.), so v plasti drobnozrnatega peska na površini 1 m<sup>2</sup> ležali več kosov keramičnih posod z analogijami na zgodnjebronastodobnih koliščih Mali Otavnik<sup>2</sup> in Zornica pri Blatni Brezovici,<sup>3</sup> živalske kosti in rogovi kaprovodov ter kamni z zaobljenimi robovi. Iz plasti v profilu so vodoravno štrleli trije kosi lesa in deblo s premerom 30 cm. Nizvodno od terase so v globljem koritu pravokotnega preseka (285,4 m n. m. v.), ki je delno zapolnjen s peščenimi sipinami, ležali posamični kosi keramike, najdene so bile tudi živalske kosti, sekira iz rogovja in del kalote človeške lobanje.

Okoli 50 m pod omenjenim tolmunom se začnejo v strugi pojavljati leseni vertikalni koli (Veliki Otavnik Ib), in sicer v 28 m dolgem in do 8 metrov širokem pasu, ki poteka diagonalno od levega brega proti desnemu v smeri zahod/jugozahod-vzhod/severovzhod (sl. 6.3). Med preseki 40 vertikalnih kolov je najpogostejši okrogel, manj je pravokotno obtesanih (sl. 6.4). Vsaj dva kola s pravokotnim presekom sta bila pred zabijanjem ožgana. Iz tlorisa (sl. 6.3) so prepoznavne tri vzporedne podolgovate skupine oz. linije kolov v smeri jugozahod-severovzhod. V štirih primerih so bili koli zabiti v razmiku 30 cm ali manj.

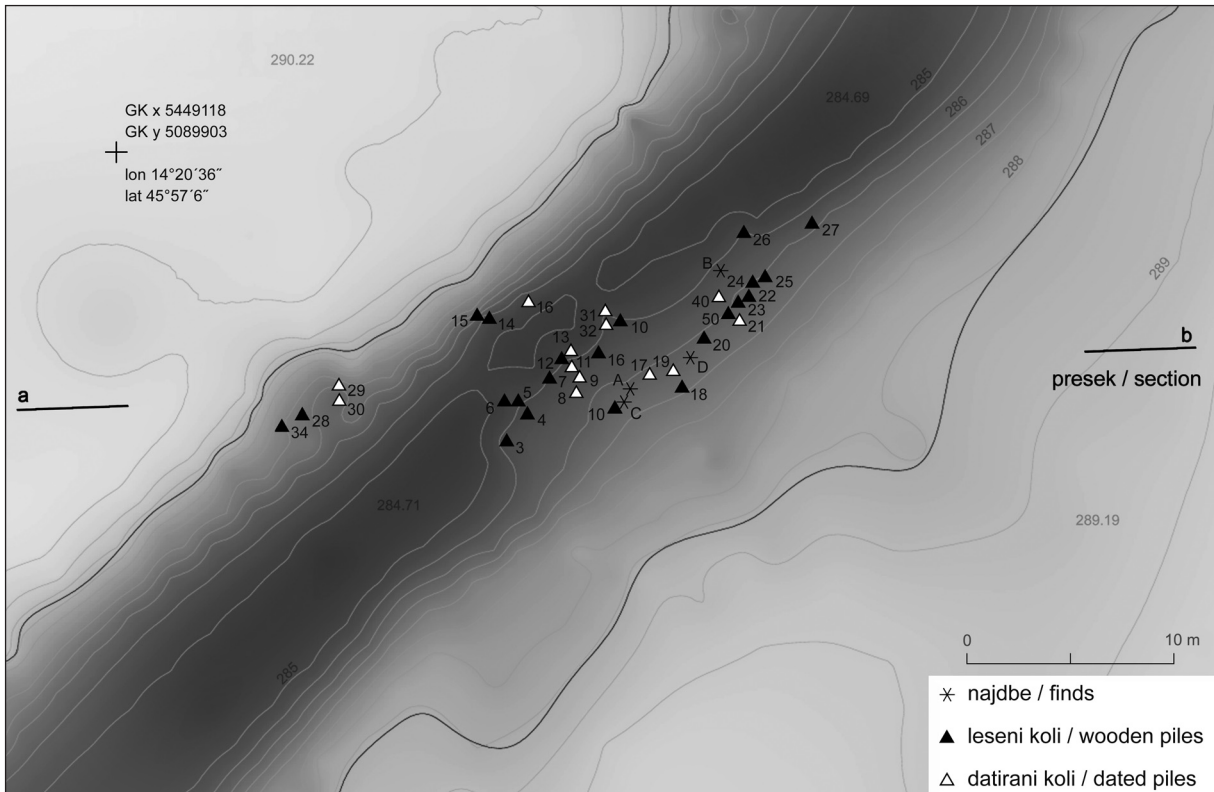
a.s.l.) that is partly filled in with dunes, pottery sherds occur, and animal bones, an antler axe and part of a human cranium were found.

Vertical wooden piles start to occur in the riverbed, c. 50 m downstream from the pool mentioned above (Veliki Otavnik Ib), namely in a 28 m long and up to 8 m wide section, running diagonally from left to right bank in the WSW-ENE direction (Fig. 6.3). A circular cross-section is the most frequent among 40 vertical piles. Rectangular piles are rarer (Fig. 6.4). At least two piles with rectangular cross-sections were burned before driven into the ground. From the ground plan, we can recognise three parallel oblong groups/lines of piles, running in SW-NE direction (Fig. 6.3). In four cases piles were driven into the ground 30 cm or less apart from one another.

Remains of piles are concentrated in a 6 m wide area in the middle of the riverbed. A larger group is preserved in the central part of the riverbed, which is cut up to 2 m deep into lake marl. Altitude variation between the preserved pile tops is up to 1.4 m. The highest piles are located on a shelf just below the left bank, which is an eroded surface of lake marl (Fig. 6.5). It is located at 286.7 m a.s.l., which is very similar to the documented height of lake marl at the Veliki Otavnik Ia and the pile-dwelling Mali Otavnik (I), which were 286.9–287.1 m a.s.l.. Identification of an assumed cultural horizon in banks was not possible due to siltation of the right third of the riverbed and root systems, which cover the upper lying parts of the left bank.

<sup>2</sup> Glej Gaspari 2008, 57–89.

<sup>3</sup> Dirjec 1991, t. 1: 1; 3; 2; 4: 3.

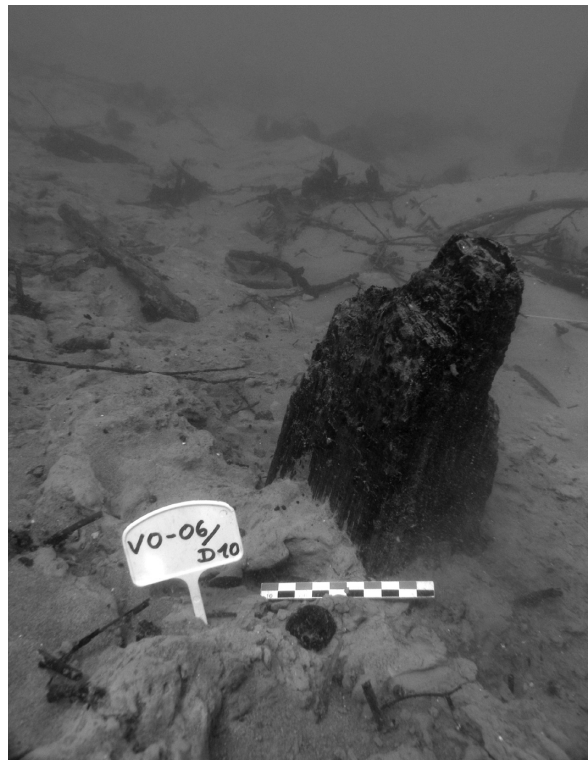


Sl. 6.3: Tlorisni načrt kolov in lokacij dvignjenih predmetov na najdišču Veliki Otavnik Ib. Pripravil: M. Erič.

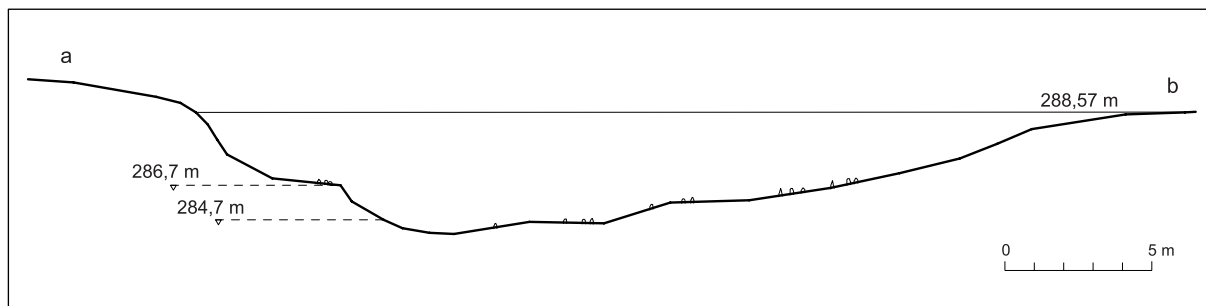
Fig. 6.3: Ground plan of piles and locations of collected objects at the site Veliki Otavnik Ib. Prepared by: M. Erič.

Ostanki kolov se zgoščajo v 6 m širokem pasu v sredini struge, večja skupina je ohranjena tudi v osrednjem delu korita, ki je na tem mestu do 2 m globoko vrezano v polzarico. Višinska razlika med ohranjenimi vrhovi kolov dosega 1,4 m. Najvišje ležeči koli so ohranjeni na stopnici tik pod levim bregom, ki predstavlja erodirano površino polzarice (sl. 6.5). Ta leži na 286,7 m n. m. v., kar je zelo podobno višini polzarice na lokaciji Veliki Otavnik Ia in situaciji na kolišču Mali Otavnik (I), kjer je bila polzarica dokumentirana na 286,9–287,1 m n. m. v. Identifikacijo domnevanega kulturnega horizonta v brežinah sta preprečila močna zamuljenost desne tretjine struge in koreninski spleti, ki prekrivajo nadvodni del leve brežine.

Najdb v okolici kolov na najdišču Veliki Otavnik Ib je malo. Poleg redkih kostnih ostankov živali je bilo opaženih le nekaj odtikov in ne več kot 5 odlomkov keramike, nekaj metrov po toku navzdol, kjer kolov ni več, pa so predmeti še redkejši. V globljem tolmunu, okoli 20 m nizvodno od kolišča, sta bila najdena še vijček in rogovje navadnega jelena brez sledov obdelave, nato pa najdbe povsem izginijo. Nanje ponovno naletimo tik pred koncem ravnega severnega dela meandra, kjer je bila v sredini korita ugotovljena večja koncentracija keramike in orodij na prevrtanih bazah jelenjih rogovij (Veliki Otavnik II). Vzporedno z mestom najdbe sta oba bregova zamuljena, koli pa niso bili opaženi. Predmeti se posamično pojavljajo še dobrih 30 m po toku navzdol.



Sl. 6.4: Lesen kol. Kolišče Veliki Otavnik Ib. Foto: A. Gaspari.  
Fig. 6.4: Wooden pile. Pile-dwelling Veliki Otavnik Ib. Photo: A. Gaspari.



Sl. 6.5: Prečni presek struge na območju najdišča. Risba: M. Erič.

Fig. 6.5: Cross section of the riverbed in the area of the site. Drawn by: M. Erič.

### 6.3 OPREDELITEV GRADIVA

V okolici kolov s kolišča Veliki Otavnik Ib se poleg natančneje neopredeljivih odlomkov keramičnih posod pojavljajo tudi kamniti predmeti, med njimi odlomek žrmelj iz bele luknjičave kamnine (t. 6.1: 5), v celoti ohranjen terilni kamen okroglega preseka z ravno zgornjo in spodnjo površino iz temnega peščenjaka (t. 6.1: 4), ostanek enostransko izrobljenega diskastega jedra iz sivozelenega roženca (t. 6.1: 3), strgalo (t. 6.1: 2) in praskalo na klini iz presojnega rjavega roženca (t. 6.1: 1). Med keramičnimi najdbami z Velikega Otavnika Ib izstopa samo kroglasti lonček iz temnosivo žgane gline z močnimi primesmi karbonatnega peska (t. 6.1: 6).

### 6.4 DENDROKRONOLOŠKA ANALIZA

V dendrokronološkem laboratoriju smo pregledali 30 vzorcev in določili lesne vrste: 17 vzorcev hrasta (*Quercus* sp.), 6 jesena (*Fraxinus* sp.) in po 2-3 vzorcev topola (*Populus* sp.), vrbe (*Salix* sp.) in črne jelše (*Alnus glutinosa*) (tab. 6.1).

Na 13 vzorcih (11 hrastovih in 2 jesenovih), ki so imeli dovolj branik, smo opravili dendrokronološko analizo. Vsa zaporedja širin branik smo medsebojno sinhronizirali, kar pomeni, da je bil preiskani les iz istega obdobja. Na osnovi 10 zaporedij širin branik smo sestavili plavajočo kronologijo in jo primerjali z razpoložljivimi kronologijami koliščarskih naselbin z Ljubljanskega barja. Izkazalo se je, da je preiskani les z Velikega Otavnika Ib del konstrukcije, ki je bila postavljena v času koliščarske naselbine Stare gmajne, natančneje v času, ko so šle gradbene aktivnosti na Starih gmajnah h koncu.<sup>4</sup>

Relativni dendrokronološki datumi najmlajših branik (tab. 6.1) so od leta 85 do 178, zato se tudi kronologija Velikega Otavnika Ib: VO6-QUSP1, konča v relativnem letu 178. S tabele 6.1 je razvidno, da imajo

Only a small amount of finds occur near the piles at the Veliki Otavnik Ib. Besides rare animal bone remains, we found a small number of flakes and no more than 5 pottery fragments. Finds are even rarer a few metres downstream, where piles are not present anymore. A spindle whorl and an unworked red deer antler were found in a deeper pool, c. 20 m downstream from the pile-dwelling. There were no finds present beyond this point. They occur again just prior to the end of the straight northern part of the meander. There, larger concentration of pottery and tools, made on perforated deer antler beams, were discovered in the middle of the riverbed (Veliki Otavnik II). Both riverbanks, parallel to this area of concentration, are silted. We have not notice any piles. Individual finds still occur in an area of 30 m downstream.

### 6.3 DEFINITION OF FINDS

Apart from indefinable pottery sherds, found in the vicinity of the pile-dwelling Veliki Otavnik Ib, also stone objects occur, such as a fragment of a quern made of white porous rock (Pl. 6.1: 5), an entirely preserved ground stone with circular cross-section and straight upper and lower surface, made of dark sandstone (Pl. 6.1: 4), a fragment of unipolar discoid core, made of grey green chert (Pl. 6.1: 3), scraper (Pl. 6.1: 2) and an endscraper on a blade made of translucent brown chert (Pl. 6.1: 1). Only a small round pot, made of dark grey fired clay with rich additions of carbonate sand (Pl. 6.1: 6), stands out among pottery finds from the Veliki Otavnik Ib.

### 6.4 DENDROCHRONOLOGICAL ANALYSIS

In dendrochronological laboratory, we investigated and determined wood species of 30 samples: 17 were oak (*Quercus* sp.), 6 ash (*Fraxinus* sp.) and 2-3 samples each were poplar (*Populus* sp.), willow (*Salix* sp.) and black alder (*Alnus glutinosa*) (Tab. 6.1).

<sup>4</sup> Glej poglavje 7 v tem zborniku.



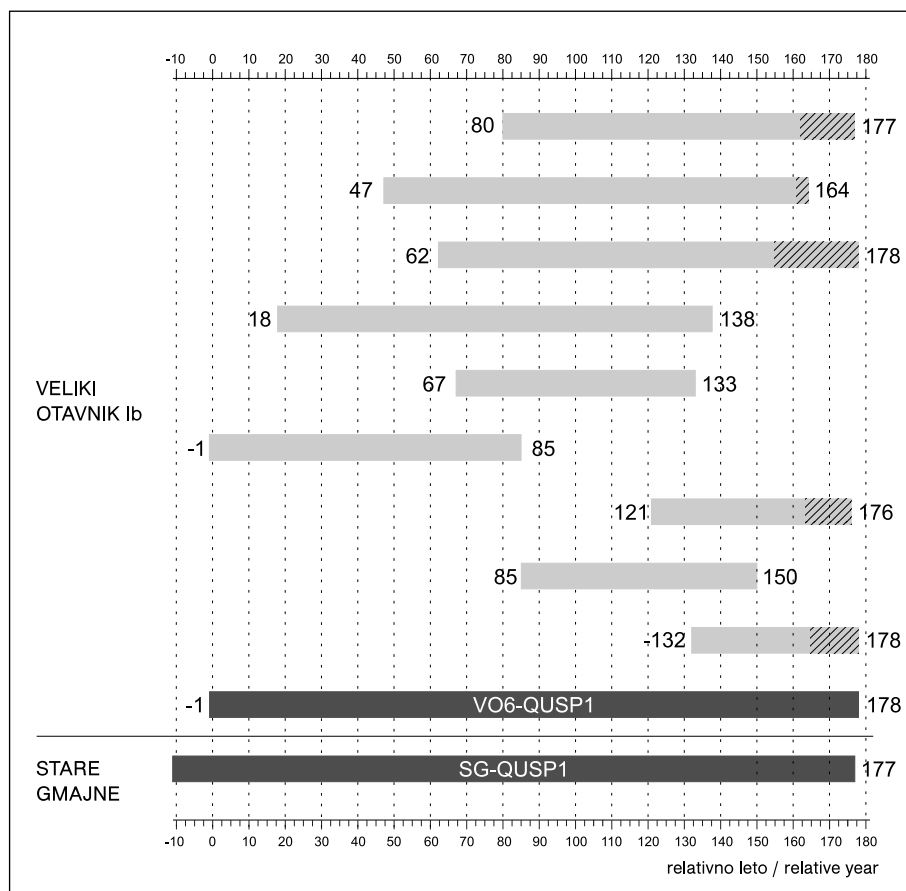
Tab. 6.1: Podatki o vzorcih lesa z Velikega Otavnika Ib (VO-06). Relativno leto 178 po radiokarbonski dataciji predstavlja leto 3108 ± 12 pr. Kr.

Tab. 6.1: Wood samples from Veliki Otavnik Ib (VO-06). Relative year 178 according to radiocarbon dating represents a year 3108 ± 12 BC.

VZOREC SAMPLE	Dendro	Drevesna vrsta Tree species	Premer Diameter	Klan Splitted	Branike Tree rings	Branike beljave Sapwood tree rings	Skorja Bark	Relativni datumi Relative dates
VO-06-D03		<i>Populus</i> sp.	11,5	ne / no	22		da / yes	
VO-06-D04		<i>Quercus</i> sp.	6,5	ne / no	13		da / yes	
VO-06-D05		<i>Salix</i> sp.	9,5	ne / no	20		da / yes	
VO-06-D06		<i>Quercus</i> sp.	12,5	ne / no	23		ne / no	
VO-06-D07		<i>Quercus</i> sp.	10,0	ne / no	22		da / yes	
VO-06-D08	da / yes	<i>Quercus</i> sp.	11,5	da / yes	99	13	ne / no	<b>177</b>
VO-06-D09	da / yes	<i>Quercus</i> sp.	13,5	da / yes	119	2	ne / no	<b>164</b>
VO-06-D11	da / yes	<i>Quercus</i> sp.	14,0	da / yes	118	20	ne / no	<b>178</b>
VO-06-D12		<i>Fraxinus</i> sp.	4,0	ne / no	13		da / yes	
VO-06-D13	da / yes	<i>Quercus</i> sp.	10,5	da / yes	121	0	ne / no	<b>138</b>
VO-06-D14		<i>Quercus</i> sp.	6,3	ne / no	12		da / yes	
VO-06-D15		<i>Alnus glutinosa</i>	15,0	ne / no	25		da / yes	
VO-06-D16	da / yes	<i>Quercus</i> sp.	9,0	da / yes	68	0	ne / no	<b>133</b>
VO-06-D17	da / yes	<i>Quercus</i> sp.	13,5	ne / no	145	26	ne / no	
VO-06-D19	da / yes	<i>Quercus</i> sp.	9,5	da / yes	88	0	ne / no	<b>85</b>
VO-06-D20		<i>Quercus</i> sp.	9,0	da / yes	38		ne / no	
VO-06-D21	da / yes	<i>Quercus</i> sp.	12,0	da / yes	57	11	ne / no	<b>176</b>
VO-06-D22		<i>Fraxinus</i> sp.	9,0	ne / no	26		?ne / no	
VO-06-D23		<i>Quercus</i> sp.	7,5	da / yes	31		ne / no	
VO-06-D24		<i>Fraxinus</i> sp.	6,0	ne / no	24		?da / yes	
VO-06-D25		<i>Salix</i> sp.	7,0	ne / no	14		ne / no	
VO-06-D26		<i>Populus</i> sp.	4,0	ne / no	9		ne / no	
VO-06-D27		<i>Populus</i> sp.	5,5	ne / no	7		ne / no	
VO-06-D28		<i>Fraxinus</i> sp.	11,0	ne / no	28		ne / no	
VO-06-D29	da / yes	<i>Quercus</i> sp.	12,0	da / yes	71	0	ne / no	
VO-06-D30	da / yes	<i>Fraxinus</i> sp.	10,0	ne / no	53		da / yes	
VO-06-D31	da / yes	<i>Fraxinus</i> sp.	9,0	ne / no	36		da / yes	
VO-06-D32	da / yes	<i>Quercus</i> sp.	6,5	ne / no	67	0	ne / no	<b>150</b>
VO-06-D34		<i>Alnus glutinosa</i>	12,5	da / yes	40		ne / no	
VO-06-D40	da / yes	<i>Quercus</i> sp.	11,5	da / yes	48	16	ne / no	<b>178</b>

vzorci različno število branik beljave. Vzorci, datirani v relativna leta 176–178, so imeli ohranjeno večino beljave, pri ostalih vzorcih pa jo je ohranjen le del beljave ali pa manjka zaradi obdelave lesa ali zaradi obrabe oz. poškodovanja. Vzorec VO-06-D11 ima tako 20 branik beljave in relativni datum zadnje branike 178. Ker ne vsebuje skorje in ker je zadnja branika nepopolna, ne moremo zagotovo ugotoviti, ali je zadnja branika na vzorcu tudi zadnja branika, ki je nastala, ko je drevo še rastlo. Vzorec VO-06-D19 nima beljave, relativni datum zadnje branike pa je 85. Glede na njegovo obliko sklepamo, da zunanji del vzorca ni ohranjen. Glede na relativne datume in

13 samples (11 of oak and 2 of ash) contained enough annual rings for dendrochronological analysis. We cross-dated all sequences of annual-ring widths, meaning that all of the wood studied was contemporary. Based on 10 sequences of annual-ring widths, we created a floating annual-ring chronology and compared it to other available chronologies from the pile-dwelling settlements of the Ljubljansko barje. It turned out that the examined wood from Veliki Otavnik Ib was part of a construction, built contemporary to the pile-dwelling



Sl. 6.6: Časovni razponi zaporedij širin branik in relativni datumi najmlajše branike vzorcev iz Velikega Otavnika (VO-06-D08–VO-06-D40), združenih v kronologijo (VO6-QUSP1) in relativno datiranih s kronologijo Starih gmajn (SG-QUSP1, verzija 2007). Šrafura predstavlja število branik v beljavi. Relativno leto 178 po radiokarbonski dataciji predstavlja leto  $3108 \pm 12$  pr. Kr.

Fig. 6.6: Time spans of annual-ring sequences and relative dates of the youngest annual rings from Veliki Otavnik (VO-06-D08–VO-06-D40) integrated to chronology (VO6-QUSP1) and relatively dated with the chronology of Stare gmajne (SG-QUSP1, version 2007). The hatch represents the quantity of sapwood annual rings. Relative year 178 corresponds with  $3108 \pm 12$  BC.

ohranjenost lesa sklepamo, da je bil ves datirani les za konstrukcijo z Velikega Otavnika Ib posekan sočasno, razlike v datiranju pa so posledica manjkajočih branik na periferiji vzorcev.

Plavajočo kronologijo VO6-QUSP1 smo primerjali z vsemi razpoložljivimi kronologijami dendrokronološkega laboratorija na Oddelku za lesarstvo. Ujemala se je s hrastovo kronologijo iz Starih gmajn: SG-QUSP1, verzija 2007. Statistični kazalniki ujemanja ( $GLK = 71\%$ ,  $t_{BP} = 8,6$ ) nedvoumno potrjujejo sočasnost kronologij.

Slika 6.6 kaže, da je zadnja branika kronologije VO6-QUSP1 nastala 1 leto kasneje kot zadnja branika kronologije s Starih gmajn: SG-QUSP1. Les z relativnim datumom 177 (natančneje 172–177 oz. med letoma 3114 in  $3109 \pm 12$  pr. Kr.) smo našli v jarkih številka 1, 3 in 5 na vzhodnem in v jarku 13 na zahodnem delu naselbine.<sup>5</sup> Glede na radiokarbonsko datacijo zadnje branike v kronologiji Starih gmajn SG-QUSP1 so se gradbene

settlement Stare gmajne, during the last stages of building activity at Stare gmajne to be precise.<sup>4</sup>

Relative dendrochronological dates of the youngest annual rings (Tab. 6.1) are 85 to 178. That is why the chronology of Veliki Otavnik Ib: VO6-QUSP1, ends in the relative year 178. Table 6.1 shows that samples have different quantity of sapwood annual rings. Samples, dated to relative years 176–178, have the majority of sapwood preserved, while the other samples only contain some sapwood or sapwood is entirely missing due to woodworking/wear and tear. Sample VO-06-D11 contains 20 sapwood annual rings with the relative date of the outmost annual ring being 178. As it does not contain bark and because its last annual ring is partial, we cannot define whether the last annual ring is also the last annual ring of the tree. Sample VO-06-D19 does not contain sapwood (relative year of the last annual ring is 85). Based on its form, we assume that the outmost part of the sample is not preserved. Considering relative dates

<sup>5</sup> Glej poglavje 7 v tem zborniku: sl. 7.8.

<sup>4</sup> See Chapter 7 in this monograph.

aktivnosti v okviru hrastove kronologije na Velikem Otavniku Ib končale v letu  $3108 \pm 12$  pr. Kr.<sup>6</sup>

## 6.5 SKLEP

Na podlagi dendrokronološke analize sklepamo, da je koliščarska naselbina Veliki Otavnik Ib sočasna z zamrtjem koliščarske naselbine Stare gmajne, ki leži približno 1 km proti severozahodu. Kot tako jo uvrščamo v skupino kolišč 4. tisočletja pr. Kr., med katerimi poznamo z jugozahodnega dela Ljubljanskega barja še Hočevarico,<sup>7</sup> Črešnjo pri Bistri<sup>8</sup> in Blatno Brezovico.<sup>9</sup>

## 6.6 KATALOG NAJDB / CATALOGUE OF FINDS

Tabla 6.1

1. Praskalo na fragmentirani klini iz svetlorjavega, rahlo presojnega roženca. Talon je ravno fasetiran. Na distalnem delu dorzalne strani je izdelano čelo praskala.

2. Strgalo na odbitku iz temnorjavega roženca. Talon je pokrit s korteksom. Na desnem lateralnem robu dorzalne strani so retuše. Na distalnem delu dorzalne strani so stopnjevite školjkovite retuše. Na distalnem delu levega lateralnega roba na ventralni strani so retuše.

3. Enostransko izroblijeno diskasto jedro iz temnozelenega roženca.

4. Okrogel tolkač oz. terilnik iz temno zelenkastosivega skrilastega peščenjaka.

5. Kos žrnelj s stanjšanim robom in usločeno delovno površino iz bele, luknjičave kamnine.

6. Odlomek ostenja iz gline s primesmi belega peska do 5 mm velikosti; notranja površina temnosivo žgana, zunanja površina siva do temnosivo žgana.

and preservation of wood, we presume that all the wood that we dated and was used for the construction from Veliki Otavnik Ib, was felled simultaneously. Differences in dates are a consequence of missing annual rings on the outmost parts of the samples.

We compared the floating chronology VO6-QUSP1 with all available chronologies of the Dendrochronological laboratory of the Department of Wood Technology. It corresponds with the oak chronology from Stare gmajne: SG-QUSP1, version 2007. The statistical cross-dating parameters (GLK = 71 %,  $t_{BP} = 8.6$ ) undoubtedly confirm synchronicity of chronologies.

Figure 6.6 shows that the last annual ring of VO6-QUSP1 chronology occurred 1 year after the youngest annual ring of chronology from the Stare gmajne: SG-QUSP1. Wood with relative date 177 (172–177 to be precise, or between  $3114$  and  $3109 \pm 12$  BC) was found in ditches 1, 3 and 5 in the eastern and in ditch 13 in the western part of the settlement.<sup>5</sup> Considering the radiocarbon date of the youngest annual ring in chronology of the Stare gmajne SG-QUSP1, building activities at Veliki Otavnik Ib terminated in  $3108 \pm 12$  BC, according to oak chronology.<sup>6</sup>

## 6.5 CONCLUSION

Based on dendrochronological analysis, we presume that the pile-dwelling settlement Veliki Otavnik Ib was contemporary with the last stages of the pile-dwelling settlement Stare Gmajne, which lies c. 1 km to the north-west. It can therefore be categorised into a group of pile-dwellings of the 4<sup>th</sup> millennium BC. This group also contains Hočevarica,<sup>7</sup> Črešnja pri Bistri<sup>8</sup> and Blatna Brezovica,<sup>9</sup> all from the south-western part of the Ljubljansko barje.

<sup>6</sup> Glej poglavje 7.1.2.1 v tem zborniku.

<sup>7</sup> Velušček 2004a.

<sup>8</sup> Velušček et al. 2004.

<sup>9</sup> Glej Korošec 1963 ter poglavji 5 in 7 v tem zborniku.

<sup>5</sup> See Chapter 7 in this monograph: Fig. 7.8.

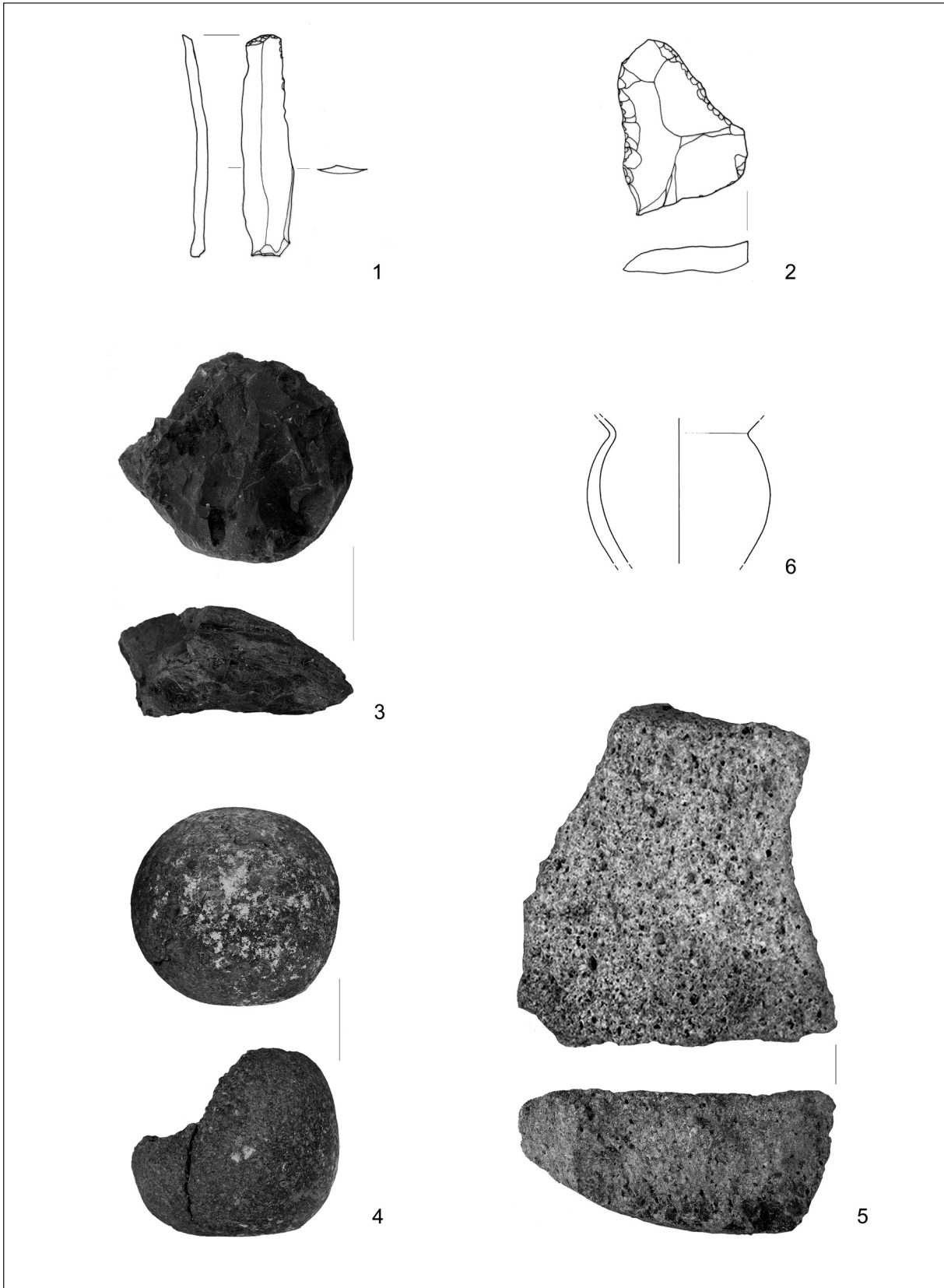
<sup>6</sup> See Chapter 7.1.2.1 in this monograph.

<sup>7</sup> Velušček 2004a.

<sup>8</sup> Velušček et al. 2004.

<sup>9</sup> See Chapters 5 and 7 in this monograph and Korošec 1963.





*T. I:* Najdbe z območja kolišča Veliki Otavnik Ib iz potoka Bistra. 1-5, kamen. 6, keramika. Risbe: 1-2 B. Kavur; 6 J. Tratnik; foto: 3-5 A. Gaspari. Kamen: m = 1 : 2; keramika: m = 1 : 3.

*Pl. I:* Finds from the area of the pile-dwelling Veliki Otavnik Ib, discovered in the Bistra stream. 1-5, stone. 6, pottery. Drawn by: 1-2 B. Kavur; 6 J. Tratnik; photo: 3-5 A. Gaspari. Stone: scale = 1 : 2; pottery: scale = 1 : 3.



## 7. DENDROKRONOLOŠKE RAZISKAVE NA KOLIŠČARSKIH NASELBINAH STARE GMAJNE IN BLATNA BREZOVICA

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TOLAR & Bernd KROMER

### Izvleček

Predstavljeni so rezultati dendrokronoloških in radiometričnih raziskav na koliščarskih naselbinah Stare gmajne in Blatna Brezovica na Ljubljanskem barju.

Koliščarski naselbini sta obstajali okoli leta 3100 pr. Kr. Raziskava je tudi pokazala, da sta bili poseljeni v približno istem obdobju oz. da je Blatna Brezovica najverjetneje nekoliko mlajša.

**Ključne besede:** dendrokronologija, radiokarbonsko datiranje, Stare gmajne, Blatna Brezovica, Ljubljansko barje, eneolitik.

### 7.1 STARE GMAJNE

Koliščarska naselbina Stare gmajne leži na jugozahodnem delu Ljubljanskega barja v bližini Ljubljanice nasproti osamelca Blatna Brezovica.

V primerjavi z drugimi kolišči Ljubljanskega barja so bile Stare gmajne odkrite relativno pozno, šele leta 1992. Leta 1995 so na najdišču potekale prve arheološke terenske raziskave, vzorci lesa za dendrokronološke raziskave na Starih gmajnah pa so bili odvzeti v štirih etapah med letoma 2002 in 2007.<sup>1</sup>

#### 7.1.1 DENDROKRONOLOŠKE RAZISKAVE

##### 7.1.1.1 VZORČENJE LESA

Iz načrta (*sl. 7.1*) je razvidno, da so bili koli vzeti iz osmih jarkov, povprečno širokih približno 1 m, in iz treh sond. Tako je ekipa Inštituta za arheologijo ZRC SAZU

<sup>1</sup> Glej poglavje 3 v tem zborniku.

## 7. DENDROCHRONO- LOGICAL RESEARCH AT THE PILE-DWELLING SETTLEMENTS STARE GMAJNE AND BLATNA BREZOVICA

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### Abstract

We present the results of dendrochronological and radiometric researches on the pile-dwelling settlements Stare gmajne and Blatna Brezovica, both located at the Ljubljansko barje.

The pile-dwelling settlements date to c. 3100 BC. The research has also showed that they were contemporary or that Blatna Brezovica existed somewhat later.

**Keywords:** dendrochronology, radiocarbon dating, Stare gmajne, Blatna Brezovica, the Ljubljansko barje, Eneolithic.

### 7.1 STARE GMAJNE

The pile-dwelling settlement Stare gmajne is located on the south-western part of the Ljubljansko barje, near the Ljubljanica and opposite to the isolated hill Blatna Brezovica.

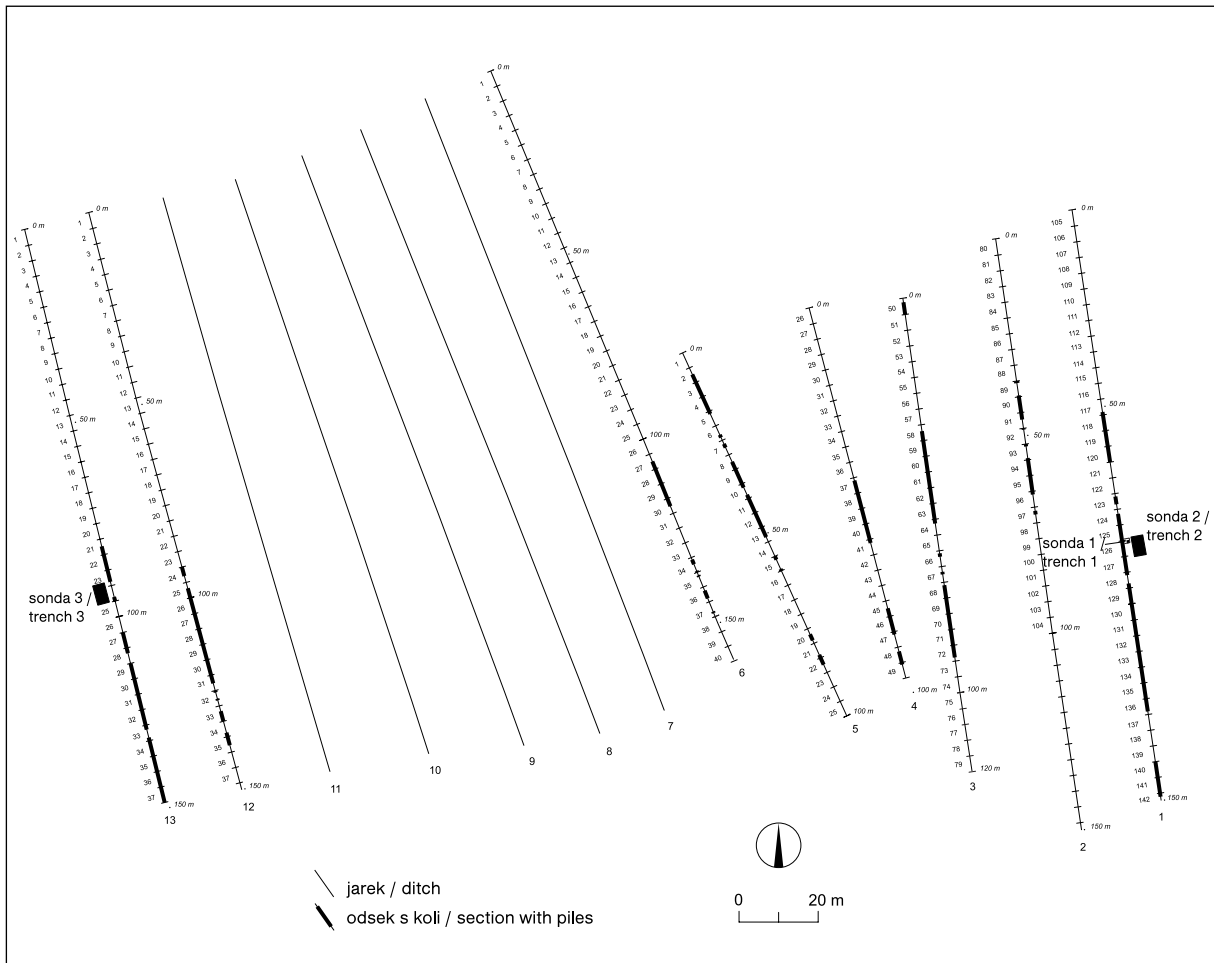
Stare gmajne was discovered in 1992, which is relatively late in comparison to other pile-dwellings of the Ljubljansko barje. The first archaeological field researches were carried out in 1995. Samples of wood for dendrochronological research were collected in four stages, between 2002 and 2007.<sup>1</sup>

#### 7.1.1 DENDROCHRONOLOGICAL RESEARCHES

##### 7.1.1.1 WOOD SAMPLING

As seen on the plan (*Fig. 7.1*), piles were collected from eight ditches with an average width of c. 1 m, and

<sup>1</sup> See Chapter 3 in this monograph.



Sl. 7.1: Načrt kolišča Stare gmajne z označenimi sondami, jarki, odseki in območji z lesenimi predmeti (koli, drevaka 1 in 2 ter kolo z osjo). Risba: T. Korošec.

Fig. 7.1: Plan of the pile-dwelling Stare gmajne with marked trenches, ditches, sections/or sectors and areas, where wooden objects were found (piles, logboats 1 and 2 and a wheel with an axle). Drawn by: T. Korošec.

leta 2002 odvzela vzorce v odvodnih jarkih 1 do 5 in v sondi 1, leta 2004 v odvodnih jarkih 6, 12 in 13, leta 2006 v sondi 2 in leta 2007 v sondi 3. Posamezni jarki so bili razdeljeni na štirimetrske odseke. Sonda 1 je bila zastavljena vzhodno od jarka 1 med odsekom 125 in 126 in je obsegala približno  $1,6 \text{ m}^2$  ( $1,4 \times 1,15 \text{ m}$ ); sonda 2 je bila zastavljena v bližini sonde 1 in je merila  $15 \text{ m}^2$  ( $3 \times 5 \text{ m}$ ); sonda 3, ki je prav tako obsegala  $15 \text{ m}^2$  ( $3 \times 5 \text{ m}$ ), pa je bila zastavljena na skrajni severozahodni strani koliščarske naselbine, zahodno od odvodnega jarka 13 v bližini odsekov 23 in 24. V odvodnih jarkih od 7 do 11 ter 14 in 15, ki se raztezata zahodno od jarka 13 in na sl. 7.1 nista predstavljena, ni bilo kolov in arheoloških najdb.

Na Starih gmajnah je bilo v štirih sezonah analiziranih 932 in identificiranih 925 vzorcev lesa (tab. 7.1). Arheološki les je tako kot pri drugih koliščarskih naselbinah na Ljubljanskem barju večinoma ostanek navpičnih kolov, ki so jih koliščarji zabili v tla in na njih postavili bivališča, s tem da smo na Starih gmajnah našli tudi na izjemne najdbe, kot so leseno kolo in os ter dva drevaka, ki so bile

from three trenches. In 2002, a team from the the Institute of Archaeology of the Scientific Research Centre of the Slovenian Academy of Sciences and Arts (ZRC SAZU), took samples from irrigation ditches 1 to 5 and in trench 1. In 2004, they took samples from irrigation ditches 6, 12 and 13, in 2006 from trench 2 and in 2007 from trench 3. Individual ditches were divided into four metres long sections. Trench 1 was opened eastwards from ditch 1, between sections 125 and 126, and it measured c.  $1.6 \text{ m}^2$  ( $1.4 \times 1.15 \text{ m}$ ); trench 2 was opened near trench 1 and measured  $15 \text{ m}^2$  ( $3 \times 5 \text{ m}$ ); trench 3, also measuring  $15 \text{ m}^2$  ( $3 \times 5 \text{ m}$ ), was opened on the north-western side of the pile-dwelling settlement, to the west from the irrigation ditch 13, near sections 23 and 24. In irrigation ditches 7 to 11 and 14 and 15, which are located westwards from ditch 13 and are not drawn on Fig. 7.1, no piles or archaeological finds have been found.

During four stages of work at Stare gmajne, we analysed 932 and identified 925 samples of wood (Tab. 7.1). Archaeological wood is, as at other pile-dwelling

Tab. 7.1: Analizirani vzorci arheološkega lesa s Starih gmajn.

Tab. 7.1: Analysed samples of archaeological wood from Stare gmajne.

Vrsta lesa Wood species	Število vzorcev Number of samples	Delež (%) * Share (%) *	Število navpičnih kolov Number of vertical piles	Delež (%) ** Share (%) **
<i>Abies alba</i>	5	1	5	1
<i>Acer</i> sp.	31	3	27	3
<i>Alnus glutinosa</i>	31	3	28	3
<i>Corylus avellana</i>	9	1	5	1
<i>Carpinus betulus</i>	3	> 0	3	> 0
<i>Fagus sylvatica</i>	32	3	31	3
<i>Fraxinus</i> sp.	409	44	405	45
<i>Populus</i> sp.	51	5	48	5
<i>Quercus</i> sp.	334	36	327	36
<i>Salix</i> sp.	20	2	20	2
Neidentificirano / Unidentified	7	1	7	1
<b>SKUPAJ TOTAL</b>	<b>932</b>	<b>100</b>	<b>906</b>	<b>100</b>

\* Delež, preračunan glede na vse vzorce. / Share calculated for the entire sample population.

\*\* Delež, preračunan glede na vse navpične kole. / Share calculated for the subsample of vertical piles.

primerne za dendrokronološko analizo in so predstavljene posebej v poglavjih 8 in 9 v tem zborniku.

#### 7.1.1.2 PRIPRAVA IN IDENTIFIKACIJA LESA

Za dendrokronološke raziskave je bil odvzet les vseh ohranjenih elementov ne glede na obliko, premer in lesno vrsto. Najdbam lesa smo najprej izmerili natančne koordinate in nato odžagali 10–20 cm dolg kos, ki smo ga takoj po odvzemu izmerili, označili z identifikacijsko številko in ga zalitega z vodo shranili v nepredušno zaprti polietilenski vrečki.

Zbrane vzorce smo odpeljali na Oddelek za lesarstvo, kjer smo jih obdelali z mizarskimi stroji. V nadaljevanju smo vsak vzorec globoko zamrznili in zamrznjenemu zgladili površino ter ga pregledali pod stereomikroskopom in mu prešteli branike. Lesno vrsto smo pri hrastu ali jesenu določili z opazovanjem pod stereomikroskopom, za preostale vrste pa smo naredili tanke preparate za mikroskopsko identifikacijo lesa.

Najpogostejša lesna vrsta na kolišču je bil jesen, ki je zastopan kar s 44 % vzorcev, sledil mu je hrast s 36 % vzorcev (tab. 7.1). Petina vzorcev je pripadala drugim vrstam, med katerimi so prevladovali koli iz lesa topolov (*Populus*), bukve (*Fagus*), jelše (*Alnus*) in javorja (*Acer*). Manjše število vzorcev (pod 1 %) je bilo preveč uničenih, da bi lahko določili njihovo lesno vrsto.

Med navpičnimi koli so z več kot 60 % prevladovali tisti s premerom od 6 do 12 cm. Približno 20 % jih je imelo premer od 12,5 do 22 cm, manj kot 10 % pa premer od 23 do 40 cm ali pod 6 cm. Koli večjih premerov so bili praviloma klani.

settlements at the Ljubljansko barje, mostly presented by the remains of vertical piles, which were driven into the ground as building foundations. Moreover, we came across some exceptional finds at Stare gmajne, such as a wooden wheel with an axle and two logboats. These were suitable for dendrochronological analysis and are discussed in chapters 8 and 9.

#### 7.1.1.2 THE PREPARATION AND IDENTIFICATION OF WOOD

Wood for dendrochronological researches was taken from all preserved elements, regardless of form, diameter and wood species. We first measured accurate coordinates of all wooden finds and then sawed off 10–20 cm long piece, measured it immediately after sawing, marked it with an identification number and stored in a hermetically closed polyethylene bag, filled with water.

The samples were taken to the Department of Wood Science and Technology, where they were prepared using carpentry equipment. Each sample was then deep-frozen, its surface was smoothed and inspected under a stereo microscope to count the annual rings. Oak and ash wood species were determined with observation under stereo microscope. To determine other species, we made thin slides of samples and identified the wood species microscopically.

The most common wood species on the pile-dwelling, with 44 % of samples, was ash. Oak followed with 36 % of samples (Tab. 7.1). One fifth of the samples belonged to other species, with poplar (*Populus*), beech

Tab. 7.2: Število vzorcev po vrstah lesa ter število in deleži dendrokronološko merjenih in sinhroniziranih (relativno datiranih) vzorcev.

Tab. 7.2: Number of samples according to wood species and percent of dendrochronologically measured and cross-dated samples.

Vrsta lesa Wood species	Število Number	Merjen (št.) Measured (no.)	Merjen (%)* Measured (%)*	Sinhroniziran (št.) Cross-dated (no.)	Sinhroniziran (%)* Cross-dated (%)*
<i>Abies alba</i>	5	0			
<i>Acer</i> sp.	31	0			
<i>Alnus glutinosa</i>	31	0			
<i>Corylus avellana</i>	9	0			
<i>Carpinus betulus</i>	3	0			
<i>Fagus sylvatica</i>	32	0			
<i>Fraxinus</i> sp.	409	115	12	34	4
<i>Populus</i> sp.	51	0			
<i>Quercus</i> sp.	334	193	21	124	13
<i>Salix</i> sp.	20	0			
Neidentificirano / Unidentified	7	0			
<b>SKUPAJ</b>					
<b>TOTAL</b>	<b>932</b>	<b>308</b>	<b>33</b>	<b>158</b>	<b>17</b>

\* Delež, preračunan glede na vse vzorce. / Share calculated for the entire sample population.

Dendrokronološke meritve smo opravili samo na vzorcih hrasta in jesena, ki so imeli vsaj 45 branik. Po tem kriteriju je bilo za merjenje širin branik primernih le 33 % vzorcev, uspešno pa smo sinhronizirali oz. relativno datirali le 17 % vzorcev (tab. 7.2).

### 7.1.1.3 MERJENJE

Postopek merjenja širin branik smo izvedli na gladko obdelanih vzorcih s pomočjo pomične mizice, stereomikroskopa in programa TSAP/X. Rezultate meritve smo grafično prikazali kot zaporedje širin branik v odvisnosti od časa. Na vsakem vzorcu smo širine branik izmerili vzdolž dveh radijev. Meritve na vsakem vzorcu smo preverili in jih združili v povprečje, ki smo ga uporabili za nadaljnje primerjave (sinhroniziranje) grafov različnih vzorcev.<sup>2</sup>

Vsa zaporedja, ki so izkazovala optično in statistično značilno ujemanje, smo združili v plavajoče nedatirane kronologije, ločeno za jesen in hrast. Sestavili smo dve jesenovni in eno hrastovo kronologijo.

## 7.1.2 REZULTATI

### 7.1.2.1 HRASTOVA KRONOLOGIJA SG-QUSP1

Na kolišču so dobro tretjino lesa predstavljali hrastovi vzorci, ki jih je bilo 334 (tab. 7.1). Od teh jih je bilo po naših kriterijih skoraj 60 % (193) primernih za dendrokronološke meritve.

<sup>2</sup> Glej npr. Čufar, Levanič 1998.

(*Fagus*), alder (*Alnus*) and maple (*Acer*) prevailing. A smaller amount of samples (under 1 %) was not preserved enough to identify wood species.

Over 60 % of vertical piles had a diameter of 6–12 cm. Around 20 % had a diameter of 12.5–22 cm and less than 10 % had a diameter from 23–40 cm or under 6 cm. Piles with larger diameters were generally cleaved.

Dendrochronological measurements were only done on oak and ash samples with at least 45 annual rings. According to this criterion, only 33 % of samples were suitable for tree-ring widths measurement, and only 17 % of samples were successfully cross-dated (Tab. 7.2).

### 7.1.1.3 MEASURING

Procedure of measuring of tree-ring widths was carried out on smoothed samples. To measure tree-ring widths, we used LINTAB measuring device, a stereo microscope and a TSAP/X program. Results of measurements were shown graphically as a sequence of tree-ring widths vs. time. Tree-ring widths were measured along two radii on each sample. The two tree-ring series of each sample were then checked and united into an average that we used for further comparisons (cross-dating) with tree-ring series of different samples.<sup>2</sup>

All sequences that matched visually and statistically, were combined into floating undated tree-ring chronologies, made separately for ash and oak. We constructed two ash- and one oak chronology.

<sup>2</sup> See e.g. Čufar, Levanič 1998.



Približno tretjina hrastovih kolov je bila narejena iz celotnih debel manjših dreves, približno dve tretjini pa iz vzdolžno razklanih večjih debel, s premeri nad 15 cm.

Hrastovi koli so bili v glavnem enakomerno razporejeni po celotnem najdišču; sorazmerno najmanj jih je bilo v jarkih 6 in 5 (*sl. 7.4*). Čeprav so se hrastovi vzorci med seboj razlikovali po številu branik in rastnih posebnostih smo jih 124 relativno datirali (*tab. 7.2*). Številke relativno datiranih kolov so:

**SG02-3**, 5, 14, 29, 38, 39, 43, 52, 53, 58, 67, 91, 98, 102, 107, 110, 112, 116, 117, 122, 126, 128, 145, 165, 200, 203, 206, 210, 214, 219, 225, 234, 236, 237, 249, 252, 257, 259, 261, 262, 266, 268, 269, 270, 271, 274, 275, 278, 279, 282, 284, 287, 292, 295, 299, 301, 308, 324, 325, 326, 346, 378, 381, 392, 393, 402, 403, 406, 409, 420, 424, 425, 427, 428, 433, 435, 441, 443, 451, 452, 461, 467, 471, 475, 477, 480, 482, 487, 488, 489, 492, 496, 499, 512, 520 in 528.

**SG04-597**, 606, 611, 615, 692, 701, 702, 704, 745, 747, 769, 770, 804 in 806.

**SG06-838**, 839, 841, 846, 847, 849, 850, 853, 854, 855, 856 in 974.

**SG07-1041** in 1054.

Večina zaporedij ni izkazovala rastnih anomalij, zato smo vse razen **SG04-701**, 702, 745, 747, **SG07-1041** in 1054 združili v kronologijo SG-QUSP1 s solidno pokritostjo in dobrim ujemanjem širin branik na mlajšem delu, dolgem približno 115 let (*sl. 7.2*). Pri mnogih vzorcih sta bili ohranjeni skorja in zadnja branika, kar nam je omogočilo, da smo zabeležili nekaj jasnih faz gradbenih aktivnosti na kolišču, ko so v kratkem časovnem obdobju (eno leto do nekaj let) posekali večje število dreves.

Tudi relativno datirani hrastovi koli so razporejeni po celotnem kolišču, večino pa smo našli v vzhodnem delu, medtem ko so na zahodnem delu manj številni (*prim. sl. 7.8*).

## 7.1.2 RESULTS

### 7.1.2.1 THE SG-QUSP1 OAK CHRONOLOGY

Oak samples represented more than one third of wood on the pile-dwelling; i.e. 334 samples (*Tab. 7.1*). Almost 60 % (193) of them were suitable for dendrochronological measurements, according to our criteria.

Around one third of oak piles were made of entire trunks of smaller trees and around two thirds from longitudinally cleaved larger trunks, with diameters over 15 cm.

Oak piles were more or less evenly spread over the entire excavation site; a smaller amount of them is only seen in ditches 6 and 5 (*Fig. 7.4*). Although oak samples differentiated to one another according to amount of annual rings and growth anomalies, we relatively dated 124 of them (*Tab. 7.2*). Relatively dated piles are as follows:

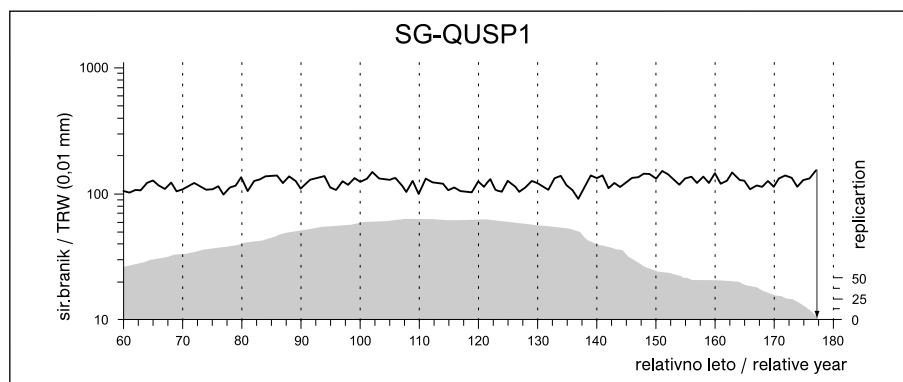
**SG02-3**, 5, 14, 29, 38, 39, 43, 52, 53, 58, 67, 91, 98, 102, 107, 110, 112, 116, 117, 122, 126, 128, 145, 165, 200, 203, 206, 210, 214, 219, 225, 234, 236, 237, 249, 252, 257, 259, 261, 262, 266, 268, 269, 270, 271, 274, 275, 278, 279, 282, 284, 287, 292, 295, 299, 301, 308, 324, 325, 326, 346, 378, 381, 392, 393, 402, 403, 406, 409, 420, 424, 425, 427, 428, 433, 435, 441, 443, 451, 452, 461, 467, 471, 475, 477, 480, 482, 487, 488, 489, 492, 496, 499, 512, 520 and 528.

**SG04-597**, 606, 611, 615, 692, 701, 702, 704, 745, 747, 769, 770, 804 and 806.

**SG06-838**, 839, 841, 846, 847, 849, 850, 853, 854, 855, 856 and 974.

**SG07-1041** and 1054.

Most of tree-ring series were not showing any growth anomalies. That is why all, except for **SG04-701**, 702, 745, 747, **SG07-1041** and in 1054, were incorporated to the SG-QUSP1 tree-ring chronology with well replicated c.



*Sl. 7.2:* Hrastova kronologija SG-QUSP1: zadnjih 117 let kronologije z dobrim pokritjem in dobrim ujemanjem širin branik. Zadnja branika (puščica, relativni datum 177) je radiokarbonsko datirana v leto  $3109 \pm 12$  pr. Kr. (razpon 3121–3095,  $2\sigma$ , 95,4 % verjetnost). TRW – širina branik; pokritost.

*Fig. 7.2:* The SG-QUSP1 oak chronology – the last 117 years of chronology is well replicated. The last annual ring (arrow, relative date 177) is radiocarbon dated to  $3109 \pm 12$  BC (span 3121–3095,  $2\sigma$ , 95.4 % probability). TRW – tree-ring widths; replication.

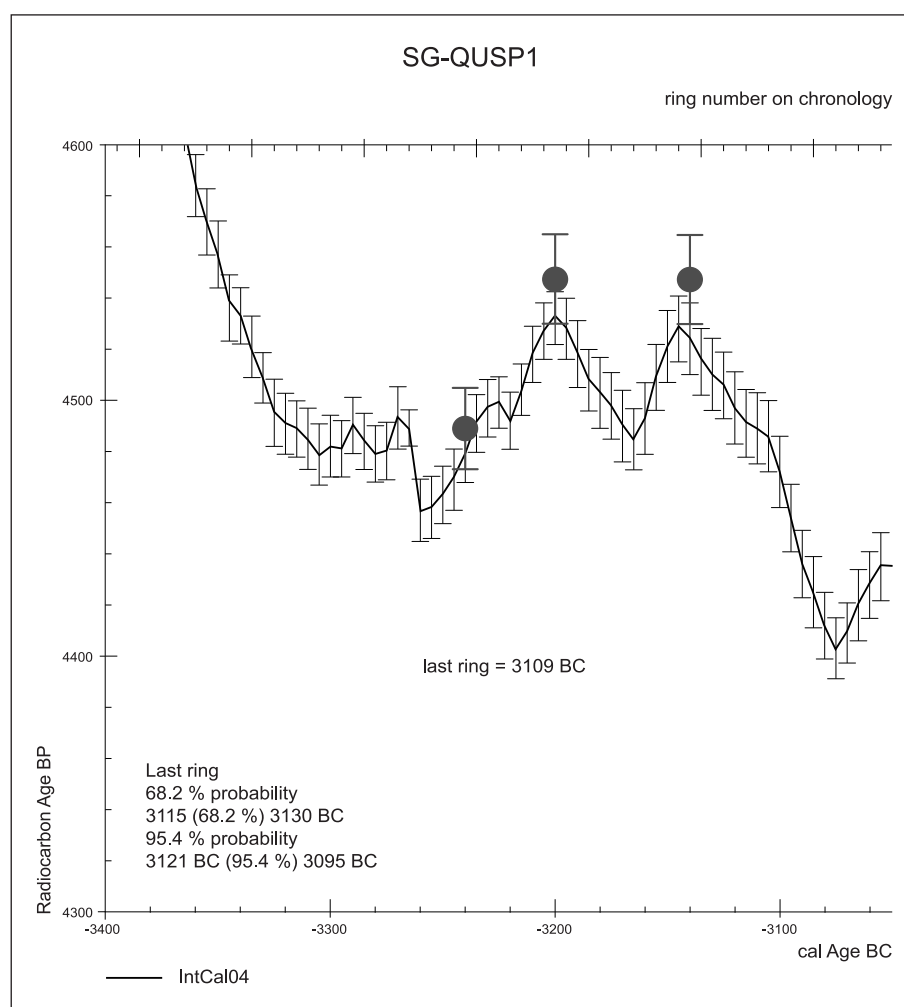
Tab. 7.3: Radiokarbonske datacije vzorcev iz hrastove kronologije SG-QUSP1 (konec v relativnem letu 177). Datiranje je bilo opravljeno v laboratoriju na Heidelberger Akademie der Wissenschaften, Radiometrische Altersbestimmung von Wasser und Sedimenten in v ETH Zürich.

Tab. 7.3: Radiocarbon dates of samples from the SG-QUSP1 oak chronology (end in relative year 177). Dating was performed in the laboratory of the Heidelberger Akademie der Wissenschaften, Radiometrische Altersbestimmung von Wasser und Sedimenten, and at the ETH Zürich.

Kol št. Pile no.	Lab. št. Lab. no.	Drevesna vrsta Wood species	Število branik Number of tree rings	Srednja branika Mid tree ring	<sup>14</sup> C-age BP
SG02-406	Hd-22911	<i>Quercus</i> sp.	20	45	4489 ± 16
SG02-499	Hd-27938	<i>Quercus</i> sp.	30	85	4589 ± 26
SG02-441	Hd-22385	<i>Quercus</i> sp.	20	145	4547 ± 17

Za kronologijo smo pridobili tri radiokarbonske datume, z metodo "wigggle-matching" pa smo zadnjo braniko kronologije datirali v leto 3109 ± 12 pr. Kr. (razpon 3121–3095, 2σ, 95,4 % verjetnost) (tab. 7.3 in 7.4; sl. 7.3).

115 years long younger part (Fig. 7.2). Many samples had preserved bark and the last annual ring, which enabled us to reconstruct some clear phases of building activities on the pile-dwelling, when they felled large amount of trees in a short time period (one year to a few years).



Sl. 7.3: Absolutno datiranje kronologije Starih gmajin SG-QUSP1 z uporabo opcije "sequence" programa OxCal 3.5.

Fig. 7.3: Absolute dating of the Stare gmajne SG-QUSP1 chronology using the "sequence" option of the OxCal 3.5 program.

*Tab. 7.4:* Radiokarbonska datacija vzorca SG04-745, ki je sinhroniziran s kronologijama Spodnjega mostišča SM2-QUSP3 in VMO-QUSP1. Datiranje je bilo opravljeno v laboratoriju na Heidelberger Akademie der Wissenschaften, Radiometrische Altersbestimmung von Wasser und Sedimenten.

*Tab. 7.4:* Radiocarbon dated sample SG04-745, which is cross-dated with the Spodnje mostišče SM2-QUSP3 and VMO-QUSP1 chronologies. Dating was performed in the laboratory at the Heidelberger Akademie der Wissenschaften, Radiometrische Altersbestimmung von Wasser und Sedimenten.

Kol št. Pile no.	Lab. št. Lab. no.	Drevesna vrsta Wood species	Število branik Number of tree rings	Srednja branika Mid tree ring	<sup>14</sup> C-age BP
SG04-745	Hd-27697	<i>Quercus</i> sp.	20	304	4552 ± 22

Zadnji datumi vzorcev lesa nakazujejo pomembnejše gradbene aktivnosti na kolišču, ki so trajale več kot 50 let, to je približno od leta od 3160 do 3109 pr. Kr.

Skupino vzorcev, ki smo jih medsebojno sinhronizirali, smo izkopal iz jarkov 12 in 13 oz. sonde 3 (številke: **SG04-701, 702, 745, 747; SG07-1041, 1054**). Sinhronizirali smo jih s kronologijama Spodnjega mostišča SM2-QUSP3 in VMO-QUSP1,<sup>3</sup> ki konec gradbenih aktivnosti na njem postavljata v obdobje okoli leta 3351 pr. Kr. To nakazuje, da so bile nekatere konstrukcije na zahodnem delu naselbine Stare gmajne verjetno postavljene približno 20 let po koncu dokumentiranih gradbenih aktivnosti na Spodnjem mostišču (kronologija VMO-QUSP1), to je okoli leta 3330 pr. Kr.<sup>4</sup> To smo ugotovili s pomočjo radiokarbonskega datiranja vzorca SG04-745 (*tab. 7.4*), 7 vzorcev s koliščarske naselbine Spodnje mostišče in uporabo metode "wigggle-matching".<sup>5</sup>

Vse to nakazuje, da je na območju Starih gmajn pred intenzivno poselitvijo večje površine (jarki 1–6 in 12, 13, sondi 1 in 2), ki je trajala več kot 50 let in se je končala v času okoli leta 3109 pr. Kr., obstajala približno od 170 do 220 let starejša, prostorsko omejena naselbina.

Na drugi strani se mlajši radiokarbonski datirani vzorci s Starih gmajn časovno ujemajo tudi z radiokarbonsko datiranim lesom s kolišča Blatna Brezovica, kjer je naša ekipa leta 2003 opravila sondiranje, dendrokronološke raziskave in radiokarbonsko datiranje na predhodno že raziskanem kolišču.<sup>6</sup> Koliščarska naselbina Veliki Otavnik Ib, kjer so bili vzorci lesa odvzeti in raziskani v letih 2006 in 2007, pa izkazuje eno samo fazo gradbenih aktivnosti, ki so se končale praktično sočasno kot najmlajša naselbinska faza na Starih gmajnah.<sup>7</sup>

#### 7.1.2.2 JESENOVI KRONOLOGIJI SG-FRSP1 IN SG-FRSP2

Jesen je bil prevladujoča lesna vrsta s 409 vzorci, kar je skoraj polovica (44 %) vseh analiziranih vzorcev

Furthermore, cross-dated oak piles spread over the entire pile-dwelling, with the majority in the eastern part, while less of them have been found in the western part (e.g. *Fig. 7.8*).

We obtained three radiocarbon dates for chronology, and established a relative date end of 3109 ± 12 BC (span 3121–3095, 2σ, 95.4 % probability) with the "wigggle-matching" procedure of OxCal (*Tab. 7.3* and *Fig. 7.3*).

The last dates of wood samples remit building activities at the pile-dwelling, which lasted over 50 years; from c. 3160 to 3109 BC.

Group of samples, that were cross-dated, was dug in ditches 12 and 13 and in trench 3 (numbers: **SG04-701, 702, 745, 747; SG07-1041, 1054**). These samples were cross-dated with the Spodnje mostišče SM2-QUSP3 and VMO-QUSP1 chronologies,<sup>3</sup> which denote the end of building activities at Spodnje mostišče in c. 3351 BC. This indicates that some constructions on the western part of the settlement Stare gmajne, were perhaps built c. 20 years after the conclusion of documented building activities at Spodnje mostišče (VMO-QUSP1 chronology); in c. 3330 BC.<sup>4</sup> We discovered this with the help of radiocarbon dating of sample SG04-745 (*Tab. 7.4*), 7 samples from pile-dwelling settlement Spodnje mostišče and the use of the "wigggle-matching" procedure.<sup>5</sup>

The above indicates that, apart from an intense settling of larger surface (ditches 1–6 and 12, 13, trenches 1 and 2), which lasted over 50 years and finished in c. 3109 BC, also a c. 170 to 220 years earlier, spatially limited settlement existed at Stare gmajne.

On the other hand, later radiocarbon dated samples from Stare gmajne match with radiocarbon dated wood from the pile-dwelling Blatna Brezovica, where our team carried out sample trenching, dendrochronological researches and radiocarbon dating in 2003, on preliminarily already investigated pile-dwelling.<sup>6</sup> Pile-dwelling settlement Veliki Otavnik Ib, where samples of wood were taken and investigated in 2006 and 2007, shows a single

<sup>3</sup> Prim. Velušček, Čufar 2002.

<sup>4</sup> Čufar et al., v pripravi.

<sup>5</sup> Čufar, Kromer, neobjavljeno.

<sup>6</sup> Glej poglavji 5 in 7.2 v tem zborniku.

<sup>7</sup> Glej poglavje 6 v tem zborniku.

<sup>3</sup> E.g. Velušček, Čufar 2002.

<sup>4</sup> Čufar et al., in prep.

<sup>5</sup> Čufar, Kromer, unpublished.

<sup>6</sup> See Chapters 5 and 7.2 in this monograph.

Tab. 7.5: Radiokarbonska datacija vzorca iz jesenove kronologije SG-FRSP1. Datiranje je bilo opravljeno v laboratoriju Heidelberger Akademie der Wissenschaften, Radiometrische Altersbestimmung von Wasser und Sedimenten.

Tab. 7.5: Radiocarbon date of sample from the SG-FRSP1 ash chronology. Dating was performed in the laboratory of the Heidelberg Akademie der Wissenschaften, Radiometrische Altersbestimmung von Wasser und Sedimenten.

Kol št. Pile no.	Lab. št. Lab. no.	Drevesna vrsta Wood species	Število branik Number of tree rings	<sup>14</sup> C-age BP
SG02-6	Hd-24026	<i>Fraxinus excelsior</i>	40	4484 ± 19

(tab. 7.1). Jesenovi koli se pojavljajo v vseh jarkih, s tem da jih je na zahodu naselbine v jarkih 12 in 13 ter v sondi 3 malo. Njihova značilnost so majhni premeri in majhno število branik, zato jih je bilo po našem kriteriju za dendrokronološke meritve primernih le 115 (tab. 7.2). Najprej smo sinhronizirali oz. relativno datirali 34 vzorcev in jih 22 vključili v kronologijo SG-FRSP1 in 12 v kronologijo SG-FRSP2. Pri večini vzorcev iz obeh kronologij je bila skorja ohranjena.

V jesenovo kronologijo SG-FRSP1 so vključeni vzorci, ki smo jih pridobili leta 2002 (SG02-1, 2, 6, 8, 9, 11, 12, 13, 66, 87, 150, 196, 232, 290, 348, 447, 478, 481, 491, 522, 532, 539) in so bili predvsem v jarkih 1 in 5, ter posamezni koli v jarkih 3 in 4. Ker je ta kronologija dokaj kratka, smo le na osnovi radiokarbonskega datuma vzorca kola SG02-6 (tab. 7.5) in s pomočjo primerjave dendrokronoloških grafov ocenili, da gradbene aktivnosti v okviru omenjene kronologije sovpadajo s koncem kronologije SG-QUSP1 ali pa predstavljajo še nekoliko mlajši del kolišča, ki je nastalo do okoli 3100 pr. Kr.

Do druge jesenove kronologije smo prišli na podlagi lesa, ki je bil dokumentiran leta 2007 pri izkopavanju v sondi 3. Šest merjenih vzorcev (SG07-1045, 1047, 1049, 1056, 1058, 1064) iz leta 2007 smo medsebojno sinhronizirali in sestavili kronologijo SG-FRSP2, na katero so se nato sinhronizirali vzorci drugih raziskovalnih let, tako da jo sestavlja skupno 12 vzorcev lesa. Vzorci se pojavljajo v sondi 3 in jarku 13 na skrajnem zahodu naselbine ter v jarkih 1, 3, 4, in 5 na vzhodu.

Kronologija SG-FRSP2 ni radiokarbonsko datirana, vendar smo jo sinhronizirali s hrastovo kronologijo SG-QUSP1 (relativni datum desno 175, OVL 119,  $t_{BP}$  4,8, GLK 61\*), kar nakazuje, da so zgoraj našete jesenove pilote vgradili verjetno sočasno s hrastovimi proti koncu gradbenih aktivnosti v okviru kronologije SG-QUSP1 okoli leta 3111 pr. Kr.

### 7.1.2.3 IZBOR GRADBENEGA LESA IN GRADBENE AKTIVNOSTI

Kot je bilo omenjeno v uvodnem delu, so koliščarji s Starih gmajn za nosilne gradbene kole uporabljali različne vrste lesa. Največ je bilo lesa jesena (*Fraxinus* sp.) in hrasta (*Quercus* sp.), uporabljali pa so tudi les topola (*Populus* sp.), bukke (*Fagus sylvatica*), jelše (*Al-*

phase of building activity, which ended simultaneously with the latest settlement phase of Stare gmajne.<sup>7</sup>

### 7.1.2.2 SG-FRSP1 AND SG-FRSP2 ASH CHRONOLOGIES

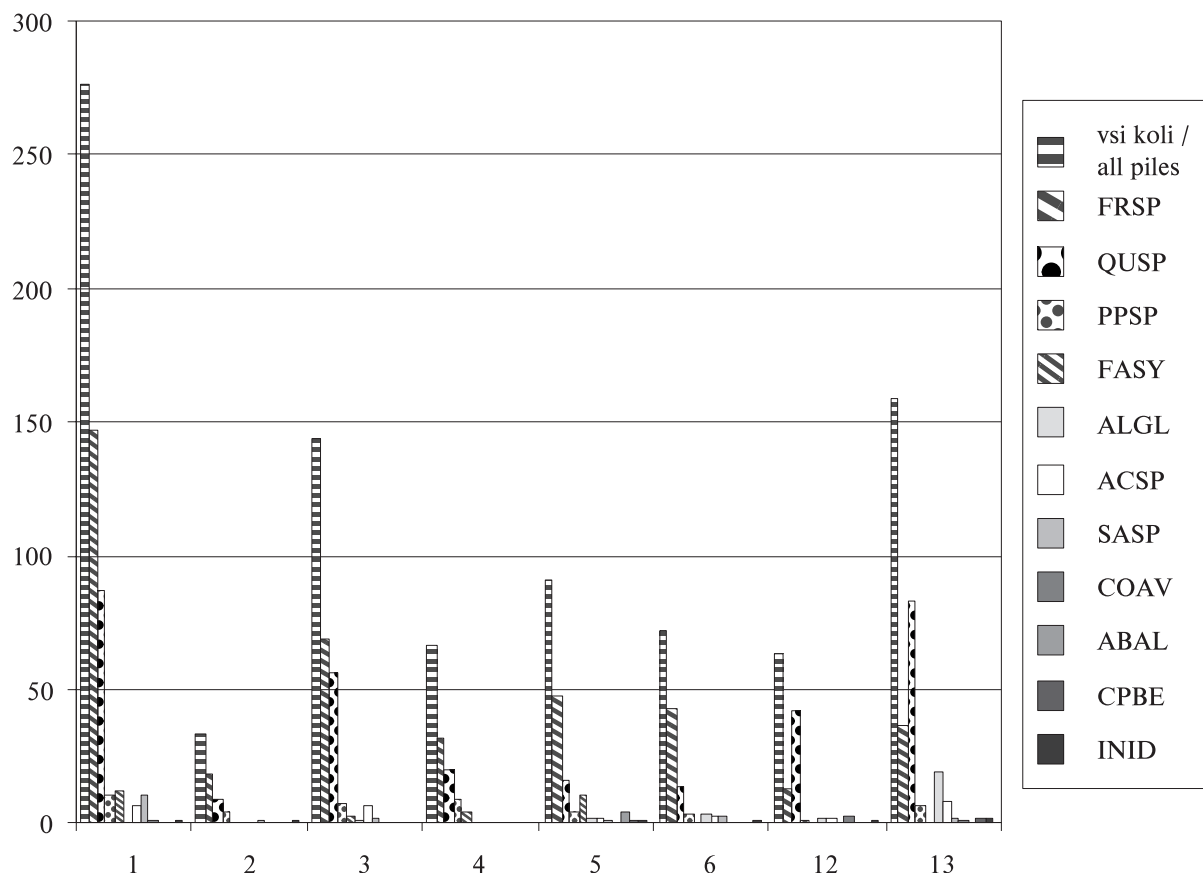
Ash was a dominant wood species with 409 samples, which is almost half (44 %) of all analysed samples (Tab. 7.1). Ash piles were present in all ditches. However, less of them occur on the western part of the settlement in ditches 12 and 13 and in trench 3. Their characteristics are small diameters and small number of annual rings. That is why, considering our criteria, only 115 of them were suitable for dendrochronological measurement (Tab. 7.2). We first cross-dated or relatively dated 34 samples. 22 of them were incorporated into the SG-FRSP1 chronology and 12 into the SG-FRSP2 chronology. Bark was preserved at most samples from both chronologies.

Samples, taken in 2002 (SG02-1, 2, 6, 8, 9, 11, 12, 13, 66, 87, 150, 196, 232, 290, 348, 447, 478, 481, 491, 522, 532, 539), are included in the SG-FRSP1 ash chronology. They were found mainly in ditches 1 and 5 and as individual piles in ditches 3 and 4. As the chronology is rather short, we evaluated period of building activity only based on a radiocarbon date of the sample pile SG02-6 (Tab. 7.5) from the mentioned chronology and with the comparison of dendrochronological diagrams. Namely, building activities are contemporary with the end of the SG-QUSP1 chronology or they indicate an even later part of the pile-dwelling, dated to c. 3100 BC.

The second ash chronology was composed with wood documented in 2007, at excavation of trench 3. Six measured samples (SG07-1045, 1047, 1049, 1056, 1058, 1064) from 2007 were mutually cross-dated and combined into the SG-FRSP2 chronology. Samples, gained during the rest of research years, were cross-dated and incorporated into it, so that the chronology is composed of 12 samples altogether. Samples originate from trench 3 and ditch 13, on the utmost western part and in ditches 1, 3, 4, and 5 on the eastern part of the settlement.

The SG-FRSP2 chronology is not radiocarbon dated, however, it was cross-dated with the SG-QUSP1

<sup>7</sup> See Chapter 6 in this monograph.



Sl. 7.4: Vsi koli iz jarkov in sond – k jarku 1 so prišteti tudi koli iz sond 1 in 2, k jarku 13 pa koli iz sonde 3 –, razvrščeni po drevesnih vrstah.

Šifrant kratic: FRSP (jesen/*Fraxinus* sp.), QUSP (hrast/*Quercus* sp.), PPSP (topol/*Populus* sp.), FASY (bukev/*Fagus sylvatica*), ALGL (jelša/*Alnus glutinosa*), ACSP (javor/*Acer* sp.), SASP (vrba/*Salix* sp.), COAV (leska/*Corylus avellana*), ABAL (jelka/*Abies alba*), CPBE (gaber/*Carpinus betulus*), INID (neidentificirano).

Fig. 7.4: All piles from ditches and trenches – ditch 1 also includes piles from trenches 1 and 2, ditch 13 also includes piles from trench 3 – sorted according to tree species.

Abbreviations used: FRSP (ash/*Fraxinus* sp.), QUSP (oak/*Quercus* sp.), PPSP (poplar/*Populus* sp.), FASY (beech/*Fagus sylvatica*), ALGL (alder/*Alnus glutinosa*), ACSP (maple/*Acer* sp.), SASP (willow/*Salix* sp.), COAV (hazel/*Corylus avellana*), ABAL (fir/*Abies alba*), CPBE (common hornbeam/*Carpinus betulus*), INID (unidentified).

*Alnus glutinosa*), javorja (*Acer* sp.), vrbe (*Salix* sp.), leske (*Corylus avellana*), jelke (*Abies alba*) in gabra (*Carpinus betulus*) (tab. 7.1).

Jesenove kole najdemo v vseh jarkih. Zdi se, da jih je sorazmerno več na vzhodnem delu naselbine (sl. 7.4).

Med jesenovimi koli jih je manj kot 10 % klanih. V nekoliko večjem številu jih najdemo edino v jarku 5 (odseki 2–12), v jarku 3 (odseki 59–63) in v jarku 1 (odseki 132–136) (glej sl. 7.5).

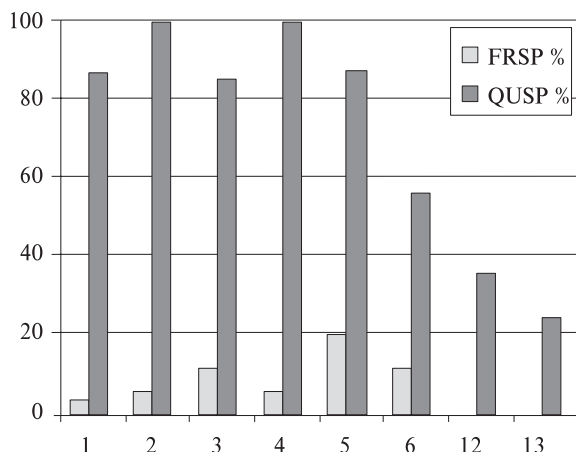
Druga najpogostejša lesna vrsta na kolišču je hrastovina. Tudi hrastovi koli so razporejeni po celotni naselbini. Z največjim deležem jih najdemo na zahodnem delu (sl. 7.4). Med hrastovimi koli jih je približno 65 % klanih. V naselbini so razporejeni zelo različno. Klani

oak chronology (relative date, right, 175, OVL 119,  $t_{BP}$  4.8, GLK 61\*), which indicates that the ash piles, listed above, were probably driven into the ground simultaneously with the oak ones, towards the end of building activities of the SG-QUSP1 chronology, in c. 3111 BC.

### 7.1.2.3 SELECTION OF WOOD AND BUILDING ACTIVITIES

As mentioned above, different species of wood were used for foundation piles at Stare gmajne. They mostly used ash (*Fraxinus* sp.) and oak (*Quercus* sp.), but also





Sl. 7.5: Delež klanih jesenovih (FRSP) in hrastovih (QUSP) kolov v % po jarkih in sondah – k jarku 1 so prišteti tudi koli iz sond 1 in 2, k jarku 13 pa koli iz sonde 3.

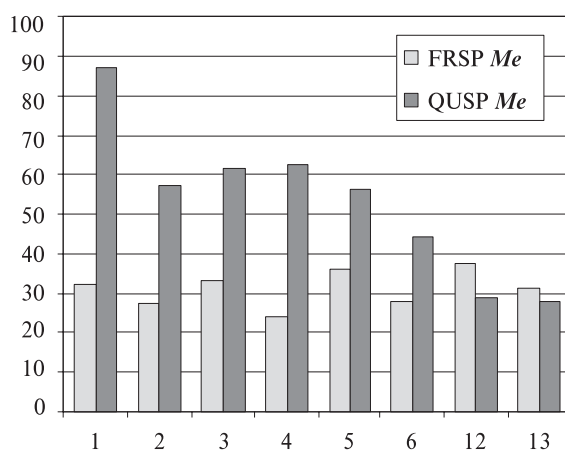
Fig. 7.5: Percentage of cleaved ash (FRSP) and oak (QUSP) piles in ditches and trenches – ditch 1 also includes piles from trenches 1 and 2, ditch 13 also includes piles from trench 3.

hrastovi koli prevladujejo v jarkih na vzhodu naselbine, kjer jih najdemo z deleži od 85 % do 100 % v jarkih od 1–5 in 57 % v jarku 6. Veliko manj pa jih je na zahodu, kjer se v jarku 13 s sondo 3 in jarku 12 pojavljajo samo s 27 do 37 % med vsemi hrastovimi koli (sl. 7.5).

Približno 20 % vseh kolov pripada ostalim drevesnim vrstam. Tudi slednji so v glavnem razporejeni po celotni naselbini. Vseeno pa je med njimi opaziti grupiranje po posameznih območjih, kjer se omembe vredna količina jelševih kolov (12 % delež) pojavlja v jarku 13, odseki 27–31, 34–35 in 37, ter skupinica treh jelševih kolov v jarku 6, odsek 34, in dva jelševa kola v jarku 5, odsek 15. Večja skupina kolov iz lesa topolov (*Populus*) se pojavlja v pasu od odsekov 38–40 v jarku 4, 58–60 v jarku 3, 89–94 v jarku 2, do odsekov 118–120 v jarku 1. Naleteli smo tudi na 5 jelovih kolov, vsi so iz jarka 5, odsek 7 (glej sl. 7.4).

Analizirali smo tudi število branik glede na drevesno vrsto. Mediana pri jesenovih kolih je manj kot 32, kar velja za vse jarke in sonde. Podobno je tudi pri večini ostalih drevesnih vrst, kjer mediana števila branik dosega naslednje vrednosti: *Populus* ( $Me = 15$ ;  $N = 48$ ), *Alnus* ( $Me = 21$ ;  $N = 28$ ), *Fagus* ( $Me = 23$ ;  $N = 31$ ), *Acer* ( $Me = 31$ ;  $N = 27$ ), *Salix* ( $Me = 19$ ;  $N = 20$ ) in *Abies* ( $Me = 33$ ;  $N = 5$ ). Slika je nekoliko drugačna pri hrastu, kjer opazimo razlike po jarkih in sondah: hrastovi koli z največ branikami so iz jarka 1 in sonde 2,  $Me = 87$ , jarkov od 2 do 5,  $Me = 59,5$ , jarka 6, kjer je  $Me = 44,5$ . V jarkih 12, 13 in sondi 3 znaša vrednost mediane števila branik 28,5 (sl. 7.6).

Hrastov les ima med uporabljenimi lesnimi vrstami edini obarvano jedrovino, ki je naravno odporna proti biološkemu razkroju (glivam in insektom), zato bi bilo



Sl. 7.6: Mediana ( $Me$ ) števila branik pri jesenovih (FRSP;  $N = 405$ ) in hrastovih (QUSP;  $N = 327$ ) kolih po jarkih in sondah – k jarku 1 so prišteti tudi koli iz sond 1 in 2, k jarku 13 pa koli iz sonde 3.

Število v analizo vključenih vzorcev po jarkih in sondah:

1 (jarek 1, sondi 1 in 2):  $N = 147$  (FRSP);  $N = 87$  (QUSP).

2 (jarek 2):  $N = 18$  (FRSP);  $N = 9$  (QUSP).

3 (jarek 3):  $N = 69$  (FRSP);  $N = 56$  (QUSP).

4 (jarek 4):  $N = 32$  (FRSP);  $N = 20$  (QUSP).

5 (jarek 5):  $N = 47$  (FRSP);  $N = 16$  (QUSP).

6 (jarek 6):  $N = 43$  (FRSP);  $N = 14$  (QUSP).

12 (jarek 12):  $N = 13$  (FRSP);  $N = 42$  (QUSP).

13 (jarek 13 in sonda 3):  $N = 36$  (FRSP);  $N = 83$  (QUSP).

Fig. 7.6: Median ( $Me$ ) of number of annual rings at ash (FRSP;  $N = 405$ ) and oak (QUSP;  $N = 327$ ) piles according to ditches and trenches – ditch 1 also includes piles from trenches 1 and 2, ditch 13 also includes piles from trench 3.

Number of samples, used for the analysis, according to ditches and trenches:

1 (ditch 1, trenches 1 and 2):  $N = 147$  (FRSP);  $N = 87$  (QUSP).

2 (ditch 2):  $N = 18$  (FRSP);  $N = 9$  (QUSP).

3 (ditch 3):  $N = 69$  (FRSP);  $N = 56$  (QUSP).

4 (ditch 4):  $N = 32$  (FRSP);  $N = 20$  (QUSP).

5 (ditch 5):  $N = 47$  (FRSP);  $N = 16$  (QUSP).

6 (ditch 6):  $N = 43$  (FRSP);  $N = 14$  (QUSP).

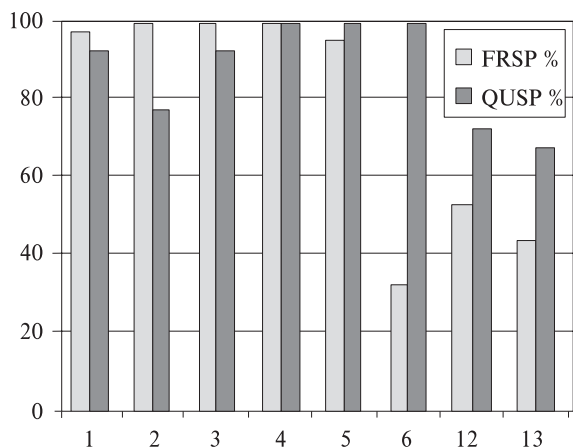
12 (ditch 12):  $N = 13$  (FRSP);  $N = 42$  (QUSP).

13 (ditch 13 and trench 3):  $N = 36$  (FRSP);  $N = 83$  (QUSP).

poplar (*Populus* sp.), beech (*Fagus sylvatica*), alder (*Alnus glutinosa*), maple (*Acer* sp.), willow (*Salix* sp.), hazel (*Corylus avellana*), fir (*Abies alba*) and wood of common hornbeam (*Carpinus betulus*) (Tab. 7.1).

Ash piles were found in all ditches. It seems that they are more common on the eastern part of the settlement (Fig. 7.4).





Sl. 7.7: Delež jesenovih in hrastovih kolov v % z ohranjeno zadnjo braniko ali s pretežno ohranjeno beljavo – k jarku 1 so prišteti tudi koli iz sond 1 in 2, k jarku 13 pa koli iz sonde 3.

Fig. 7.7: Percentage of ash and oak piles with preserved last annual ring or with almost entirely preserved sapwood – ditch 1 also includes piles from trenches 1 and 2, ditch 13 also includes piles from trench 3.

smiselno pričakovati, da so za pilote najprej uporabili predvsem hrastov les, šele ko je tega zmanjkalo, pa so posegli po drugih vrstah. Jesenov les je načeloma za kole manj primeren, ker ni naravno odporen. Jesena je bilo v okolici kolišč verjetno veliko, ker bolje uspeva na vlažnejših rastiščih (to je bližje stoječi vodi) kot hrast, poleg tega se tudi dobro pomlajuje na panju. To pomeni, da kmalu po poseku dreves iz panjev odženejo poganjki, iz katerih v nekaj letih zraste skupina novih dreves. Taka drevesa so premer 10 cm lahko dosegla že po 10 letih, kar je omogočalo relativno kratek čas med dvema sečnjama v istem sestoju.

Razlog za manjše število branik na zahodnem delu naselbine pri hrastovih in jesenovih kolih je torej iskati v tem, da so sekali mlajša drevesa s primernimi premeri (okoli 10 cm) za uporabo za nosilne kole. P. Pétrequin<sup>8</sup> ter Pétrequin et al.<sup>9</sup> so na primeru velikega števila dendrokronološko datiranih kolov na koliščih v francoski Juri ugotovili, da so za kole najprej sekali drevesa ugodnih premerov (okoli 10 cm), ki so bila praviloma mlajša in hitreje rastoča. Ko je teh zmanjkalo, pa so bili prisiljeni uporabljati tudi drevesa večjih premerov (npr. nad 15 cm). Za posek in spravilo večjih dreves je bilo treba uporabiti drugačno tehnologijo, debela velikih dreves pa so morali razklati, da so jih z razpoložljivo tehnologijo lahko zabili v tla.<sup>10</sup> Nam teh teorij zaradi velikega števila nedatiranih zaporedij širin branik še ni uspelo preveriti. Večji delež kolov iz neklanih mlajših debel na zahodu naselbine potrjuje, da so v tem delu naselbine hrastov pa tudi jesenov les posekali v mlajšem gozdu kot za gradnjo

Less than 10 % of ash piles are cleaved. They are more frequent only in ditch 5 (sections 2–12), ditch 3 (sections 59–63) and in ditch 1 (sections 132–136) (see Fig. 7.5).

The second most frequent wood species is oak. Oak piles were distributed over the entire settlement. The highest percent of them occur on the western part of the settlement (Fig. 7.4). Around 65 % of oak piles were cleaved. Their distribution is not consistent. Cleaved oak piles prevail in ditches on the eastern part of the settlement. They occur in 85 % to 100 % in ditches 1–5 and 57 % in ditch 6. A lesser amount is present on the western part, with only 27 to 37 % of oak piles in ditch 13 with trench 3 and in ditch 12 (Fig. 7.5).

Around 20 % of piles belong to other tree species. They are distributed over the entire settlement. We can notice some individual clusters, e.g. a cluster of alder piles (12 %) in ditch 13, sections 27–31, 34–35 and 37, and a cluster of three alder piles in ditch 6, section 34, and two alder piles in ditch 5, section 15. A cluster of poplar (*Populus*) piles occurs in a strip from sections 38–40 in ditch 4, 58–60 in ditch 3, 89–94 in ditch 2, to sections 118–120 in ditch 1. We also found 5 fir (*Abies*) piles in ditch 5, section 7 (see Fig. 7.4).

We also analysed the tree-ring number of particular tree species. Ash piles median is less than 32, which applies to all ditches and trenches. Similar is also true for the majority of other tree species, where median of number of annual rings is as follows: *Populus* ( $Me = 15$ ;  $N = 48$ ), *Alnus* ( $Me = 21$ ;  $N = 28$ ), *Fagus* ( $Me = 23$ ;  $N = 31$ ), *Acer* ( $Me = 31$ ;  $N = 27$ ), *Salix* ( $Me = 19$ ;  $N = 20$ ) and *Abies* ( $Me = 33$ ;  $N = 5$ ). Oak is somewhat different. Namely, we noticed differences in ditches and trenches: oak piles with the most annual rings are present in ditch 1 and trench 2,  $Me = 87$ , in ditches 2 to 5,  $Me = 59.5$ , and median in ditch 6 is 44.5. In ditches 12, 13 and in trench 3, median of tree-ring number amounts to 28.5 (Fig. 7.6).

Oak wood is the only used species with coloured heartwood, which is naturally resistant against biological decay (fungi and insects). That is why it would be reasonable to expect that mostly oak was used for piles at first. When the pile dwellers ran out of oak, they started to use other species. Ash wood is less suitable for piles as it is not durable. Ash was probably growing in large amounts close to pile-dwellings, because it can grow in habitats that are temporarily flooded, and because of a good regeneration (coppice). To be precise, soon after the felling of trees, new shoots sprout from the stumps and they represent new trees that grow rapidly. Such trees could achieve diameters of 10 cm in 10 years, which was allowing relatively short time span between two felling activities in the same stand.

The reason for smaller number of annual rings in the piles on the western part of the settlement is therefore felling and using of younger trees with suitable diameters

<sup>8</sup> 1996.

<sup>9</sup> 1998.

<sup>10</sup> Eberschweiler, Riethmann 1998.

na vzhodnem delu naselbine. V smislu zgoraj citiranih referenc bi tudi to posredno lahko nakazovalo, da je zahodni del naselbine starejši, na kar nakazujejo tudi ugotovitve dendrokronoloških raziskav.

Na splošno lahko rečemo, da so koliščarji na Starih gmajnah za nosilne kole uporabljali les, ki je bil posekan v mladem gozdu, oz. so za to uporabili mlada drevesa, kar je tudi olajšalo transport in pripravo kolov. Zdi pa se tudi, da so bili sčasoma na vzhodnem delu naselbine prisiljeni poseči tudi po debelejših, v glavnem starejših hrastovih drevesih, v posameznih obdobjih pa tudi po drugih sicer manj primernih vrstah lesa.

### 7.1.2.3.1 Gradbene aktivnosti

Ker smo raziskali razmeroma veliko območje in ker nam je uspelo sinhronizirati večino hrastovih kolov ter zaporedja širin branik združiti v eno kronologijo, nam podatki omogočajo tudi rekonstrukcijo gradbenih aktivnosti na Starih gmajnah. Veliko omejitev pri tem pa predstavlja to, da les izvira le iz jarkov, ki sekajo kolišče, kar onemogoča prepoznavanje tlorisov konstrukcij na terenu. Kot kaže manjša skupina sinhroniziranih hrastovih kolov, je bila najstarejša poselitev verjetno na območju jarka 13 in sonde 3 ter jarka 12.

Najboljšo rekonstrukcijo omogoča les, posekan po letu 3160 pr. Kr., ki sestavlja glavnino hrastove kronologije SG-QUSP1, ki je na tem delu podprta z več kot 100 vzorci, razporejenimi po skoraj celotni naselbini. Največ jih je na vzhodnem delu, veliko manj na zahodu (*sl. 7.8*).

Omenjena kronologija kaže, da se je poselitev na Starih gmajnah začela malo pred letom 3160 pr. Kr.: največ kolov, posekanih v tem obdobju, najdemo v jarkih 1 in 3 ter po enega v jarkih 5, 6 in 13.

Čez približno 10 let, okoli 3151 do 3148 pr. Kr., sledi obdobje intenzivnejše gradbene aktivnosti. Objekte, ki so bili postavljeni v tem času, najdemo v jarku 4 na območju odsekov 38–40 ter na območju med jarkom 4, odsek 46, in jarkom 3, odseka 69–70. Posamezni koli pa kažejo na gradbeno aktivnost tudi na območju sonde 2 ter jarkov 1, 5 in 6.

V obdobju po letu 3144 pr. Kr. sledi še ena intenzivnejša faza gradbene aktivnosti, kot kaže les, posekan okoli let 3144 do 3138 pr. Kr. Objekte, ki so bili postavljeni v tem času, najdemo v jarku 3 na območju odsekov 60 do 63 in v sosednjem jarku 4, odsek 39, ter v jarku 2, odsek 95. V jarku 3 je zaznati gradbeno aktivnost tudi nekoliko južneje na območju odsekov 69 in 70. Prav tako ocenjujemo, da se je v tem času gradilo tudi na območju sonde 2 in jarka 1 ter na območju jarka 5, odsek 3, in jarka 13, odsek 30.

V obdobju okoli let med 3133 in 3130 pr. Kr. so postavljali objekte na območju jarka 5, odseki 9, 11 in 12, in jarka 6, odsek 29. Gradbeno aktivnost pa je

(c. 10 cm). Pétrequin<sup>8</sup> and Pétrequin et al.<sup>9</sup> studied a large number of dendrochronologically dated piles from pile-dwellings in the French Jura, and discovered that trees with diameters, suitable for piles (c. 10 cm) were usually felled first. These trees were normally younger and were growing fast. When the dwellers ran out of such trees, they were forced to use trees with larger diameters (e.g. above 15 cm). Different technology had to be used for removal and skidding of larger trees. Trunks of large trees had to be cleaved in order to be driven into the ground with then available technology.<sup>10</sup> We could not yet verify if such practices were used in the Ljubljansko barje too because in our case most of the piles are undated due to limited amount of tree-rings. Large percentage of piles from the uncleaved younger trunks from the western part of the settlement is confirming that oak and ash wood was felled in younger forest, in contrast to the eastern part of the settlement. This, together with the references quoted above, could be an indirect hint that the western part of the settlement is somewhat older; dendrochronological researches indicate the same.

We can say that pile-dwellers from Stare gmajne used wood from young forest or used young trees for foundation piles, which also eased transport and preparation of piles. It also appears that, at the eastern part of the settlement, they later used larger, mainly older oak trees and sometimes also other, less suitable wood species.

### 7.1.2.3.1 Building activities

As we researched a comparatively large area and we managed to cross-date the majority of oak piles and to incorporate tree-ring series to a single chronology, we can also reconstruct building activities at Stare gmajne. However, a large restraint for the reconstruction exists. Namely, wood only originates from ditches, which cut the pile-dwelling. This makes recognizing of ground plans of constructions difficult or impossible. A small group of cross-dated oak piles indicates that the earliest settlement probably existed in ditch 13 and trench 3, and in ditch 12.

<sup>8</sup> 1996.

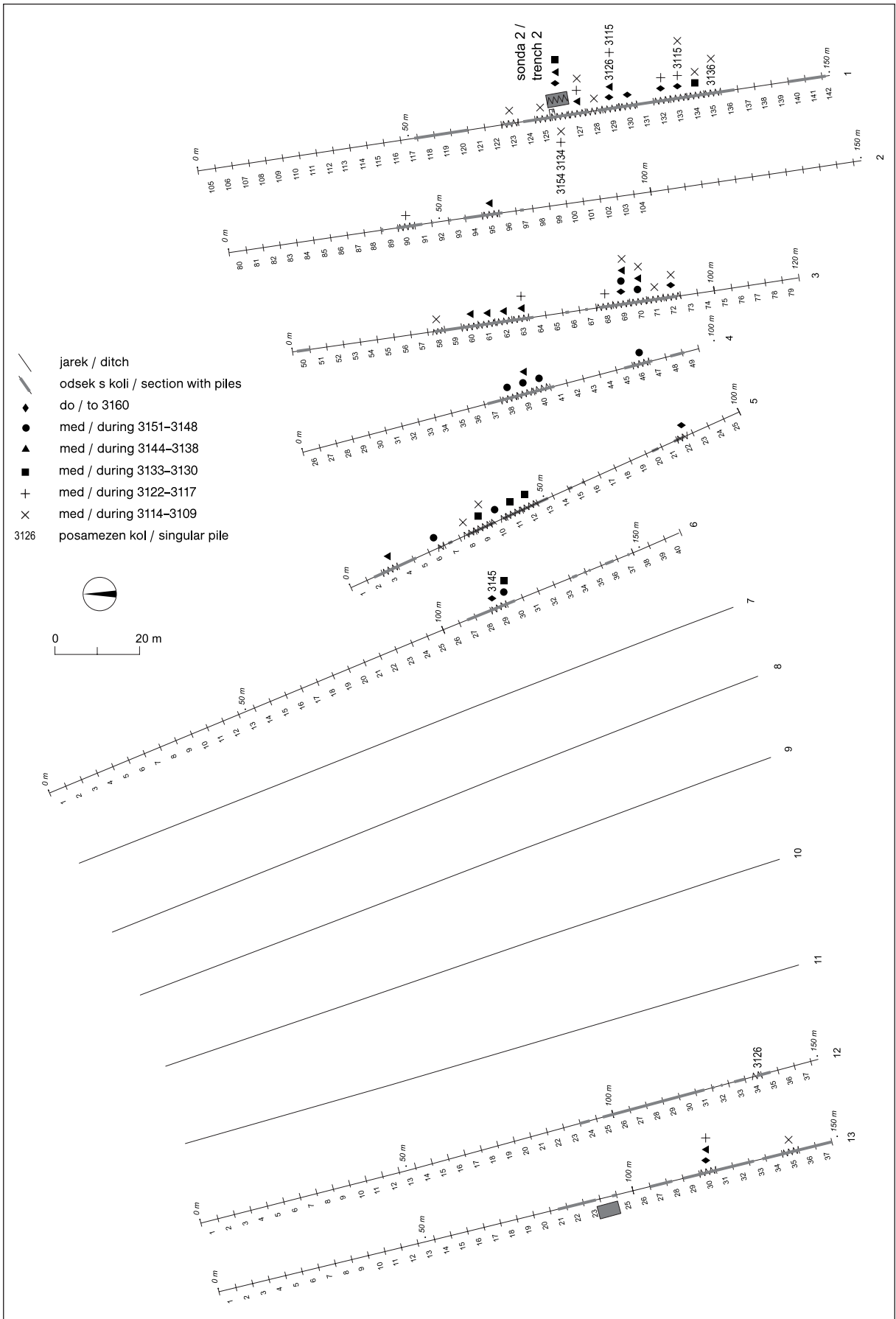
<sup>9</sup> 1998.

<sup>10</sup> Eberschweiler, Reithmann 1998.



*Sl. 7.8:* Razporeditev datiranih kolov mlajšega dela hrastove kronologije SG-QUSP1. Številke označujejo kalibrirana koledarska leta pred Kristusom, pri katerih je treba upoštevati standardno napako  $\pm 12$  let. Risba: T. Korošec.

*Fig. 7.8:* Distribution of dated piles in the later part of the SG-QUSP1 oak chronology. The numbers mark calibrated calendar years BC, with a standard error of  $\pm 12$  years. Drawn by: T. Korošec.



zaznati v sondi 2 in njeni bližini v jarku 1 ter odsekih 134 in 135.

Gradbena aktivnost okoli leta 3126 pr. Kr. je ugotovljena v jarku 1, odsek 129, ter v jarku 12, odsek 34. Na aktivnosti med letoma 3122 in 3117 pr. Kr. lahko sklepamo po kolih iz jarka 1, odseka 132 in 133, najizraziteje pa iz odsekov 126 in 127, in na podlagi kolov iz jarkov 2, odsek 90, in 3, odseka 63 in 68.

V obdobju po letu 3117 pr. Kr. je zaznati gradbeno aktivnost v jarku 1, v odsekih 129 in 133. Med letoma 3114 in 3109 pr. Kr. je zaznavana gradbena aktivnost v jarku 13, odsek 35. Nove objekte so verjetno postavljali v jarku 5, odseka 8 in 9, v jarku 3, odseki 69 do 72, in v jarku 1 v bližini sonde 2 ter v odsekih 133 do 135. Domnevamo, da koli, posekani v tem obdobju, kažejo na zadnje obdobje gradbenih aktivnosti na kolišču Stare gmajne.

Kratka, v okviru mlajšega dela hrastove kronologije SG-QUSP1 lahko sledimo gradbenim aktivnostim, ki so trajale dobrih 50 let in se končale z letom 3109 pr. Kr. To je okvirno čas, ko je na Starih gmajnah najverjetneje živela mlajša naselbina. Zahodni del pa je bil, sicer krajše obdobje, zelo verjetno posejen že po koncu aktivnosti na Spodnjem mostišču, torej po letu 3351 pr. Kr.

Glede na razpored in razpoložljive datacije jesenovih kolov domnevamo, da so ves čas po celotnem kolišču hkrati s hrastovim lesom sekali in uporabljali tudi jesenovega.

## 7.2 BLATNA BREZOVICA

Koliščarska naselbina Blatna Brezovica leži na jugozahodu Ljubljanskega barja med istoimenskim osamelcem in reko Ljubljanico, nasproti ji stojita koliščarski naselbini Hočevarica in Stare Gmajne. Naselbina je bila odkrita med drugo svetovno vojno. Prvo in doslej najobsežnejše arheološko izkopavanje pa je potekalo leta 1953, ko je J. Korošec na parceli št. 408 k. o. Blatna Brezovica zastavil 304 m<sup>2</sup> veliko izkopavalnišče. Pri izkopavanju je pionirsko sodeloval tudi paleobotanik A. Šercelj, ki je determiniral koliščarski les in ugotovil, da z 80 % prevladuje kostanj, nato sledijo hrast z 10 %, breza, jelša, bukev itn.<sup>11</sup> Kasneje so ugotovili, da je bil kostanjev les v resnici jesenov, dendrokronoloških raziskav pa takrat še niso izvajali.

Leta 2003 je v maju, oktobru in novembru ekipa Inštituta za arheologijo ZRC SAZU v okviru temeljnega raziskovalnega projekta "Arheološke in dendrokronološke raziskave na Ljubljanskem barju" (J6-3075) na Blatni Brezovici na območju Koroščevega izkopavalnišča zastavila dve sondi z namenom, da pridobi les za dendrokronološke raziskave.<sup>12</sup> V nadaljevanju opisujemo raziskave lesa.

<sup>11</sup> Šercelj 1955, 142.

<sup>12</sup> Glej poglavje 5 v tem zborniku.

Wood, felled after 3160 BC, enables the best reconstruction. It forms the main body of the SG-QUSP1 oak chronology, with more than 100 samples from this area, which are dispersed almost over the entire settlement. The eastern part contains the most, while there are much less on the western part (*Fig. 7.8*).

The mentioned chronology indicates that the settlement of Stare gmajne was established just before 3160 BC: the most piles, felled in this period come from ditches 1 and 3, while ditches 5, 6 and 13 contained one example each.

After c. 10 years, during c. 3151 to 3148 BC, a period of more intensive building activity follows. Constructions, dating to this period, were present in sections 38–40 of ditch 4, and in the area between ditch 4, section 46 and ditch 3, sections 69–70. Individual piles also show building activity in trench 2 and ditches 1, 5 and 6.

Another intense building phase follows in the period after 3144 BC, particularly with the usage of wood felled in c. 3144 to 3138 BC. Constructions, dating to this period, were found in ditch 3, sections 60 to 63, in adjoining ditch 4, section 39 and in ditch 2, section 95. Building activity in ditch 3 spreads southwards, to sections 69 and 70. We also assume that building activity was also performed in trench 2, ditch 1, in ditch 5, section 3, and in ditch 13, section 30.

In the period between c. 3133 and 3130 BC, construction work was carried out in ditch 5, sections 9, 11 and 12, and ditch 6, section 29. Building activity is also seen in trench 2, ditch 1 and sections 134–135.

Building activity in c. 3126 BC was discovered in ditch 1, section 129 and in ditch 12, section 34. Activities between 3122 and 3117 BC are indicated by piles from ditch 1, sections 132–133, the most explicitly from sections 126 and 127, and by piles from ditch 2, section 90 and ditch 3, sections 63 and 68.

After 3117 BC, building activity can be seen in ditch 1, sections 129 and 133. Between 3114 and 3109 BC building activities were performed in ditch 13, section 35. New constructions were probably built in ditch 5, sections 8 and 9, in ditch 3, sections 69 to 72 and in ditch 1, close to trench 2, and in sections 133 to 135. We suppose that piles, felled in this period, indicate the last period of building activities at the pile-dwelling Stare gmajne.

To summarise, the later part of the SG-QUSP1 oak chronology enables us to follow building activities that lasted more than 50 years and ended in 3109 BC. This is, in general, most probably period of the later settlement on Stare gmajne. Western part of the site was probably, for a shorter period, populated as soon as the activities on Spodnje mostišče ended, i.e. after 3351 BC.

Considering the ash pile disposition and available dates, we suppose that pile-dwellers felled and used oak and ash over the entire pile-dwelling simultaneously.

## 7.2.1 DENDROKRONOLOŠKE RAZISKAVE

### 7.2.1.1 VZORČENJE LESA

Iz načrta (*sl.* 7.9) je razvidno, da so bili koli vzeti z območja, ki je obsegalo približno 50 m<sup>2</sup>. Glede na Koroščekov načrt iz leta 1953<sup>13</sup> sklepamo, da sta bili naši izkopavališči zastavljeni na vzhodnem delu Koroščekovega izkopavališča.<sup>14</sup> V obeh izkopavanjih je bilo vzetih in raziskanih skupno 170 vzorcev navpičnih kolov.

### 7.2.1.2 PRIPRAVA IN IDENTIFIKACIJA LESA

Za dendrokronološke raziskave je bil odvzet les vseh ohranjenih elementov ne glede na obliko, premer in lesno vrsto. Najdbam lesa smo najprej izmerili natančne koordinate in nato odžagali 10–20 cm dolg kos, ki smo ga takoj po odvzemu izmerili, označili z identifikacijsko številko in ga zalitega z vodo shranili v nepredušno zaprti polietilenski vrečki.

Zbrane vzorce smo odpeljali na Oddelek za lesarstvo, kjer so jih raziskali po ustaljeni metodi.<sup>15</sup>

Postopek merjenja je potekal podobno kot pri lesu s Starih gmajn.<sup>16</sup> Dendrokronološke meritve smo opravili samo na vzorcih hrasta in jesena, ki so imeli vsaj 45 branik (*tab.* 7.6).

## 7.2.2 REZULTATI

Največ je bilo hrastovega lesa, ki je zastopan kar z 51 % vzorcev, sledil mu je jesen z 32 % vzorcev (*tab.* 7.6). Približno 15 % vzorcev je pripadalo drugim vrstam, med katerimi je prevladoval javor (*Acer*).

Za merjenje je bilo primernih le 28 % vzorcev, z vsaj 45 branikami, sinhronizirali oz. relativno datirali pa smo le 7 % vzorcev, kar je precej manj kot npr. pri Starih gmajnah in drugih koliščarskih naselbinah.<sup>17</sup> To morda nakazuje, da je bil izbor lesa osiromašen zaradi izkopavanj pred več kot 50 leti.

Od 31 merjenih hrastovih vzorcev smo jih sinhronizirali samo 13 (**BB03-29, 46, 48, 68, 84, 110, 114, 118, 125, 129, 130, 133 in 167**) ter sestavili 87 let dolgo hrastovo kronologijo. Ker imajo malo branik in veliko rastnih anomalij, statistično značilna sinhronizacija ni bila možna z nobeno od kronologij z Ljubljanskega barja. Rastne anomalije kažejo na močne antropogene vplive v sestojih, kjer je bil les posekan.

<sup>13</sup> Koršček 1963, pril. 10.

<sup>14</sup> Glej poglavje 5.2.2.1 v tem zborniku: *sl.* 5.4.

<sup>15</sup> Glej poglavje 7.1.1.2 v tem prispevku.

<sup>16</sup> Glej poglavje 7.1.1.3 v tem prispevku.

<sup>17</sup> Glej *tab.* 7.2 in Čufar, Velušček 2004, 267–269.

## 7.2 BLATNA BREZOVICA

The pile-dwelling settlement Blatna Brezovica is located on the south-western side of the Ljubljansko barje, between an eponymous isolated hill and the Ljubljanica River; pile-dwelling settlements of Hočevarica and Stare gmajne are located opposite to it. The settlement was discovered during the 2<sup>nd</sup> World War. In 1953, the first and the most extensive archaeological excavation so far was carried out. J. Korošček opened a 304 m<sup>2</sup> large excavation site on plot no. 408 in the Blatna Brezovica cadastral registry. A pioneer collaboration with a palaeobotanist A. Šercelj was performed at the excavation. Šercelj determined pile-dwelling wood and discovered, that chestnut prevails with 80 %, followed by oak with 10 %, birch, alder, beech etc.<sup>11</sup> It was revealed afterwards, that chestnut wood is actually ash. Dendrochronological researches were not performed at that time yet.

In 2003, in May, October and November, a team of the Institute of Archaeology ZRC SAZU, opened two trenches at Blatna Brezovica, inside the area of the site dug by Korošček. This was done as a part of the “Archaeological and Dendrochronological Research in the Ljubljana Moor” (J6-3075) research project, with the intention to gain wood for dendrochronological researches.<sup>12</sup> Investigations of wood are presented below.

## 7.2.1 DENDROCHRONOLOGICAL RESEARCHES

### 7.2.1.1 SAMPLING OF WOOD

As we can see from the plan (*Fig.* 7.9), piles were taken from the area of c. 50 m<sup>2</sup>. We assume, considering the Korošček's plan from 1953,<sup>13</sup> that our excavation sites were opened on the eastern part of the Korošček's excavation site.<sup>14</sup> Altogether, 170 samples of vertical piles were taken and investigated.

### 7.2.1.2 THE PREPARATION AND IDENTIFICATION OF WOOD

Wood for dendrochronological researches was taken from all preserved elements, regardless of form, diameter and wood species. We first measured accurate coordinates of all wooden finds and then sawed off 10–20 cm long piece, measured it immediately after sawing, marked it with an identification number and stored in a hermetically closed polyethylene bag, filled with water.

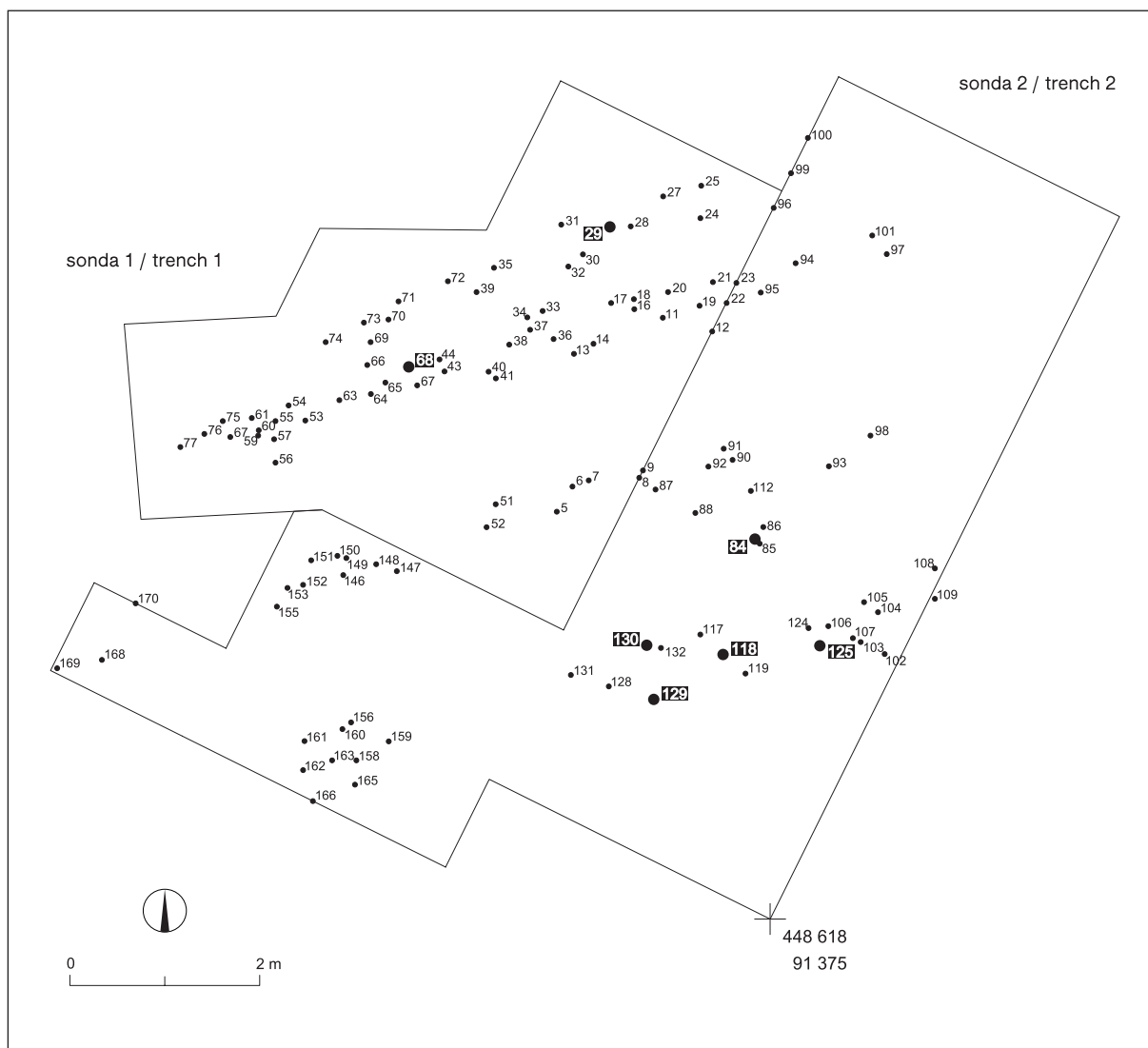
<sup>11</sup> Šercelj 1955, 142.

<sup>12</sup> See Chapter 5 in this monograph.

<sup>13</sup> Korošček 1963, appendix 10.

<sup>14</sup> See Chapter 5.2.2.1 in this monograph: *Fig.* 5.4.





Sl. 7.9: Blatna Brezovica – sondi 1 in 2 iz leta 2003 z označenimi navpičnimi koli; poudarjeni so sinhronizirani koli. Risba: T. Korošec.

Fig. 7.9: Blatna Brezovica – trenches 1 and 2 from 2003 with marked vertical piles; cross-dated piles shown in bold. Drawn by: T. Korošec.

Glede na radiokarbonsko datiranje vzorca kola BB03-48 ( $4499 \pm 21$  uncal BP) (tab. 7.7) in potek kronologije smo s pomočjo metode “wigggle-matching” ocenili leto zadnje branike v kronologiji BB-QUSP1 na  $3071 \pm 12$  pr. Kr.

Tako sklepamo, da je naselbina nekoliko mlajša kot Stare gmajne oz. da je bil posek lesa raziskanih vzorcev z Blatne Brezovice opravljen po poseku najmlajših hrastov s Starimi gmajni. Skorajšna sočasnost pa nakazuje tudi analiza arheoloških najdb, predvsem keramike.<sup>18</sup>

The selected samples were taken to the Department of Wood Science and Technology, where they were prepared using standard procedure.<sup>15</sup>

Measuring procedure was similar as the one used on wood from Stare gmajne.<sup>16</sup> Dendrochronological measurements were only done on oak and ash samples with at least 45 annual rings (Tab. 7.6).

<sup>18</sup> Glej poglavje 1.3 v tem zborniku.

<sup>15</sup> See Chapter 7.1.1.2 in this article.

<sup>16</sup> See Chapter 7.1.1.3 in this article.



Tab. 7.6: Število vzorcev po vrstah lesa ter število in deleži dendrokronološko merjenih in sinhroniziranih vzorcev.

Tab. 7.6: The number of samples according to wood species and number and percentage of dendrochronologically measured and cross-dated samples.

Vrsta lesa Wood species	Število Number	Delež (%)* Percentage	Merjen (št.) Measured (no.)	Merjen (%)* Measured (%)*	Sinhroniziran (št.) Cross-dated (no.)	Sinhroniziran (%)* Cross-dated (%)*
<i>Acer</i> sp.	15	9	0			
<i>Alnus glutinosa</i>	3	2	0			
<i>Corylus avellana</i>	4	2	0			
<i>Fagus sylvatica</i>	3	2	0			
<i>Fraxinus</i> sp.	55	32	19	11	0	0
<i>Populus</i> sp.	1	1	0			
<i>Quercus</i> sp.	87	51	31	17	13	7
<i>Salix</i> sp.	2	1	0			
<b>SKUPAJ TOTAL</b>	<b>170</b>	<b>100</b>	<b>50</b>	<b>28</b>	<b>13</b>	<b>7</b>

\* Delež, preračunan glede na vse vzorce. / Share calculated for the entire sample population.

Tab. 7.7: Radiokarbonska datacija vzorca kola z Blatne Brezovice. Datiranje je bilo opravljeno v laboratoriju na Heidelberger Akademie der Wissenschaften, Radiometrische Altersbestimmung von Wasser und Sedimenten.

Tab. 7.7: Radiocarbon dates of sample piles from Blatna Brezovica. Dating was performed in the laboratory of the Heidelberger Akademie der Wissenschaften, Radiometrische Altersbestimmung von Wasser und Sedimenten.

Kol št. Pile no.	Lab. št. Lab. no.	Drevesna vrsta Wood species	Srednja branika Mid tree ring	<sup>14</sup> C-age BP
<b>BB03-48</b>	Hd-24036	<i>Quercus</i>	181	4499 ± 21

### 7.3 SKLEP

V prispevku smo analizirali arheološki les s koliščarske naselbine Stare gmajne na Ljubljanskem barju in dobljene rezultate primerjali z raziskavami lesa z naselbine Blatna Brezovica.

Na podlagi arheološkega lesa s Starih gmajn, kjer med vzorci prevladujejo navpični koli, nam je uspelo sestaviti eno hrastovo in dve jesenovi kronologiji.

Največ vzorcev smo vključili v hrastovo kronologijo SG-QUSP1, kjer smo zadnjo braniko s pomočjo radiokarbonskega datiranja in metode "wigggle-matching" datirali v leto 3109 ± 12 pr. Kr. (razpon 3121–3095, 2σ, 95,4 % verjetnost). Na podlagi absolutno in relativno datiranih lesenih kolov ugotavljamo, da je bilo skoraj celotno območje (jarki 1–6, 12, 13 in sonde 1–3) intenzivno poseljeno več kot 50 let in da so se gradbene aktivnosti po hrastovi kronologiji najverjetneje končale leta 3109 pr. Kr. oz. nekaj let pozneje, kot nakazuje kronologija SG-FRSP1, ter skoraj sočasno kot na 1 km oddaljeni naselbini Veliki Otavnik Ib.<sup>19</sup>

Manjše število dendrokronološko datiranih vzorcev nakazuje, da je na Starih gmajnah obstajala naselbina že

### 7.2.2 RESULTS

As much as 51 % of samples were oak, followed by 32 % of ash (Tab. 7.6). C. 15 % of samples belonged to other species, with maple (*Acer*) prevailing.

Only 28 % of samples with at least 45 annual rings were suitable for measurements, with as little as 7 % of samples cross-dated or relatively dated, which is a lot less than e.g. at Stare gmajne and other pile-dwelling settlements.<sup>17</sup> This perhaps indicates that the selection of wood was impoverished because of excavations that were taking place over 50 years ago.

From 31 measured oak samples, only 13 were cross-dated (BB03-29, 46, 48, 68, 84, 110, 114, 118, 125, 129, 130, 133 and 167) and composed an 87 years long oak chronology. As the samples have few annual rings and many growth anomalies, statistically significant cross-dating was not possible with any of the chronologies from the Ljubljansko barje. Growth anomalies indicate strong anthropogenic impacts in stands, where wood was felled.

<sup>17</sup> See Tab. 7.2 in this article and Čufar, Velušček 2004, 267–269.

<sup>19</sup> Glej poglavje 6 v tem zborniku.

v 34. stoletju, okoli leta 3330 pr. Kr., ki je bila verjetno postavljena, potem ko so se končale gradbene aktivnosti (in poselitve) na kolišču Spodnje mostišče.

Na podlagi vzorcev, sinhroniziranih po hrastovi kronologiji Starih gmajn SG-QUSP1, smo dobili tudi vpogled, kje in kdaj so potekale gradbene aktivnosti v obdobju mlajše naselbine. Naselbina ni bila postavljena naenkrat, temveč se je njen tloris skozi čas spreminjal. Ljudje so v njej živeli na njenem vzhodnem in tudi zahodnem delu (glej *sl.* 7.8).

Natančna analiza lesa navpičnih kolov je tudi pokazala, da so koliščarji na Starih gmajnah za nosilne kole največkrat uporabili les jesena in hrasta, sledi les topola, bukve, jelše in javorja. Med navpičnimi koli so z več kot 60 % prevladovali tisti s premerom od 6 do 12 cm. Približno 20 % jih je imelo premer od 12,5 do 22 cm, manj kot 10 % pa premer od 23 do 40 cm ali pod 6 cm. Koli večjih premerov so bili praviloma klani. Za gradnjo je bil večinoma uporabljen les iz dreves z okoli 20–50 branikami (približno 60 %), manj pa les iz dreves z več kot 50 branikami (približno 30 %) ali z manj kot 20 branikami (približno 10 %).

Debla so torej v splošnem imela manj kot 50 branik, razen pri hrastu, kjer so kole iz starejših dreves v glavnem zabijali na vzhodnem delu naselbine, predvsem na območju jarka 1 in sonde 2 ter v jarkih 2–5, kjer je tudi velik delež klanih kolov. Nasprotno pa se zdi, da so na zahodu naselbine posegali po tanjših in mlajših drevesih, tudi hrastovih. Debla večjih starejših dreves so za uporabo za kole namreč morali razklati. Značilno je tudi, da so nekateri koli iz drugih vrst lesa razporejeni po skupinah, kar vsaj v nekaterih primerih morda kaže, da so jih posekali in uporabili sočasno. Slednje še posebej lahko trdimo za kole iz lesa jelše, topola in jelke. Žal rekonstrukcijo otežuje to, da preučujemo samo transekte skozi naselbino in da večine kolov ne moremo datirati, ker imajo za to premalo branik.

Iz zaporedij širin branik lesa z arheološkega najdišča na Blatni Brezovici, ki je bilo že raziskano leta 1953,<sup>20</sup> smo sicer sestavili hrastovo kronologijo, ki pa nam je ni uspelo z zanesljivostjo sinhronizirati z nobeno drugo kronologijo z Ljubljanskega barja, medtem ko radiokarbonski datum nakazuje, da je naselbina živela v mlajšem obdobju ali že po koncu poselitve Starih gmajn.

Na koncu naj v primeru dendrokronoloških raziskav lesa s Starih gmajn in Blatne Brezovice še enkrat poudarimo, da je statistično najboljše pokrita hrastova kronologija SG-QUSP1, na podlagi katere smo ugotovili:

1. Razmeroma veliko število relativno datiranih kolov omogoča vpogled v dinamiko gradbenih aktivnosti po celotni koliščarski naselbini na Starih gmajnah.

2. S hrastovo kronologijo smo sinhronizirali kronologijo z Velikega Otavnika Ib, ki kaže, da so bila najmlajša drevesa iz kronologije VO-QUSP1 posekana

Considering the radiocarbon date of the pile BB03-48 ( $4499 \pm 21$  uncal BP) (*Tab.* 7.7), the pattern of the chronology, and with the help of the “wiggle-matching” procedure, we assessed the last annual ring date of the BB-QUSP1 chronology to be  $3071 \pm 12$  BC.

We therefore assume that the settlement is somewhat later as the one at Stare gmajne, or, that wood felling of investigated samples from Blatna Brezovica ended after the felling of the youngest oaks from Stare gmajne. Moreover, also an analysis of archaeological finds, primarily pottery, indicates that the settlements were nearly contemporary.<sup>18</sup>

### 7.3 CONCLUSION

In this chapter, we analysed archaeological wood from the pile-dwelling settlement Stare gmajne at the Ljubljansko barje and compared the results with researches of wood from the settlement Blatna Brezovica.

Based on archaeological wood from Stare gmajne, where vertical piles prevail among samples, we succeeded to make one oak and two ash chronologies.

Most of the samples were incorporated into the SG-QUSP1 oak chronology, where the last annual ring was, with the help of radiocarbon dating and the “wiggle-matching” procedure, dated to  $3109 \pm 12$  BC (span 3121–3095,  $2\sigma$ , 95.4 % probability). Based on absolutely and relatively dated wooden piles we presume, that almost the entire area (ditches 1–6, 12, 13 and trenches 1–3) was intensely populated for more than 50 years. Moreover, the building activities, denoted by the oak chronology, most probably finished in 3109BC or a few years later, as remitted by the SG-FRSP1 chronology, and almost simultaneously with the settlement Veliki Otavnik Ib, situated 1 km away.<sup>19</sup>

Smaller number of dendrochronologically dated samples remit that a settlement existed at Stare gmajne in the 34<sup>th</sup> century, in around 3330 BC. It was probably constructed after the building activities (and settling) on the pile-dwelling Spodnje mostišče ended.

Based on samples, cross-dated in the Stare gmajne SG-QUSP1 oak chronology, we also obtained information on where and when the building activities in the period of the later settlement were taking place. The settlement was not constructed at once. Instead, its ground plan was changing in time. Activities within the settlement were taking place in its eastern as well as in its western part (see *Fig.* 7.8).

Precise analysis of vertical piles also showed that wood of ash and oak were used most often for foundation piles at Stare gmajne, followed by poplar, beech, alder and maple. Over 60 % of vertical piles had a diameter from 6 to 12 cm. C. 20 % had diameter from 12.5 to

<sup>20</sup> Korošec 1963.

<sup>18</sup> See Chapter 1.3 in this monograph.

<sup>19</sup> See Chapter 6 in this monograph.

praktično sočasno (eno leto kasneje) kot najmlajša drevesa iz SG-QUSP1.

Dendrokronološke raziskave na Starih gmajnah in Blatni Brezovici, podprte z radiokarbonskimi datacijami, so omogočile dokaj natančno absolutno datiranje obstoja obeh naselbin, ki sta mlajši od naselbin iz sredine in tretje četrtine 4. tisočletja pr. Kr. (približno od 3500 do 3330 pr. Kr.). Najstarejša med temi koliščarskimi naselbinami je Maharski prekop, nato sledijo Črešnja pri Bistri, Spodnje mostišče in Stare gmajne (starejša naselbina).

22 cm and less than 10 % a diameter from 23 to 40 cm or under 6 cm. Piles with larger diameters were generally cleaved. Wood with c. 20–50 annual rings (c. 60 %) was most regularly used for construction. Wood with more than 50 annual rings (c. 30 %) or with less than 20 annual rings (c. 10 %) was not used as often.

Generally, trunks had less than 50 annual rings, except for oak, where piles from older trees were mainly driven into ground on the eastern part of the settlement, especially in ditch 1 and trench 2, and in ditches 2–5, which also have high percentage of cleaved piles. On the contrary, it seems that on the western part of the settlement, thinner and younger trees were used, also oak. Namely, they had to cleave trunks of larger older trees in order to use them as piles. Another characteristic of this site are clusters of piles from different species of wood are, which perhaps indicates that, at least in some cases, they were felled and used all at once. The latter can especially be claimed for alder, poplar and fir piles. It is, unfortunately, difficult to make reconstruction, as we are only observing transects through the settlement and as the majority of piles cannot be dated, as they do not contain enough annual rings.

From tree-ring series of wood from the site Blatna Brezovica, which was investigated in 1953,<sup>20</sup> we constructed one oak chronology, which we could not reliably cross-date with any other chronology from the Ljubljansko barje. Moreover, the radiocarbon date indicates that the settlement existed during the later period of the settlement Stare gmajne or after it was abandoned.

Let us emphasise once again that the SG-QUSP1 oak chronology is best replicated. The following was established based on it:

1. Comparatively large number of relatively dated piles enabled us to examine the dynamic of building activities across the entire pile-dwelling settlement Stare gmajne.

2. Oak chronology was cross-dated with the chronology from Veliki Otavnik Ib. The results indicate that the youngest trees from the VO-QUSP1 chronology fell practically at the same time (one year later) as the youngest trees from the SG-QUSP1.

Dendrochronological researches at Stare gmajne and Blatna Brezovica, supported with radiocarbon dates, gave us rather accurate absolute dating of the existence of both settlements, which existed later than settlements from the middle and third quarter of the 4<sup>th</sup> millennium BC (c. 3500 to 3330 BC). The earliest of these 4<sup>th</sup> millennium BC pile-dwelling settlements is Maharski prekop, followed by Črešnja near the Bistra, Spodnje mostišče and Stare gmajne (the earlier phase of the settlement).

<sup>20</sup> Korošec 1963.



# 8. PRAZGODOVINSKO LESENO KOLO Z OSJO S KOLIŠČA STARE GMAJNE NA LJUBLJANSKEM BARJU

Anton VELUŠČEK, Katarina ČUFAR &  
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## Izvleček

Predstavljeno je prazgodovinsko leseno kolo z osjo s koliščarske naselbine Stare gmajne na Ljubljanskem barju, ki je bilo odkrito leta 2002. Analize kažejo, da gre za vrhunski tehniški izdelek prazgodovinskega kolarja. Glede na datiranje naselbine, kjer je bilo kolo najdeno, njegovo starost ocenjujemo na približno 5150 let.

**Ključne besede:** leseno kolo z osjo, predstavitev in datiranje, kolišče, Stare gmajne, Ljubljansko barje, 4. tisočletje pr. Kr.

## 8.1 UVOD

Ko se je ekipa Inštituta za arheologijo ZRC SAZU<sup>1</sup> v zgodnji pomladi leta 2002 podala na dokumentiranje in vzorčenje arheološkega lesa iz odvodnih jarkov na Starih gmajnah, si ni bilo mogoče niti v sanjah predstavljati, na kaj vse bomo naleteli. Najprej nas je nemalo presenetilo odkritje odlično ohranjenega drevaka v jarku 4 (*sl. 8.1*).

Ko smo najdbo dokumentirali in organizirali srečanje arheološke nadzorne komisije ter skupaj odločili, da drevak pustimo tam, kjer smo ga našli, smo v jarku 1 na skrajnem vzhodu odkritega dela naselbine (*sl. 8.1*) naleteli na še en drevak podobnega tipa kot prvi, le s to razliko, da je bil bolj poškodovan.<sup>2</sup>

Na Veliki petek 29. marca 2002, ko so bile naše misli že na krajših velikonočnih počitnicah, je sodelavec J. Dirjec slabih 20 m južno v istem jarku naletel na poškodovan kos lesa, ki je sprva spominjal na desko (*sl. 8.3*), po natančnejšem ogledu pa se je zdelo, da gre morda za pokrov lesenega soda,

<sup>1</sup> Arheološko ekipo so sestavljali: A. Velušček, J. Dirjec, B. Toškan in študent arheologije M. Turk.

<sup>2</sup> Glej poglavje 9 v tem zborniku.

# 8. PREHISTORIC WOODEN WHEEL WITH AN AXLE FROM THE PILE-DWELLING STARE GMAJNE AT THE LJUBLJANSKO BARJE

Anton VELUŠČEK, Katarina ČUFAR &  
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## Abstract

This chapter introduces a prehistoric wooden wheel with an axle discovered in 2002 at the pile-dwelling settlement Stare gmajne at the Ljubljansko barje. Analyses indicate that it was a technologically advanced product, manufactured by a prehistoric wheelwright. Considering its radiocarbon dating and the age of the settlement, where it was found, the wheel is c. 5150 years old.

**Keywords:** wooden wheel with an axle, presentation and dating, pile-dwelling, Stare gmajne, the Ljubljansko barje, 4<sup>th</sup> millennium BC.

## 8.1 INTRODUCTION

When a team including members of the Institute of Archaeology of the Scientific Research Centre of the Slovenian Academy of Sciences and Arts (ZRC SAZU)<sup>1</sup> began documenting and sampling archaeological wood from drainage ditches at Stare gmajne in the early spring of 2002, it was impossible to imagine even in the wildest dreams, what we will discover. A discovery of an excellently preserved logboat in ditch 4 (*Fig. 8.1*) was the first surprise.

After the find was documented and the meeting with the archaeological supervisory committee was organised, we decided that the logboat should be left where found; in ditch 1, on the eastern most part of the settlement (*Fig. 8.1*), however, we immediately came across another logboat, similar to the first one, but in a worse state of preservation.<sup>2</sup>

On the Good Friday, 29<sup>th</sup> March 2002, when our thoughts were already directed towards the Easter holi-

<sup>1</sup> A. Velušček, J. Dirjec, B. Toškan and archaeology student M. Turk.

<sup>2</sup> See Chapter 9 in this monograph.

skratka za eno izmed novodobnih smeti, ki so jih odvodni jarki na Ljubljanskem barju še vedno prepolni.

Po Veliki noči, ko smo dokončevali dokumentiranje drevakov, je prišla na vrsto tudi obravnavana najdba. Po odstranitvi blata je sila teže najdbo odlepila od stene jarka. Takoj se je pokazalo, da gre za odkritje lesenega kolesa, ki je po možnosti tako staro kot naselbina, ki smo jo na podlagi tipologije keramike in prvih radiokarbonskih analiz lesa z drugih "sočasnih" najdišč datirali v sredo 4. tisočletja pr. Kr.<sup>3</sup>

Našo najdbo smo prepoznali kot kolo tudi zato, ker smo od obiska pri H. Schlichtherleju v Hemmenhofnu v Nemčiji pred nekaj leti že poznali najstarejša prazgodovinska lesena kolesa v Srednji Evropi. Neverjetna se nam je zdela le njegova domnevna starost, ki smo jo ob odkritju ocenjevali na približno 5500 let.

Odkritje kolesa z osjo na Starih gmajnah je doma in po svetu takoj zbudilo veliko strokovno in tudi laično zanimanje. Kmalu po odkritju je bilo pripravljenih nekaj poročil v domačih in tujih strokovnih revijah in zbornikih. Priprava besedila in slikovnega gradiva za prvo objavo je sledila samo nekaj dni po odkritju,<sup>4</sup> ko najdba niti še ni bila dobro očiščena.

Včasih se naglica izplača, v našem primeru pa se ni. V surovem, neočiščenem stanju se je namreč dozdevalo, da je kolo sestavljeno iz treh desk, kar smo tudi objavili in je bilo potem citirano v strokovni literaturi.<sup>5</sup> Napako, bolje rečeno prenačelnost, smo pri poznejših objavah popravili.<sup>6</sup> Upamo, da bo sčasoma izginila tudi iz strokovne literature.

S pričujočo objavo preiskav kolesa in osi torej izpolnjujemo naš dolg do strokovne pa tudi laične javnosti. Kot je razvidno v nadaljevanju, gre za predmet, ki je pravi tehniški biser prazgodovinskih mojstrov, čeprav predstavlja eno najstarejših lesenih najdb te vrste nasploh.<sup>7</sup>

## 8.2 ODKRITJE IN OKOLIŠČINE

Delno poškodovano prazgodovinsko kolo je ležalo v vzhodnem profilu jarka 1 v odseku 126, na meji z odsekom 125 (sl. 8.1).

Prvotno je bilo kolo nasajeno na os. Pri odstranjevanju plasti blata pa se je kolo z delom osi odlomilo, v prvotni legi je tako ostala glavnina osi, ki je štrlela iz vzhodne stene jarka (sl. 8.4). Dne 3. aprila 2002 je že omenjena ekipa Inštituta za arheologijo ZRC SAZU v smeri lesene osi zastavila manjšo sondo 1 (sl. 8.2). Pokazalo se je, da os leži pod kulturno plastjo v plasti gytjtje (sl. 8.5).<sup>8</sup>

<sup>3</sup> Glej Velušček 2001.

<sup>4</sup> Velušček 2002a; 2002b.

<sup>5</sup> Npr. Pare 2006, 53, sl. 5.

<sup>6</sup> Velušček 2006c.

<sup>7</sup> Prim. z Bakker et al. 1999; Voosten 1999; Ruoff, Jacomet 2002; Ruoff 2006.

<sup>8</sup> Glej poglavje 3.1.2.1 v tem zborniku.

days, our co-worker J. Dirjec stumbled upon a damaged piece of wood in the same ditch, some 20 m southward of the second logboat. It reminded of a plank at first (Fig. 8.3), a lid of a wooden barrel perhaps, i.e. modern rubbish, which can still be found in abundance in the Ljubljansko barje drainage ditches.

After Easter, when we were finishing with documenting of logboats, we also needed to document this find. After the removal of mud, the gravity force detached the find from the wall of the ditch. It turned out that it is a wooden wheel, perhaps as old as the settlement itself, which was, according to typology of pottery and the radiocarbon analyses of wood derived from other "contemporary" sites, dated to the middle of the 4<sup>th</sup> millennium BC.<sup>3</sup>

We visited H. Schlichtherle in Hemmenhofen in Germany a few years ago and were therefore familiar with the oldest prehistoric wooden wheels in Central Europe. We identified this find as a wheel. However, its presumed age seemed unbelievable, as we assessed it to be c. 5500 years old.

The discovery of the wheel with an axle at Stare gmajne immediately evoked amateur and scientific interest in Slovenia and across the globe. Soon after the discovery, several reports in local and foreign specialist journals and proceedings were published. Text and images were prepared only a few days after the discovery,<sup>4</sup> when the find has not yet been entirely cleaned.

Haste sometimes pays off, but not in this case. Raw, uncleaned condition of the find made us suspect that the wheel has been made of three planks. We published this observation and it was later quoted in scientific literature.<sup>5</sup> An error or precipitation was corrected in later publications.<sup>6</sup> We hope that the error mentioned will disappear from scientific literature in time.

With this publication of investigations of the wheel and its axle, we pay our debt to scientific and popular archaeology. As we shall see, this object is a real technical gem made by prehistoric masters, although it is one of the oldest wooden finds of this kind.<sup>7</sup>

## 8.2 DISCOVERY AND CIRCUMSTANCES

Somewhat damaged prehistoric wheel was discovered in the eastern profile of ditch 1 in section/sector 126, right on the edge of section 125 (Fig. 8.1).

The wheel was fixed onto the axle at first. Upon removing a layer of mud, the wheel fell off; the majority

<sup>3</sup> See Velušček 2001.

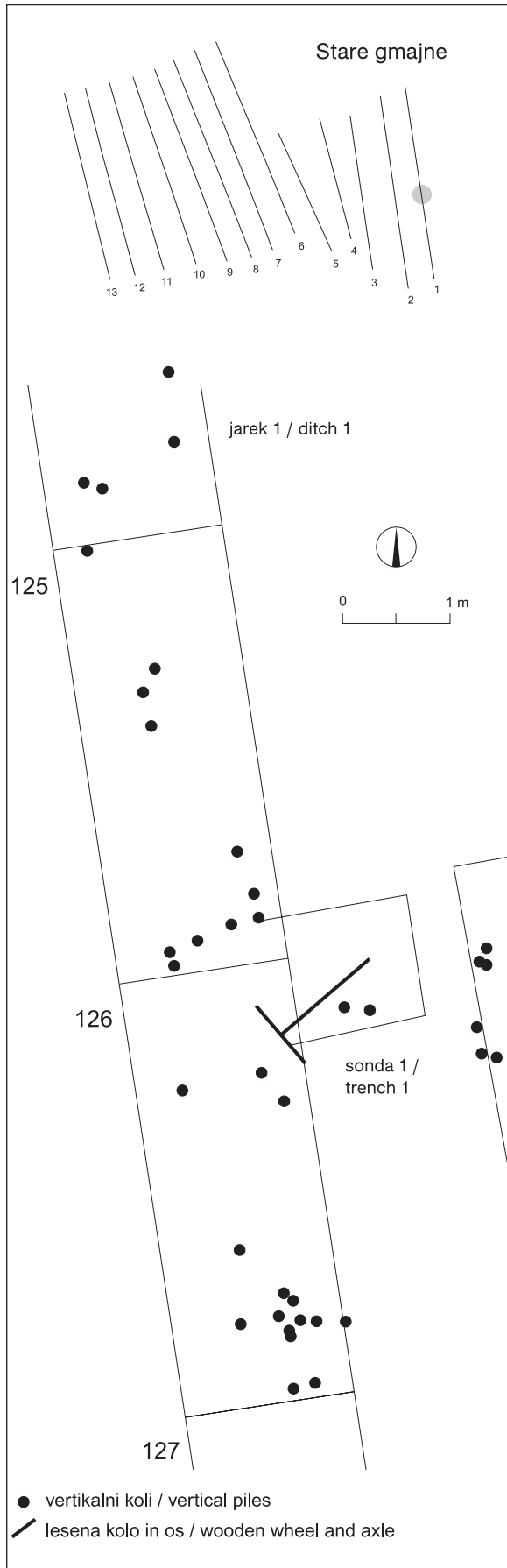
<sup>4</sup> Velušček 2002a; 2002b.

<sup>5</sup> E.g. Pare 2006, 53, Fig. 5.

<sup>6</sup> Velušček 2006c.

<sup>7</sup> E.g. Bakker et al. 1999; Voosten 1999; Ruoff, Jacomet 2002; Ruoff 2006.





Sl. 8.1: Načrt raziskanih odvodnih jarkov 1-13 na najdišču Stare gmajne s podrobnejšim prikazom razmer v jarku 1 ob sondi 1. Risba: T. Korošec.

Fig. 8.1: Plan of investigated irrigation ditches 1-13 at the site Stare gmajne, with details of ditch 1, adjacent to trench 1. Drawn by: T. Korošec.



Sl. 8.2: Sonda 1 v vzhodni steni jarka 1, med izkopavanjem. Foto: M. Turk.

Fig. 8.2: Trench 1 in eastern profile of ditch 1, during excavation. Photo: M. Turk.

of the axle stayed in its primary position, i.e. jutting out of the eastern profile of the ditch (Fig. 8.4). On the 3<sup>rd</sup> April 2002, a small trench 1 was opened in the direction of the wooden axle (Fig. 8.2). It turned out, that the axle was positioned under a cultural layer, in layer of gyttia (Fig. 8.5).<sup>8</sup>

## 8.3 DESCRIPTION OF THE FIND

### 8.3.1 WOODEN WHEEL

#### 8.3.1.1 THE DISC AND BATTENS

A wheel is a circular device capable of rotating on its axis. When a wheel forms part of a vehicle, generally the force of rolling resistance is less than that associated with kinetic friction. Therefore, only a small amount of effort is necessary to move the vehicle. Wheel is usually fixed to an axle, which rotates the wheel. The earliest and the simplest wheels, used for wheeled vehicles, were single-piece disc wheels with a central opening for the hub.<sup>9</sup>

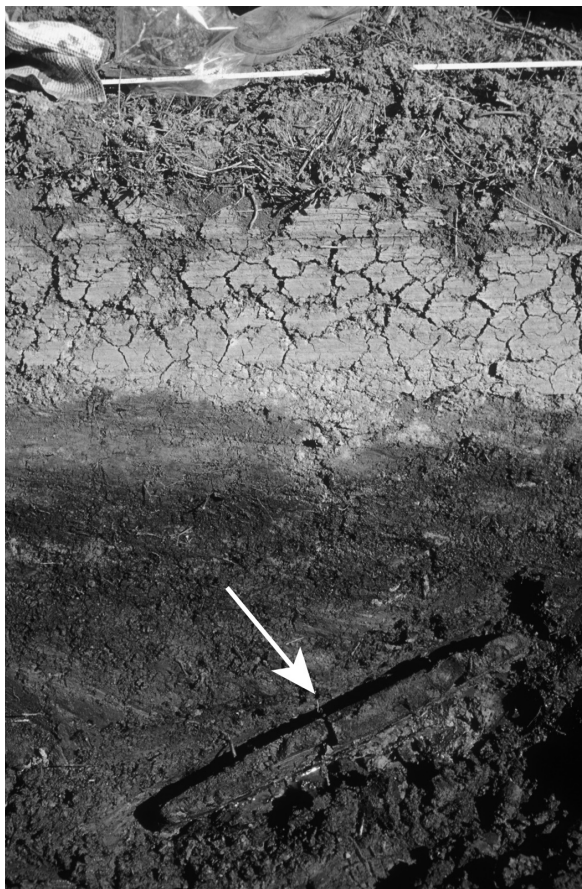
It is not yet known where wheeled vehicle was invented. Several theories exist.<sup>10</sup> It was perhaps invented in Mesopotamia,<sup>11</sup> contemporary in Mesopotamia and

<sup>8</sup> See Chapter 3.1.2.1 in this monograph.

<sup>9</sup> Piggott 1983; Vosteen 1999.

<sup>10</sup> E.g. Péterquin, Péterquin, Bailly 2006, Fig. 4; Hartmann 2006, 71-93.

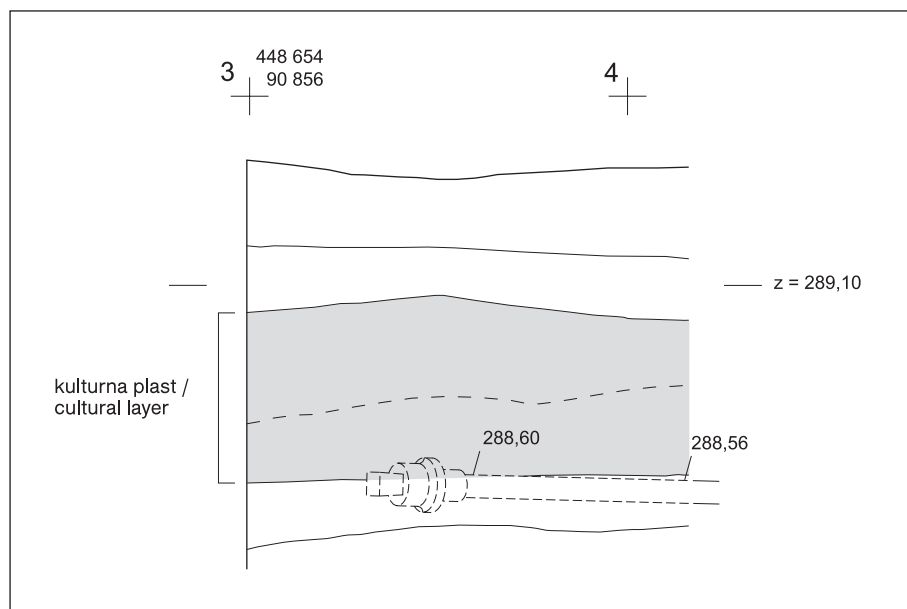
<sup>11</sup> E.g. Sherratt 2006.



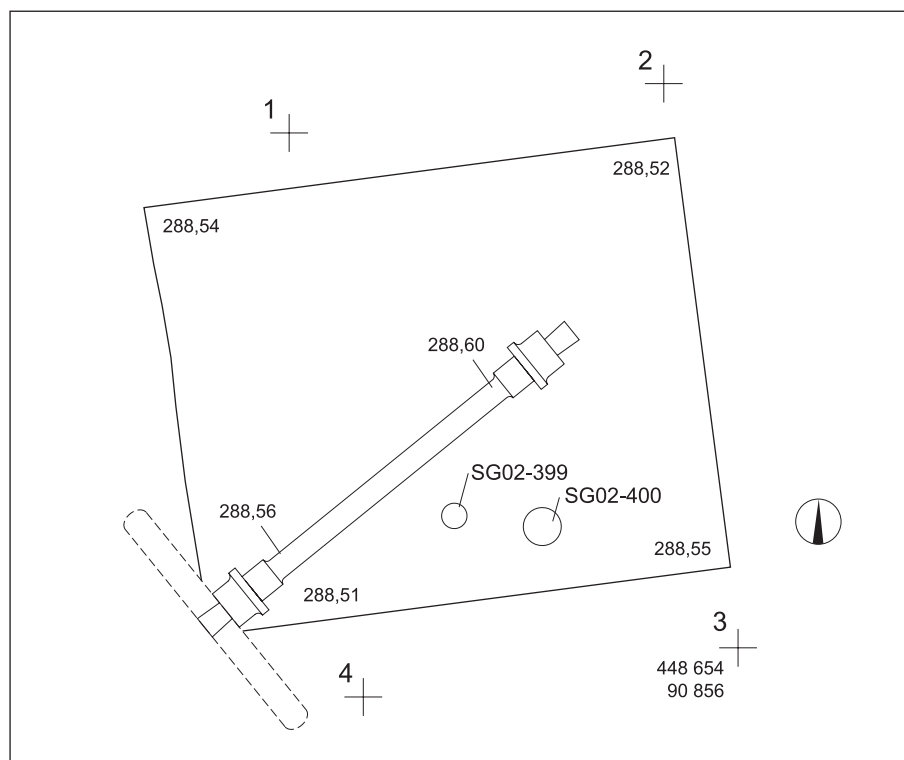
Sl. 8.3: S kmetijskim strojem poškodovano kolo *in situ* (puščica) na dnu v vzhodnem profilu jarka 1. Foto: M. Turk.  
 Fig. 8.3: Wheel, damaged by JCB, *in situ* (shown with arrow) at the base of the eastern profile of ditch 1. Photo: M. Turk.



Sl. 8.4: Os na strani A1 (oznaka s sl. 8.21-8.23) *in situ* z vidnim ležiščem kolesa. Foto: M. Turk.  
 Fig. 8.4: Axle, side A1 (see Fig. 8.21-8.23), *in situ*, with visible wheel bed. Photo: M. Turk.



Sl. 8.5: Južni profil sonde 1 s projekcijo osi na profil. Risba: T. Korošec. M = 1 : 20.  
 Fig. 8.5: Southern profile of ditch 1 with projection of the axle. Drawn by: T. Korošec. Scale = 1 : 20.



Sl. 8.6: Os v sondi 1 z obrisom kolesa v prvotni legi. Risba: T. Korošec. M = 1 : 20.

Fig. 8.6: Axle in ditch 1 with an outline of the wheel in its primary position. Drawn by: T. Korošec. Scale = 1 : 20.

## 8.3 OPIS NAJDBE

### 8.3.1 LESENO KOLO

#### 8.3.1.1 DISK IN GREBENASTE LETVE

Po definiciji je kolo naprava okrogle oblike, ki z vrtenjem omogoča premikanje. Kadar je kolo del vozila, pri njegovem premikanju po podlagi nastaja kotalno trenje, ki je precej manjše od drsnega, zaradi česar je potrebna relativno majhna sila za premikanje. Kolo je navadno nasajeno na pogonsko os, ki prenaša vrtenje. V svoji prvotni in najpreprostejši obliki je bilo kolo vozil poln lesen kolut oz. disk, z odprtino v sredini.<sup>9</sup>

Območje iznajdbe vozila na kolesih še ni ugotovljeno. Obstaja več teorij.<sup>10</sup> Po prvi naj bi ga izumili v Mezopotamiji,<sup>11</sup> po drugi neodvisno in sočasno kot v Mezopotamiji tudi v Evropi,<sup>12</sup> po tretji pa najprej v Evropi.<sup>13</sup> Raziskovalci so si edini, da se je to zgodilo v 4. tisočletju pr. Kr.<sup>14</sup>

Europe independently from one another,<sup>12</sup> or in Europe.<sup>13</sup> However, general opinion is that the invention occurred in the 4<sup>th</sup> millennium BC.<sup>14</sup>

The prehistoric wheel from Stare gmajne was made as a disc with a rectangular central opening for the hub. The disc was made of two (A1 and A2) planks joined (tongue-and-groove joint) with four battens (B1–B4).

Planks are made of ash (*Fraxinus excelsior*) with wide annual rings, of trunk of over 40 cm in diameter and over 80 years old. The trunk belonged to a large tree; unlike trunks used for vertical piles in settlements, which had c. 10 cm in diameter. They used the same trunk to make both wheel planks (A1 and A2). A1 was closer to the pith, but it did not contain the pith and annual rings next to it (Fig. 8.13). It was radially oriented. Plank A2 was cut further away from the pith, and that is why at its radial orientation gradually turns to tangential. They followed a general rule, according to which radial planks without the pith and juvenile wood around it are dimensionally the most stable. Central part of a trunk (containing the pith and juvenile wood), which was not used, is generally considered as low-grade wood (Fig. 8.12).

<sup>9</sup> Piggott 1983; Vosteen 1999.

<sup>10</sup> Npr. Pétrequin, Pétrequin, Bailly 2006, sl. 4; Hartmann 2006, 71–93.

<sup>11</sup> Npr. Sherratt 2006.

<sup>12</sup> Npr. Vosteen 2006.

<sup>13</sup> Npr. Matuschik 2006.

<sup>14</sup> Glej npr. Hartmann 2006, 90.

<sup>12</sup> E.g. Vosteen 2006.

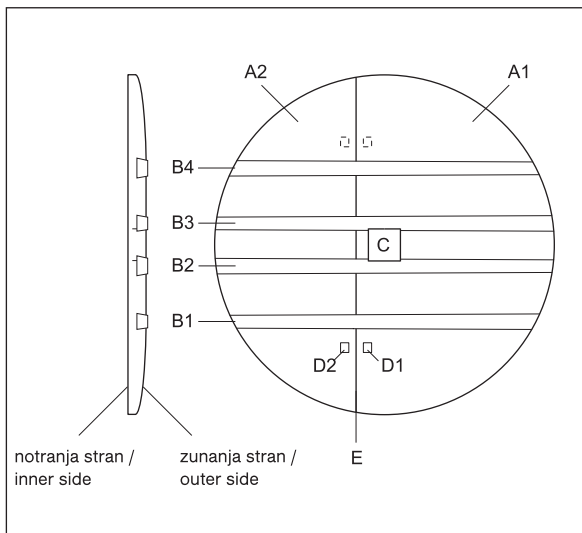
<sup>13</sup> E.g. Matuschik 2006.

<sup>14</sup> See e.g. Hartmann 2006, 90.





Sl. 8.7: Lesena os v sondi 1 *in situ*. Foto: A. Velušček.  
Fig. 8.7: Wooden axle in ditch 1 *in situ*. Photo: A. Velušček.



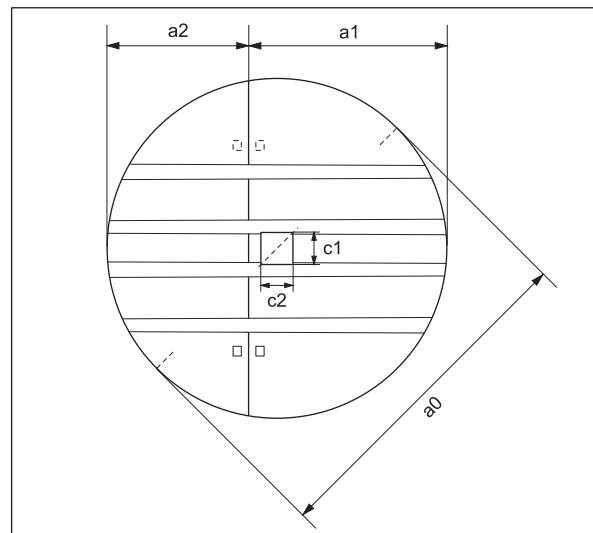
Sl. 8.8: Oznake delov kolesa:  
- A1 in A2: kolesni deski  
- B1 do B4: grebenaste letve  
- C: pesto  
- D1 in D2: odprtini v deski  
- E: stik med kolesnima deskama.

Risba: T. Korošec.

Fig. 8.8: Parts of the wheel:

- A1 and A2: wheel planks
- B1 to B4: battens
- C: hub
- D1 and D2: openings in plank
- E: joint between wheel planks.

Drawn by: T. Korošec.



Sl. 8.9: Dimenzije kolesa in njegovih delov:

- premer:  $a_0 = 71,2$  cm
- širina deske A1:  $a_1 = 41,6$  cm
- širina deske A2:  $a_2 = 29,6$  cm
- širina pesta:  $c_1 = 5,8$  cm
- širina pesta:  $c_2 = 6,8$  cm
- debelina kolesa: na najdebelejšem osrednjem delu =  $\sim 6$  cm.

Risba: T. Korošec.

Fig. 8.9: Dimensions of the wheel and its parts:

Dimensions of the wheel:

- diameter:  $a_0 = 71.2$  cm
- width of plank A1:  $a_1 = 41.6$  cm
- width of plank A2:  $a_2 = 29.6$  cm
- width of hub:  $c_1 = 5.8$  cm
- width of hub:  $c_2 = 6.8$  cm
- thickness of the wheel: thickest central part =  $\sim 6$  cm.

Drawn by: T. Korošec.

→  
Sl. 8.10 / Fig. 8.10  
Sl. 8.11 / Fig. 8.11

Prazgodovinsko kolo s Starih gmajn je bilo narejeno kot poln disk z odprtino štirikotne oblike na sredini. Disk je bil sestavljen iz dveh desk (A1 in A2), ki sta širinsko spojeni (topi spoj) s štirimi grebenastimi letvami (B1–B4).

Deski sta iz lesa jesena (*Fraxinus excelsior*) s širokimi branikami iz debla premera nad 40 cm in starosti nad 80 let. Deblo je bilo iz drevesa večjih dimenzij, za razliko od debel, ki so jih uporabljali za vertikalne kole bivališč, za katere so bili najbolj zaželeni premeri okoli 10 cm. Iz istega debla so torej izdelali dve deski za obe polovici kolesa (A1 in A2). A1 je bila bliže strženu, vendar ni vsebovala stržena in branik neposredno ob njem (sl. 8.13). Bila je radialno orientirana. Deska A2 je bila v drevesu bolj oddaljena od stržena, zato pri njej radialna orientacija prehaja v tangencialno. Pri tem so upoštevali splošno znano pravilo, po katerem so dimenzijsko najstabilnejše radialne deske brez stržena in juvenilnega lesa okoli njega. Osrednji del debla, ki tu ni bil vključen, tudi sicer praviloma vsebuje les slabših lastnosti (sl. 8.12).

Glede na razpoložljivo prazgodovinsko tehnologijo so desko iz debla zelo verjetno izdelali s cepljenjem (klanjem) in tesanjem, saj kovinske žage, ki bi bila primerna za takšno opravilo, v 4. tisočletju pr. Kr. naj še ne bi poznali.<sup>15</sup> Za izdelavo kolesa so potrebovali približno 80 cm dolg kos hloda z lesom brez rastiških napak. Iz njega so nato odcepili dve deski debeline nad 6 cm (sl. 8.13). Ker je kolo izdelano iz dveh desk (A1 in A2), je bila pomembna obdelava robov, saj so ju širinsko topo spojili. Nato so izdelali štiri lastovičje utore trapezoidne oblike, ki so se izmenoma nekoliko ožali od leve proti desni oz. od desne proti levi (sl. 8.10b, 8.11b). Tako so se izmenjevali utori, ki so imeli ožji del na levi in desni strani.

<sup>15</sup> F. M. Feldhaus, Die Säge, 1921, v: <http://www.sbg.at/sendlhofer/geschichte/geschichte.htm>; Stappel 2007.

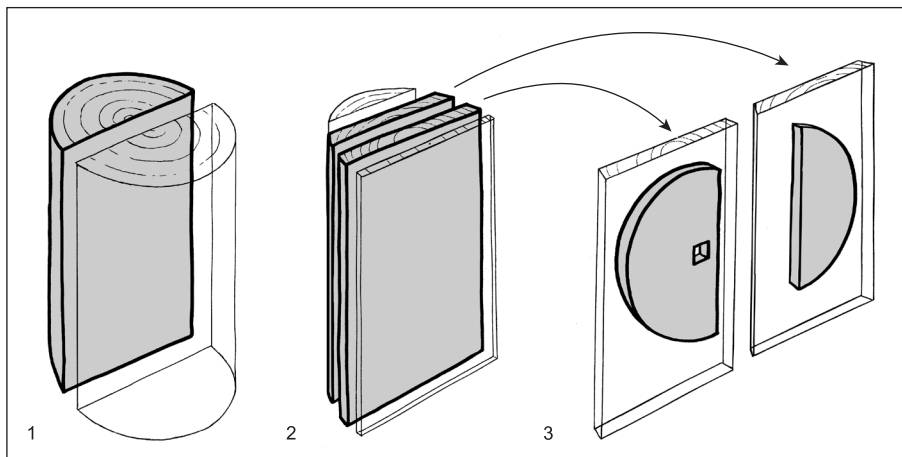


Sl. 8.12: Prečni prerez jesenovega debla. Osrednjemu delu, ki je na sliki temno obarvan in razpokan, so se pri izdelavi kolesa izognili, saj praviloma vsebuje les slabših lastnosti. Foto: M. Zupančič.

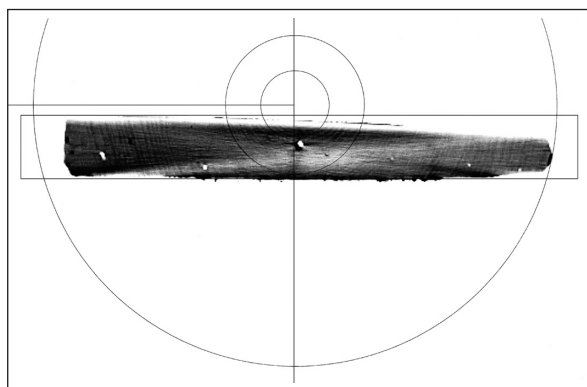
Fig. 8.12: Ash trunk; cross-section. The central part, which is darker and checked, was not used for making the wheel, as it generally contains low-grade wood. Photo: M. Zupančič.

Considering the available prehistoric technology, the plank was most probably made by splitting (cleaving) and hewing, as metal saws, suitable for such task, were not known in the 4<sup>th</sup> millennium BC.<sup>15</sup> C. 80 cm long piece of logwood without growth anomalies was needed for making the wheel. Two planks over 6 cm thick were then (Fig. 8.13) split off the log. As the wheel has been made of two planks (A1 and A2), the handling of edges was important, because they were horizontally tongue-and-groove spliced. Then four trapezoidal-shaped dovetail grooves were made, alternating in narrowness from left to right or from right to left (Figs. 8.10b, 8.11b).

<sup>15</sup> F. M. Feldhaus, Die Säge, 1921, in: <http://www.sbg.at/sendlhofer/geschichte/geschichte.htm>; Stappel 2007.

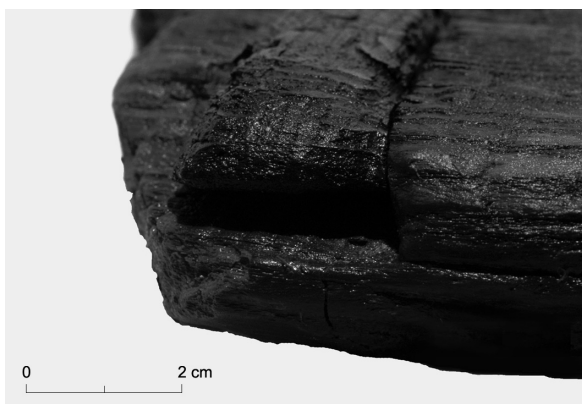


Sl. 8.13: Položaj desk za izdelavo kolesa v deblu (1, 2) in položaj kolesnih desk A1 in A2 v radialnih deskah (3). Risbe: T. Korošec.  
Fig. 8.13: Position of planks used for making a wheel in log (1, 2) and position of the wheel planks A1 and A2 in radial boards (3). Drawn by: T. Korošec.



Sl. 8.14: CT kolesne deske A1, kjer so vidne branike. Pripravil: M. Pflaum.

Fig. 8.14: CT of the wheel plank A1 with visible annual rings. Prepared by: M. Pflaum.



Sl. 8.16: Pogled na grebenasto letev B3, kjer je viden potek branik pravokotno na kolesno desko A2. Foto: M. Zaplatil.

Fig. 8.16: Batten B3 with visible annual rings running vertically to the wheel plank A2. Photo: M. Zaplatil.

V utore so zabili enakomerno široke letve, ki so se v ožjem delu utora zagodile. Tako izdelana lastovičja vez je omogočila, da sta bili deski trdno spojeni navkljub pričakovanemu krčenju in nabrekanju lesa.

Vloga štirih grebenastih hrastovih letev (B1–B4) (sl. 8.10b, 8.11b) je torej povezovanje desk. Od kakovosti izdelave utorov in letev, njihovega prileganja in namestitve je odvisna tudi trdnost kolesa.

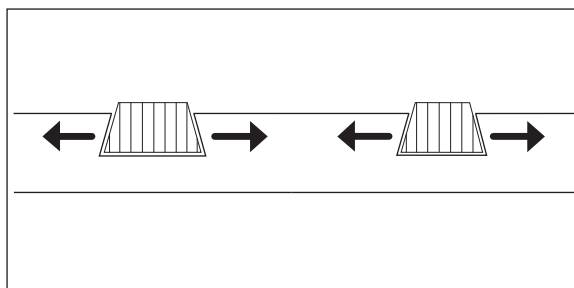
Letve so v preseku izdelane v obliki t. i. lastovičjega repa (sl. 8.15), po dolžini pa v konus. To pomeni, da sta na isti deski konca sosednjih grebenastih letev izmenično pahljačasto koničasta oz. koničasto pahljačasta (sl. 8.10b, 8.11b).

Ni natančno znano, ali so morda obe deski pred izdelavo utorov začasno pritrđili skupaj in ali so pri tem uporabili luknji ovalne oblike: D1 in D2, ki ju najdemo na obeh deskah (sl. 8.10, 8.11). Prvotno so verjetno bile štiri take odprtine (glej sl. 8.8). Po mnenju J. Samsa, ki je



Sl. 8.15: Grebenasti letvi B1 in B2 s presekom v obliki t. i. lastovičjega repa na kolesni deski A2. Foto: M. Turk.

Fig. 8.15: Battens B1 and B2 with cross-sections in the shape of a so-called dovetail on the wheel plank A2. Photo: M. Turk.



Sl. 8.17: Radialno orientirane grebenaste letve v kolesu (branike v letvah na sliki potekajo navpično). Nabrekanje (in krčenje) lesa v smeri puščic je tako manjše, kot če bi bil les orientiran tangencialno. Risba: T. Korošec.

Fig. 8.17: Radially oriented battens in the wheel (batten's annual rings running vertically). Swelling (and shrinkage) of wood in the direction of the arrows is smaller as it would be if oriented tangentially. Drawn by: T. Korošec.

As a result, grooves with narrower left and right sides were alternating.

Evenly wide battens that served as tongues were then fitted into the grooves. They were wedged into narrower parts of grooves. Dovetail grooves allowed solid splicing of the planks, in spite of expected shrinkage and swelling of wood.

The function of the four oak battens (B1–B4) (Figs. 8.10b, 8.11b) was linking the planks. Moreover, strength of the wheel depends upon the quality of making of grooves and battens, of fitting and insertion of them.

Battens are of a so-called dovetail (Fig. 8.15) shape in cross-section and cone-shaped longitudinally; i.e. ends of adjoining battens are alternately fanlike-pointed or pointed-fanlike on the same plank (Figs. 8.10b, 8.11b).

It is not known for certain if the two planks were temporary attached to one another before making the grooves and if the two oval shaped holes, D1 and D2



izdelal kopijo kolesa in osi, so luknje verjetno rabili samo pri izdelavi kolesa. Zaradi potrebe po čim natančnejšem prilaganju grebenastih letev in utorov je bilo najprej treba natančno in v ravni liniji speljati uture čez obe deski. Da je prazgodovinski kolar pri delu lahko dosegel takšno natančnost, je pred tem moral deski povezati, kar je verjetno naredil s pomočjo štirih lukenj, skozi katere je speljal povezovalni element rastlinskega ali živalskega izvora. Na Starih gmajnah smo v neposredni bližini kolesa, v sondi 2, npr. našli ostanke preje rastlinskega izvora, ki bi lahko služila tudi za izdelavo vrvi.<sup>16</sup> Po vstavitvi grebenastih letev v uture ni bilo več potrebe po dodatnem učvrščenju, zato ob odkritju v kolesu ni bilo ostankov vrvi ali podobnega materiala.

Grebenaste letve so bile izdelane iz hrastovega lesa trapezoidne oblike in radialno orientirane, tako da je bilo krčenje in nabrekanje letev po njihovi širini minimalno (sl. 8.17). Utori in letve so bili zelo skrbno izdelani, tako da je bilo prilaganje izredno natančno.

Kolo je imelo obliko diska, ki je bil na najdebelejšem osrednjem delu debel približno 6 cm. Ker je bilo iz masivnega lesa, je tehtalo več kot 20 kg, saj znaša gostota zračno suhega jesenovega lesa okoli 700 kg/m<sup>3</sup>.<sup>17</sup> Z večanjem debeline bi sicer lahko dosegli še večjo trdnost, ki bi bila zaželena, hkrati pa bi bilo kolo tudi težje, kar ni bilo zaželeno. Z diskasto obliko, deski sta bili debelejši na sredini in zožani proti robu, so tako verjetno dosegli kompromis med trdnostjo in maso.

Z orientacijo lesa, kolo je bilo izdelano iz radialnih desk brez stržena in juvenilnega lesa, so izdelali kolesno desko, ki je izkazovala najmanjše možno krčenje po širini (sl. 8.14, 8.18–8.20). Če bi bila jesenova deska v deblu orientirana tangencialno, bi bilo krčenje precej večje, saj znaša totalni skrček od napojenega do absolutno suhega stanja lesa v tangencialni smeri 7 %, v radialni pa 4,5 % oz. se les glede na podatke o diferencialnem nabreku (q) ob spremembi vlažnosti lesa za 1 % skrči v tangencialni smeri za 0,38 %, v radialni pa za 0,21 %.<sup>18</sup>

Izbor lesa za kolo je bil zelo smiseln, saj je jesenov les zelo žilav oz. ima veliko dinamično trdnost, ki je potrebna za izdelek, kot je kolo. Jesenovega lesa je bilo v bližini kolišč dovolj.<sup>19</sup> Pomembno je tudi, da jesen lahko zraste v veliko drevo, saj so za desko potrebovali drevo z deblom brez grč in premerom nad 40 cm. Lastnosti lesa, tudi gostota in trdnost, so pri posamezni lesni vrsti variabilne, zato so pri izbiri pomembne tudi značilnosti posameznega kosa lesa in njegove orientacije. Pri jesenu je najtrdnější les širših branik.<sup>20</sup> Prav take so bile branike

<sup>16</sup> Glej poglavje 15 v tem zborniku in tam navedeno literaturo.

<sup>17</sup> H. G. Richter in M. Oelker, INTKEY MACROHOLZDATA: Innovative digital tool for macroscopic wood identification and information retrieval for educational facilities and professionals in wood industry and trade: Computer programme; 2002 in dalje.

<sup>18</sup> Glej op. 17.

<sup>19</sup> Glej npr. Culiberg, Šercelj 1991 in poglavje 7 v tem zborniku.

<sup>20</sup> Čufar 2006.

(Figs. 8.10, 8.11), present on both planks, were used for this. Most likely, four such openings existed primarily (see Fig. 8.8). According to J. Samsa, who made a replica of the wheel and its axle, they probably needed these holes only while making the wheel. Accurate fixing of battens and grooves required precisely levelled grooves on both planks. In order to achieve such accuracy, the prehistoric wheelwright had to first fasten the planks to one another. This was probably done with the help of four holes through which a connecting element of vegetal or animal origin was tied. Remains of yarn of vegetal origin were found in direct vicinity of the wheel, in trench 2. It could perhaps be used for making a rope.<sup>16</sup> There was no need for additional fitting after battens were fitted into grooves. This is perhaps the reason why remains of rope or similar material were not found next to the wheel.

Battens were made of oak wood. They were of a trapezoid shape and radially oriented in order to achieve minimal shrinkage and swelling (Fig. 8.17). Grooves and battens were made very carefully and affixing was extremely accurate.

The wheel was disc-shaped and c. 6 cm thick in its central part. It was made of massive wood and therefore weighing over 20 kg, as the density of dry ash wood is c. 700 kg/m<sup>3</sup>.<sup>17</sup> If thicker, the wheel could be even stronger. However, it would also be heavier. With its disc shape; planks were thicker in the centre and thinning towards the rim; they probably achieved a compromise between the wheel's strength and weight.

The wheel was made of radial planks without the pith and juvenile wood. They achieved minimal contraction of planks with radial orientation (Figs. 8.14, 8.18–8.20). If ash plank would be oriented tangentially, contraction would be higher, as the total shrinkage from water saturated to oven dry condition of wood amounts 7 % tangentially and only 4.5 % radially. Moreover, considering data of differential swelling (q) at 1 % change of moisture content of wood, ash wood shrinks 0.38 % tangentially and 0.21 % radially.<sup>18</sup>

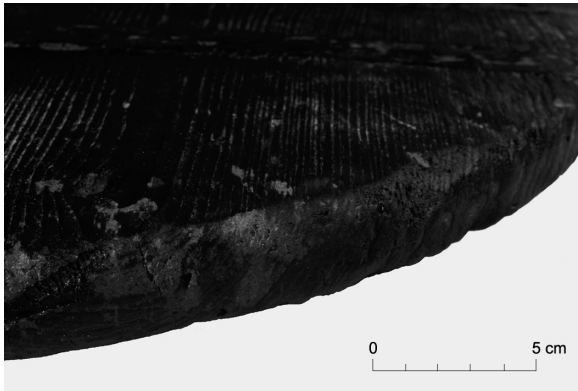
Selection of wood was very rational as ash wood is very tough, i.e. it has high impact strength, which is necessary for a product such as a wheel. There was enough ash wood near pile-dwellings.<sup>19</sup> It is also important that ash trees can grow big, because they needed a tree with a trunk without knots and with a diameter of over 40 cm. Characteristics of wood, its density and strength vary within an individual wood species. That is

<sup>16</sup> See Chapter 15 in this monograph and there cited bibliography.

<sup>17</sup> H. G. Richter in M. Oelker, INTKEY MACROHOLZDATA: Innovative digital tool for macroscopic wood identification and information retrieval for educational facilities and professionals in wood industry and trade: Computer programme - 2002, onwards.

<sup>18</sup> See Footnote no. 17.

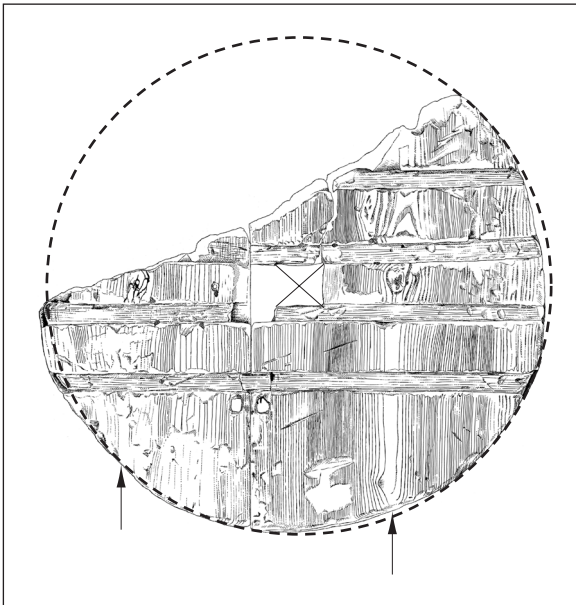
<sup>19</sup> See e.g. Culiberg, Šercelj 1991 and Chapter 7 in this monograph.



Sl. 8.18: Kolesna deska A1. Detajl z branikami, ki potekajo pravokotno na letve. Foto: M. Zaplatil.  
 Fig. 8.18: Wheel plank A1. Detail with annual rings running vertically to battens. Photo: M. Zaplatil.



Sl. 8.20: Kolesna deska A1. Pogled na branike v smeri grebenastih letev. Foto: M. Zaplatil.  
 Fig. 8.20: The wheel plank A1. View on annual rings oriented perpendicularly to the direction of battens. Photo: M. Zaplatil.



Sl. 8.19: Kolo s Starih gmajn postavljeno v idealno krožnico. S puščicama je označeno mesto, ki je najbližje strženu drevesa. Risba: T. Korošec. Ni v merilu.  
 Fig. 8.19: The wheel of Stare gmajne positioned within a perfect perimeter. The area closest to the pith is marked with arrows. Drawn by: T. Korošec. Not in scale.

pri lesu kolesa s povprečno širino 2,7 mm, kar potrjuje zelo skrben in smiseln izbor lesa. Izbrani les je zato imel dokaj visoko gostoto, trdnost ter trdoto in je imel visoko obrabno odpornost, kar je pomembno za življenjsko dobo kolesa. Izbor lesa kaže na to, da so les jesena, ki so ga dobro poznali in množično uporabljali za nosilne kole bivališč, znali optimalno izkoristiti tudi za specialen izdelek, kot je kolo.

Upoštevanje krčenja in nabrekanja lesa je pri izdelku, kot je kolo, prav tako zelo pomembno, saj je bilo izpostavljeno navlaževanju (dež, vožnja po mokrem) in

why characteristics of individual piece of wood and its orientations are also important at selection. Ash wood with wider annual rings has the best mechanical properties.<sup>20</sup> Moreover, annual rings with an average width of 2.7 mm confirm very careful and rational selection of wood. Wood chosen, had rather high density, strength and hardness and had high impact resistance, which is important for functioning of the wheel. Selection of wood shows that the knowledge of ash wood, which was used massively for foundation piles of the buildings, was also optimally utilized for special products, such as wheels.

Consideration of shrinkage and swelling of wood is very important, because the wheels are exposed to moisture (rain, wet ground) and drying, which is intense when exposed to hot sun. When used in this way, moisture of wood can vary 5–10 %. As shrinkage in radial direction is twice as low as tangentially, wood was rationally oriented (radial plank). Selection of ash wood also makes sense, as it has greater dimensional stability as oak or beech wood, which otherwise have comparable density and mechanical properties to ash. The fact that ash has always been the most popular wood species in wheelwright's trade, used for making wooden wheels, and that it is still the most common wood species used for products requiring high impact strength of wood (e.g. sport equipment and tool handles), prove that wood was chosen rationally.

Battens were made of oak wood. An important advantage of oak in contrary to ash is that oak has coloured heartwood, which is naturally resistant against biological deterioration. The use of heartwood assures better durability of wooden products that are in contact with the ground or are exposed to moisture. Density and strength of oak are analogous to ash. However, ash wood is generally more suitable for dynamic loads. Hygroscopic shrinkage and swelling of oak wood is larger as at ash wood. Production of battens required straight wood as well. Only wood with wide annual rings and with

<sup>20</sup> Čufar 2006.

sušenju, ki je predvsem ob izpostavitvi sončni pripeki zelo intenzivno. Pri uporabi kolesa je zato vlažnost lesa lahko variirala za 5–10 %. Ker je krčenje v radialni smeri dvakrat manjše kot v tangencialni, je bil les smiselno orientiran (radialna deska). Tako je smiselna izbira lesa jesena tudi zato, ker ima večjo dimenzijsko stabilnost kot na primer les hrasta ali bukve, ki imata sicer primerljivo gostoto in trdnost. Da je bil les smiselno izbran, priča tudi to, da je bila jesenovina še tisočletja po tem glavna lesna vrsta v kolarstvu, torej za izdelavo koles, dokler so bila ta še lesena, in je še danes vodilna domača lesna vrsta za izdelke, ki so dinamično obremenjeni (npr. športno orodje in ročaji orodij).

Letve so bile narejene iz hrastovega lesa. Pomembna prednost hrastovega lesa pred jesenovim je ta, da ima hrast obarvano jedrovino, ki je naravno odporna proti biološkimi škodljivcem. Uporaba jedrovine zagotavlja daljšo življenjsko dobo lesenim izdelkom, ki so v stiku s tlemi ali so izpostavljeni navlaževanju. Gostota in trdnost hrastovine sta podobni kot pri jesenovini, s tem da slednjo vedno omenjajo kot primernejšo za dinamične obremenitve. Higroskopsko krčenje in nabrekanje lesa hrasta je večje kot pri lesu jesena. Tudi za letve so potrebovali ravno raščen les. Izbrali so les s širšimi branikami brez rastnih anomalij. V izdelku je bil les strogo radialno orientiran, tako da je bilo krčenje grebenastih letov po širini (gledano na kolo) najmanjše (sl. 8.15–8.17).

Na osnovi omenjenih lastnosti ne moremo natančno pojasniti, ali so bile letve narejene iz hrastovega lesa zaradi izstopajočih lastnosti hrastovine ali morda samo zato, ker so po naključju imeli na razpolago ustrezen hrastov les.

Iz naštetega je razvidno, da je prazgodovinski kolar odlično poznal lastnosti lesa in da ga je znal optimalno izbrati in uporabiti. Dobro je poznal lesne vrste in tudi variabilnost lastnosti lesa iste vrste ter jih znal s pravilno izbiro, orientacijo in obdelavo izkoristiti. Izdelava kolesa je zahtevala veliko natančnost obdelave. Zato je moral kolar izbrati oz. pripraviti tudi ustrezno orodje in ga spretno uporabiti. Ko gledamo izdelek, lahko potrdimo, da ga je naredil izkušen in izkušen mojster. Kolo torej ni eksperimentlani poskus začetnikov, temveč očitno produkt predhodne dolgotrajne tehniške tradicije.

### 8.3.1.2 PESTO

Središčno odprtino na kolesu imenujemo pesto, ki je pri kolesu s Starih gmajn štirikotne oblike (glej sl. 8.10, 8.11). Gre za ključni element, ki najdubo opredeljuje za kolo vozila, posebno še, ker je bil v pesto vstavljen dobro prilagajajoči se konec osi a1 (glej sl. 8.4, 8.6, 8.21–8.23). Os se je vrtela skupaj s kolesom, kar kaže, da je bilo vozilo dvokolesno. To predstavlja ugodno konstrukcijsko rešitev za premo gibanje na slabih hribovitih terenih.<sup>21</sup>

<sup>21</sup>Schlichtherle 2002, 31.

no growth anomalies was useful for such purpose. Wood was strictly radially oriented so that shrinkage of batten widths was as low as possible (Figs. 8.15–8.17).

We cannot explain, based on the characteristics mentioned, whether battens were made of oak wood because of oak's characteristics, or perhaps only because they happened to have suitable oak wood available at the time.

We can conclude from above that prehistoric wheelwright was aware of characteristics of wood, and he knew how to select and use wood optimally. He was familiar with wood species, as well as with variability of wood properties within the same species; he utilized the advantages of wood with its correct selection, orientation and handling. Producing a wheel demanded precise processing of wood. That is why the wheelwright also had to choose and prepare suitable tools and use them with skill. We can confirm that a skilled wheelwright produced the wheel. A wheel is not an experimental product, but obviously a product of long-term technical tradition and knowledge.

### 8.3.1.2 HUB

A hub is the central opening on a wheel; it is of a rectangular shape on the wheel from Stare gmajne (see Figs. 8.10, 8.11). It is the key element, which verifies that this is a wheel belonging to some sort of a vehicle, particularly because the well fitted end of the axle a1 was fixed into the hub (see Figs. 8.4, 8.6, 8.21–8.23). The axle was turning simultaneously with the wheel, which indicates that the cart was two-wheeled. This is an excellent constructional solution for stable and continuous movement over hilly land.<sup>21</sup>

## 8.3.2 WOODEN AXLE

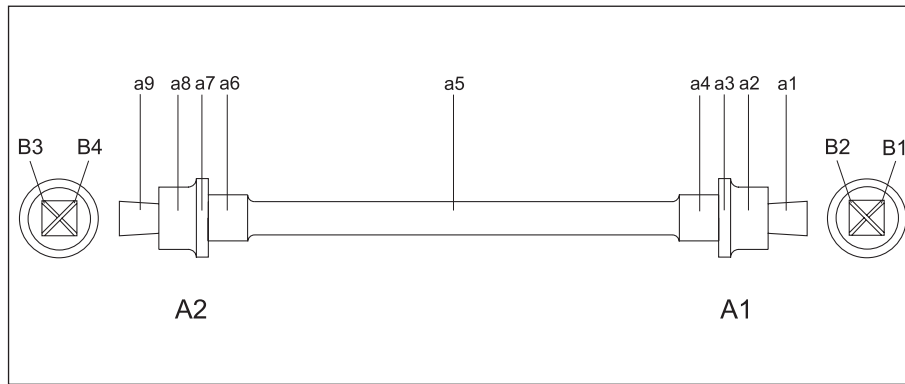
### 8.3.2.1 AXLE BAR

An axle is a central shaft for a rotating wheel. In this case, the wooden axle is straight and symmetrical, with circular and rectangular (at each end) cross-section (Figs. 8.22, 8.23). Both end pieces (A1 and A2) have wedges fixed into the axle (B1–B4).

The axle from Stare gmajne is made of a single piece of oak wood (Figs. 8.22, 8.24). They used a piece of straight stem without knots or other anomalies with a diameter of at least 20 cm.

As mentioned before, strength and hardness of oak and ash wood are similar. Heartwood in the centre of a stem has larger resistance against biological deterioration and the thin sapwood around it is not resistant. It was important that stem was straight and without growth anomalies. It appears, they had a suitable oak trunk available, which is perhaps the main reason for using this wood.

<sup>21</sup>Schlichtherle 2002, 31.



Sl. 8.21: Oznake delov osi. Dimezije osi:

- dl. osi = 125,7 cm
- db. a5 = od 5,4 cm do 6,7 cm; na sredini = 6,1 cm.

Risba: T. Korošec.

Fig. 8.21: Parts of the axle. Dimensions of the axle:

- length = 125.7 cm
- diameter a5 = 5.4 to 6.7 cm; centre = 6.1 cm.

Drawn by: T. Korošec.

## 8.3.2 LESENA OS

### 8.3.2.1 DROG

Po definiciji je os drog, ki prenaša vrtenje (na kolo). V našem primeru gre za lesen simetrično izdelan raven drog okroglega in na koncih štirikotnega preseka (sl. 8.22, 8.23). Na obeh straneh (A1 in A2) so v os zabite zagozde (B1-B4).

Os s Starih gmajn je izdelana iz enega kosa lesa hrasta (sl. 8.22, 8.24). Očitno so v ta namen uporabili kos ravnega debla brez grč in drugih napak premera vsaj 20 cm.

Kot že omenjeno, je po trdnosti in trdoti les hrasta podoben lesu jesena. Jedrovina na sredini debla ima večjo odpornost proti biološkim škodljivcem, ozka beljava na zunanjem delu pa je neodporna. Pomembno je bilo, da je bilo deblo ravno in brez rastiških napak. Zdi se, da so imeli na razpolago primerno hrastovo deblo, kar je morda glavni razlog za uporabo tega lesa.

Dolžina osi s Starih gmajn je pribl. 125 cm, kar pomeni, da je kolesnica merila pribl. 115 cm. Gre za razpon, ki je v spodnjem območju variacijske širine običajnih kolesnic pri prazgodovinskih vozovih in približno četrta metra krajši od moderne angleške standardne kolesnice, ki znaša 142,6 cm.<sup>22</sup> Kakor koli že, razpon kolesnice je bil verjetno odvisen od velikosti vprežne živali, namembnosti voza, razpoložljivosti poti idr. Krajša os torej ne bi omogočala vprege živali, voz bi se tudi hitreje prevrnil. Veliko daljša os pa bi bila bolj problematična s trdnostnih vidikov. Os je morala imeti tudi ustrezen premer, da je bila zagotovljena potrebna trdnost.

→  
Sl. 8.22 / Fig. 8.22  
Sl. 8.23 / Fig. 8.23



Sl. 8.24: CT prečnega prereza osi. Pripravil: M. Pflaum.

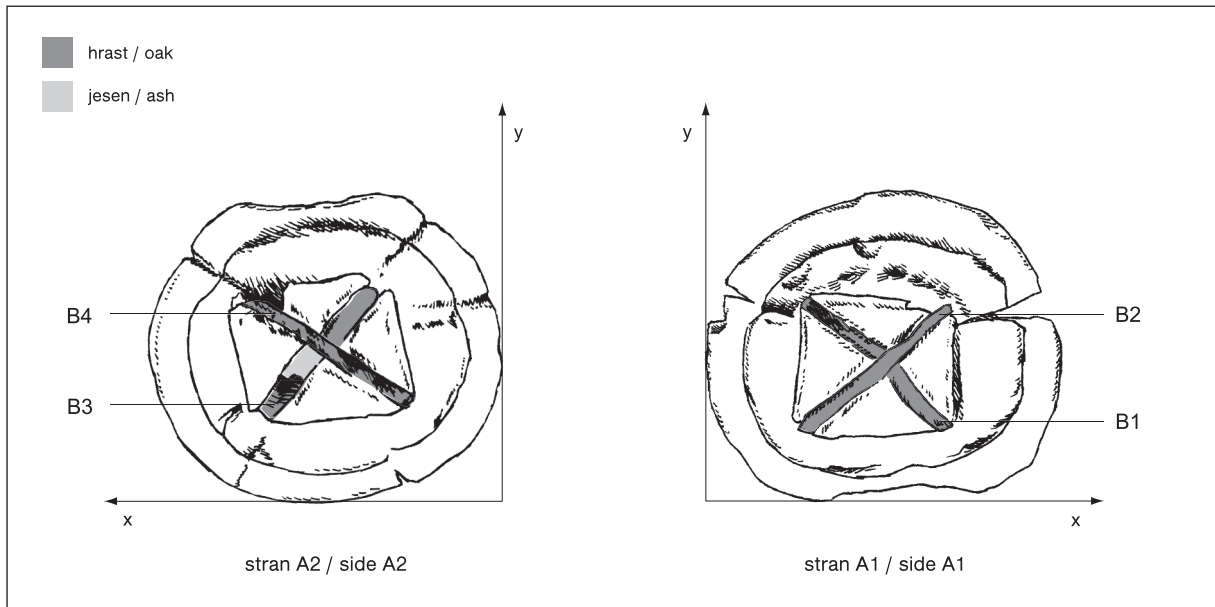
Fig. 8.24: CT of the axle's cross-section. Prepared by: M. Pflaum.

The axle from Stare gmajne is c. 125 cm long, which means, that the rut was c. 115 cm wide. This is a span that is in the lower range of the variation width of the usual ruts of prehistoric carts and c. 0.25 m shorter from a modern English standard rut, that is 142.6 cm.<sup>22</sup> Be that as it may, span of a rut probably depended upon the size of draught animal, intended usage of a cart, available routes etc. Shorter axle would not be suitable for draught animal and cart would be less stable. Moreover, much longer axle would be not as solid. An axle also had to have a suitable diameter, which ensured its necessary strength.

<sup>22</sup> Piggott 1983, 68; Burmeister 2002, sl. 6.

<sup>22</sup> Piggott 1983, 68; Burmeister 2002, Fig. 6.





Sl. 8.25: Konca osi (strani A1 in A2) z zagozdami. Risbi: T. Korošec. M = 1 : 3.

Fig. 8.25: Axle's end pieces (A1 and A2) with wedges. Drawn by: T. Korošec. Scale = 1 : 3.

### 8.3.2.2 KONCA OSI

Posebno obravnavo zaslužita tudi strani osi A1 in A2, ki sta na koncih a1 in a9 štirikotnega preseka (glej sl. 8.25, 8.26 in 8.28) ter se tako prilagata obliki pesta (prim. s sl. 8.10 in 8.11).

Na obeh koncih a1 in a9 najdemo po dve zagozdi<sup>23</sup> (sl. 8.25, 8.26). Identifikacija lesa zagozd (sl. 8.27) je pokazala, da so narejene iz hrastovine. V primeru zagozde

<sup>23</sup> Slovenski jezik pozna več izrazov za predmet, ki preprečuje, da kolo ne pade, zdrsne z osi, med katerimi naj omenimo še dva: osnik (Slovar slovenskega knjižnega jezika 3, Ljubljana 1979, 455) in lunek (Slovar slovenskega knjižnega jezika 2, Ljubljana 1975, 653).

### 8.3.2.2 AXLE'S END PIECES

Axle's end pieces A1 and A2, with rectangular cross-section ends a1 and a9 (see Figs. 8.25, 8.26 and 8.28), which fit into the hub (compare with Figs. 8.10 and 8.11), need to be mentioned.

Ends a1 and a9 contain two wedges each (Figs. 8.25, 8.26). Wedges were made of oak (Fig. 8.27). Moreover, the wedge B3 had a smaller ash wood wedge added later (Fig. 8.25: left). The wheel was perhaps falling off the axle, and it needed to be attached firmer. This is also what wedges are used for.

As the wheel detached itself from the axle, which broke off on the side A1 (Figs. 8.4 and 8.28), we can

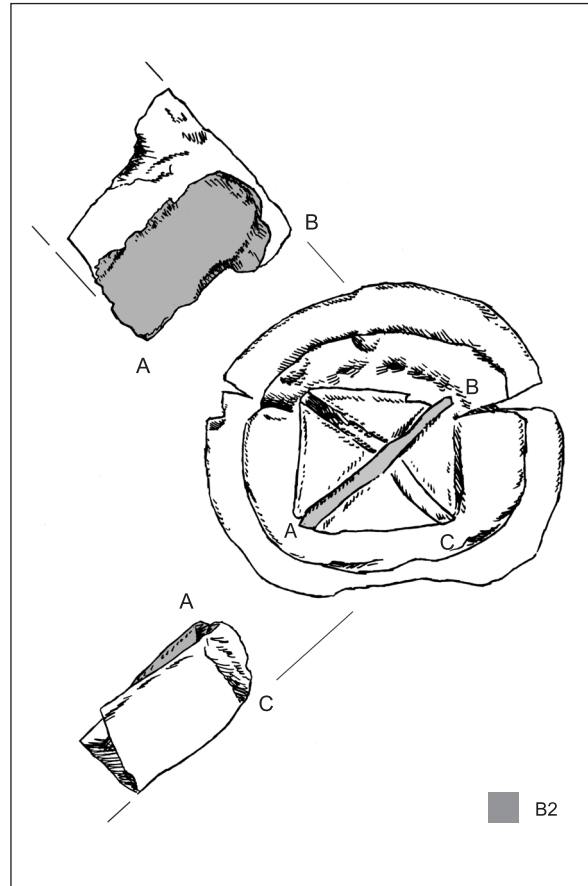


Sl. 8.26: Os. Stran A2 in stran A1. Foto: M. Turk.  
Fig. 8.26: Axle. End pieces A2 and A1. Photo: M. Turk.





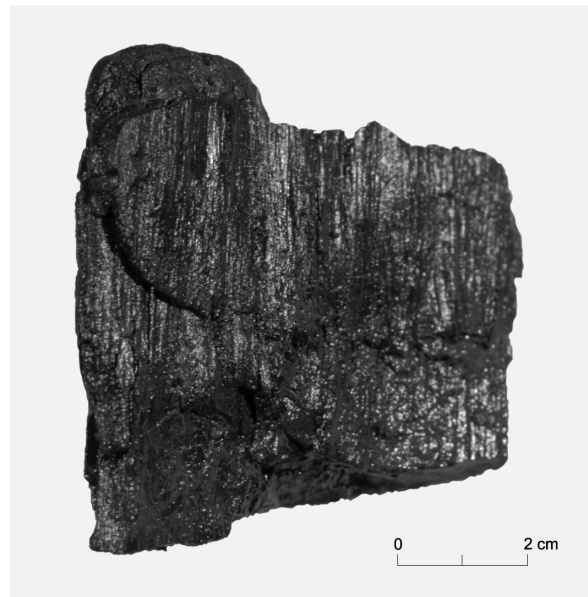
Sl. 8.27: M. Zupančič pri pripravi vzorca za identifikacijo lesa zagozd. Foto: M. Turk.  
 Fig. 8.27: M. Zupančič at preparation of a sample for identification of wood of wedges. Photo: M. Turk.



Sl. 8.29: Zagozda B2. Risba: T. Korošec. M = 1 : 3.  
 Fig. 8.29: Wedge B2. Drawn by: T. Korošec. Scale = 1 : 3.



Sl. 8.28: Os. Stran A1 z zagozdo B2. Foto: M. Turk.  
 Fig. 8.28: Axle. The end piece A1 with the wedge B2. Photo: M. Turk.



Sl. 8.30: Zagozda B2 v ležišču. Foto: M. Zaplatil.  
 Fig. 8.30: Wedge B2 in bed. Photo: M. Zaplatil.



Sl. 8.31: Zagozda B2. Pogled v smeri osi. Foto: M. Pflaum.  
Fig. 8.31: Wedge B2. View in direction of axle. Photo: M. Pflaum.

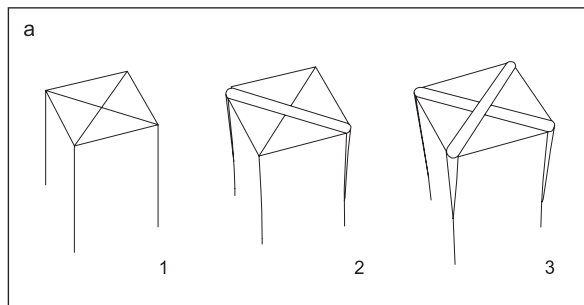
B3 pa je bila naknadno dodana manjša zagozda iz jese-novega lesa (sl. 8.25: levo). Verjetno se je kolo snemalo in ga je bilo treba pričvrstiti, kar je tudi funkcija zagozd.

Po zaslugi dejstva, da se je ob odkritju kolo snelo z osi in se je pri tem os na strani A1 odlomila (sl. 8.4 in 8.28), lahko rekonstruiramo tudi potek zabijanja zagozd v os. Na koncu osi a1 smo namreč naleteli na v celoti ohranjeno zagozdo B2 (sl. 8.28–8.31).

Zagozde so zabili po tem, ko je kolo že bilo natak-njeno na os (sl. 8.32). Pred tem so verjetno le pripravili ležišče (sl. 8.32a: 1).

Skratka, verjetno predhodno zasekana os je bila vstavljena v pesto. V primeru strani A1 je sledilo zabijanje zagozde B1 in šele nato zagozde B2; v primeru strani A2 pa je prišla najprej na vrsto zagozda B3 in nato B4 (sl. 8.25).

Dobro pritrjene zagozde so preprečevale ohlapno pritrnitev kolesa oz. njegovo snemanje. Ker les deluje, se krči in nabreka, je bilo vozilo zanesljivo treba vzdrževati in popravljati, kar kaže tudi že omenjena manjša zagozda ob zagozdi B3, ki je bila verjetno vložena naknadno (sl. 8.25: levo). Tudi grebenaste letve v utorih so verjetno pričvrstili z dodatnim zabijanjem, kadar je vez zaradi sušenja lesa postala ohlapna.



reconstruct the course of fitting of wedges into the axle. We came across an entirely preserved wedge B2 on the side a1 (Figs. 8.28–8.31).

Wedges were fitted after the wheel was already fixed onto the axle (Fig. 8.32). Some preparation was most likely done before this (Fig. 8.32a: 1).

Probably preliminarily incised axle was fitted into the hub. Wedge B1 was rammed first into the end piece A1 and wedge B2 second; wedge B3 and then B4 were rammed into the end piece A2 (Fig. 8.25).

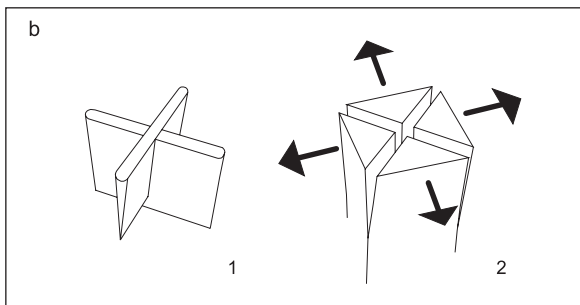
Well-fitted wedges made loosening of the wheel or falling off impossible. Wood shrinks and swells all the time, so the cart had to be maintained and repaired. Already mentioned smaller wedge next to the wedge B3, which was probably fitted later (Fig. 8.25: left), proves this. Battens were probably fitted to grooves also with additional fitting after the connection became loose because of drying of wood.

## 8.4 PRESERVATION OF THE WHEEL AND THE AXLE AND THEIR DAMAGE

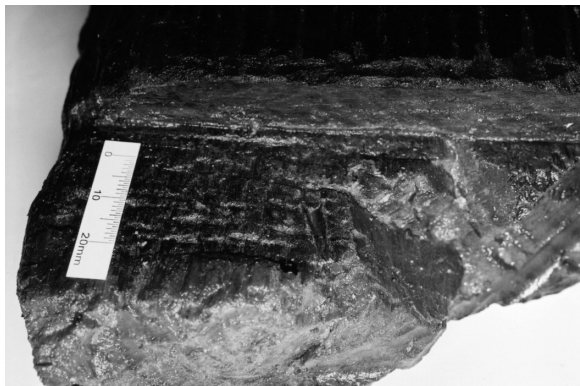
### 8.4.1 WHEEL DAMAGE

Several wheel damages were noticed. We classified them according to their origin.

*a) Planned or unplanned changes on the surface, which occurred during the process of making of the wheel:* the outer surface of the wheel is relatively smooth, while the inner surface (e.g. plank A1) shows visible traces of rougher chiselling (Figs. 8.10, 8.11). Manufacturing traces are also visible on battens (Figs. 8.10 and 8.39b). However, some of the individual cuts were unplanned, such as cut on the edge of the batten B3 on the wheel plank A1, for example (Fig. 8.11b). Damages, done during the processing, are seen as parallel cuts, visible in bed of the batten B3 (Fig. 8.33), as cuts on the batten B3 in the hub (Fig. 8.34) and as a gully with gouges in the corner of the hub on the wheel plank A1 (Fig. 8.35).



Sl. 8.32a in b: Prikaz postopka zagozdenja na podlagi najdbe s Starih gmajn. Risbe: T. Korošec.  
Fig. 8.32a and b: Wedging procedure, based on the find from Stare gmajne. Drawn by: T. Korošec.



Sl. 8.33: Vzporedne zareze v ležišču letve B3 na kolesni deski A2. Foto: M. Pflaum.

Fig. 8.33: Parallel cuts in bed of the batten B3 on the wheel plank A2. Photo: M. Pflaum.

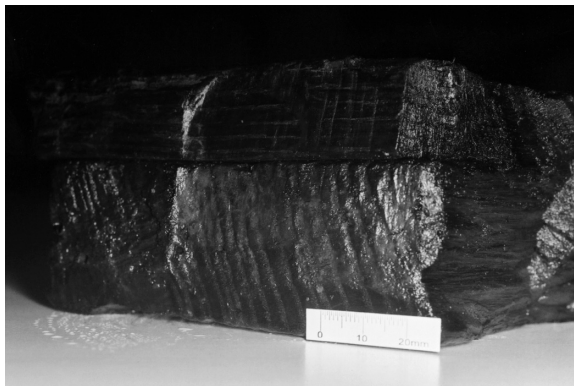
## 8.4 OHRANJENOST KOLESKA IN OSI TER POŠKODBE

### 8.4.1 POŠKODBE NA KOLESU

Na kolesu smo opazili več poškodb, ki smo jih po izvoru razdelili v različne kategorije.

**a) Načrtne ali nenačrtne spremembe na površju, nastale pri izdelavi kolesa:** zunanja stran kolesa je bila dokaj gladko in ravno obdelana, na notranji strani (npr. deska A1) pa so vidni sledovi bolj grobe obdelave z dletom ali podobnim orodjem (sl. 8.10, 8.11). Sledove izdelave lahko opazimo tudi na samih letvah (sl. 8.10 in 8.39b), s tem da so posamezne zareze nastale tudi nenačrtno kot npr. na koncu letve B3 na kolesni deski A1 (sl. 8.11b). Med poškodbe nastale pri izdelavi, uvrščamo tudi vzporedne zareze, ki so vidne v ležišču letve B3 (sl. 8.33), zareze na letvi B3 v pestu (sl. 8.34) in žleb z vdolbinami v vogalu pesta na kolesni deski A1 (sl. 8.35).

Na podlagi analogij iz jugozahodne Nemčije<sup>24</sup> smo bili pri preučevanju kolesa pozorni tudi na sledove morebitnega ožiganja na obeh kolesnih deskah in tudi na hrbitišču grebenastih letev (sl. 8.36). Pri pregledu kolesa se nam je zdelo, da bi bila površina lahko ožgana (sl. 8.37a). Domnevo je potrdil pregled lesa pod mikroskopom (sl. 8.37b), kjer lahko vidimo temno plast lesa (ogljja) na ožgani površini. Tega pa nam ni uspelo preveriti s kemijskimi analizami, pri katerih bi upoštevali, da je v normalnem lesu okoli 50 % ogljika, v kemijsko močno spremenjenem oglju pa je ta delež po pričakovanju bistveno višji. Ker je morebitna plast ogljika na površini zelo tanka, bi zato morali uporabiti metodo, pri kateri zadostuje za analizo že zelo majhna količina materiala.



Sl. 8.34: Pogled na pesto in grebenasto letev B3 na odlomljenem delu kolesne deske A1 (glej sl. 8.10 in 8.11). Razvidno je, da je bila letev vložena pred izdelavo pesta. Vidne so tudi krajše zareze, nastale s tesanjem oz. dolbenjem. Foto: M. Pflaum.

Fig. 8.34: View on the hub and the batten B3 on the broken part of the wheel plank A1 (see Figs. 8.10 and 8.11). It is visible that the batten was fitted before creating the hub. Short cuts, made by hewing or chiselling, are also visible. Photo: M. Pflaum.

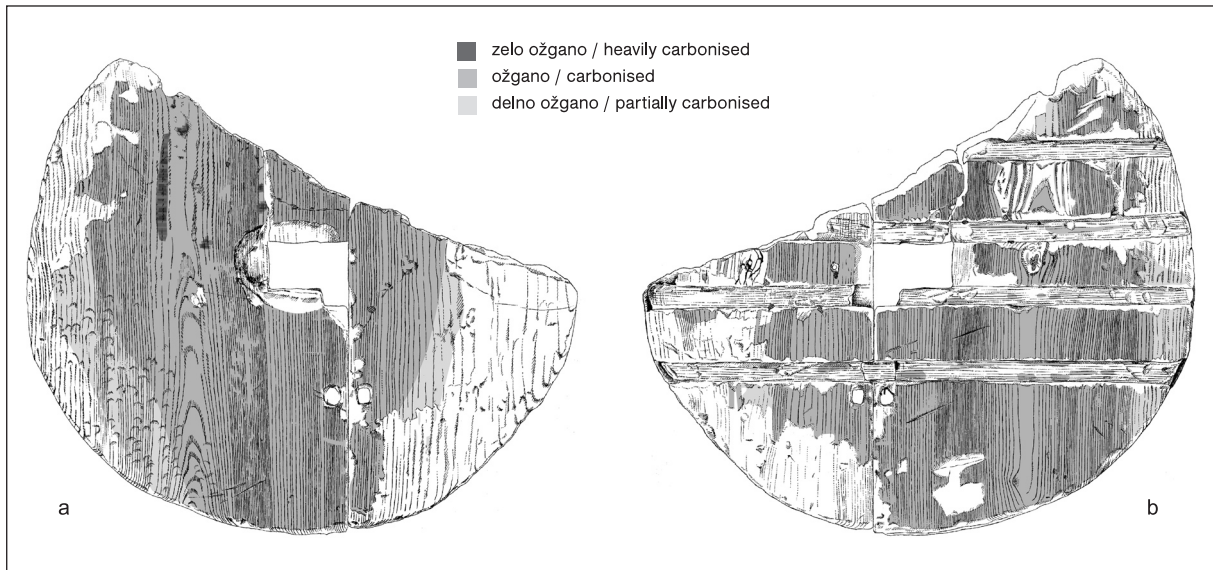


Sl. 8.35: Pogled na vogal v pestu z letvijo B3 (desno spodaj) na kolesni deski A1. Foto: M. Pflaum.

Fig. 8.35: View on the corner in the hub with the batten B3 (bottom right) on the wheel plank A1. Photo: M. Pflaum.

<sup>24</sup> Schlichtherle 2002, 20–23.





Sl. 8.36: Kolo. Svetlejša in temnejša, ožgana, območja na notranji (a) in zunanji (b) strani kolesa. Risbi: T. Korošec.

Fig. 8.36: The wheel. Brighter and darker, scorched, areas on the inner (a) and outer (b) surface of the wheel. Drawn by: T. Korošec.



Sl. 8.37: Sledovi ožiganja - (a) površina lesa na notranji strani kolesne deske A1 (foto: M. Pflaum) in (b) mikroskopski pogled lesa, odvzetega s površine deske (foto: M. Zupančič); temnejši približno 0,5 mm debel sloj predstavlja pooglenelo lesno tkivo. Merilna daljica 100  $\mu$ m.

Fig. 8.37: Traces of scorching - (a) wood on the inner surface of the wheel plank A1 (photo: M. Pflaum) and (b) microscopic view of wood taken from the surface of the plank (photo: M. Zupančič); darker, c. 0.5 mm thick layer is charred wood tissue. Scale bar: 100  $\mu$ m.

Po navedbah<sup>25</sup> so v preteklosti les ožigali, da bi povečali njegovo trdoto in ga zaščitili pred nekaterimi škodljivci. Poudariti pa je tudi treba, da se barva lesa jesena zaradi kemijskih sprememb v tisočletjih zelo spremeni (potemni), zato je dokazovanje ožiganja še toliko težavnejše.

**b) Poškodbe zaradi uporabe** so predvidljive in so posledica obrabe na najbolj obremenjenih mestih, kjer prihaja do trenja, npr. obraba oboda kolesa in mesta, kjer se je vrteča se os drgnila ob druge dele vozila.

Based on analogies from southwestern Germany,<sup>23</sup> we were also looking for traces of eventual scorching on both wheel planks and on the back of the battens (Fig. 8.36). It seems that the surface could be scorched (Fig. 8.37a). Examination of wood under a microscope confirmed this assumption (Fig. 8.37b); we could see a dark layer of wood (charcoal) on a scorched surface. We did not manage to check this with chemical analyses, where we would consider that there is c. 50 % of carbon present in normal wood and much more in chemically changed charcoal. As the suspected layer of carbon on the surface

<sup>25</sup> Schlichtherle 2002, 20.

<sup>23</sup> Schlichtherle 2002, 20-23.



Sl. 8.38: Pesto na notranji strani kolesne deske A1 z obrabljenim delom, kjer je bilo kolo v stiku z osjo. Foto: M. Pflaum.

Fig. 8.38: Hub on the inner side of the wheel plank A1 with worn part, where the wheel was rubbing against the axle. Photo: M. Pflaum.

Na sliki 8.19 je vidno, da kolo ni povsem okrogle oblike, tam, kjer so branike širše, je jesenov les trši. Obraba je večja na mestih, kjer vlakna potekajo vzporedno z obodom kolesa, in manjša tam, kjer vlakna potekajo pravokotno na obod. Poškodba je najverjetneje nastala tudi ob drgnjenju z osjo in je vidna tudi na notranji strani kolesa okoli pesta (sl. 8.38).

Drugih posebej vidnih poškodb, ki naj bi nastale zaradi uporabe na kolesu, nismo zaznali, pri čemer naj še enkrat poudarimo, da je les jesena dokaj trd. Trd je predvsem kasni les, ki prevladuje v lesu kolesa z relativno širokimi branikami.

c) Poškodbe, ki so nastale zaradi t. i. postdepozicijskih procesov, so bolj nepredvidljive in jih težje razložimo. Na osnovi stratigrafije in ohranjenosti, ki je možna

is very thin, we would have to use a procedure where a small amount of material is enough for analyses.

People were scorching wood in the past to harden it and to protect it against some pests.<sup>24</sup> It has to be emphasized that the colour of ash wood darkens over millennia due to chemical changes. That is why scorching is even harder to prove.

b) Use-wear damages are predictable and are a consequence of wear of the parts that are most burdened by friction, e.g. wear on the rim of the wheel and areas where the turning axle rubbed against other parts of the vehicle.

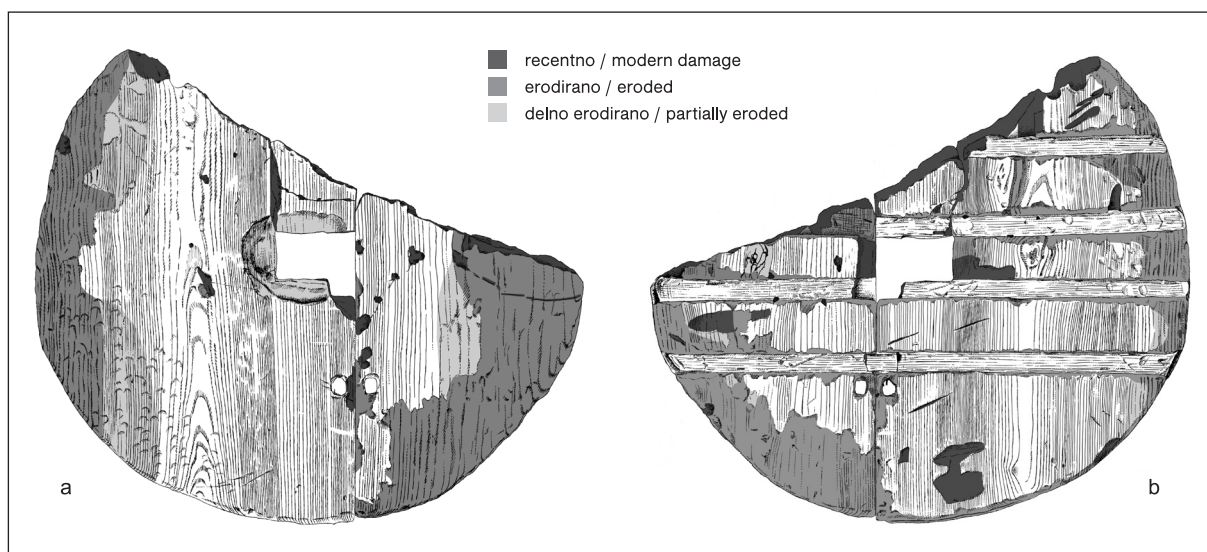
As seen on Fig. 8.19, the wheel is not completely circular; ash wood is harder on places where annual rings are wider. Wear out is faster where fibres run parallel with the rim of the wheel and slower where fibres run vertically to the rim. Damage most probably occurred at rubbing with the axle and is also visible around the hub on the inner surface of the wheel (Fig. 8.38).

There were no other visible damages that would occur at the use of the wheel. It has to be emphasized once more, that ash wood is relatively hard. Particularly hard is late wood which is predominating in the wood of which the wheel has been made.

c) Damage that occurred at so-called post-deposit processes is unpredictable and harder to explain. Based on stratigraphy and preservation, which occurs only underwater, where there is not enough oxygen for activity of destructive organisms, we could presume that the wheel was probably waterlogged after use.<sup>25</sup> Traces of

<sup>24</sup> Schilchtherle 2002, 20.

<sup>25</sup> Compare with Chapters 2 and 3 in this monograph.



Sl. 8.39: Kolo. Poškodbe na površju notranje strani kolesa (a) in poškodbe na površju zunanje strani (b). Risbi: T. Korošec.

Fig. 8.39: Wheel. Damages on the inner (a) and the outer (b) surfaces of the wheel. Drawn by: T. Korošec.





Sl. 8.40: Zunanja stran kolesne deske A2, kjer je na obodu kolesa vidna obrabljena površina. Foto: M. Zaplatil.

Fig. 8.40: Outer surface of the wheel plank A2; a worn surface is visible on the rim of the wheel. Photo: M. Zaplatil.

samo pod vodo, kjer ni kisika za delovanje destruktivnih organizmov, bi lahko sklepali, da je po končani uporabi kolo verjetno nekaj časa ležalo v vodi.<sup>26</sup> Sledovi obrabe so tako v veliki meri posledica ležanja v vodi in so vidni predvsem na zunanji strani kolesne deske A2 (sl. 8.40). Posledica tako nastalih procesov so verjetno tudi močno obrabljeni robovi utorov za letve (sl. 8.10b, 8.39b in 8.40). Ne smemo pa prezreti, da je do obrabe zaradi postdepozicijskih procesov prišlo šele po stoletjih oz. tisočletjih ležanja v vodi ali mokrih tleh, ko je bila kemijska zgradba lesa že zelo spremenjena.

č) Četrta kategorija poškodb so t. i. recentne poškodbe, ki so nastale zaradi recentnega rastlinja, predvsem pa neposredno ob odkritju kolesa in po njem, ko smo ga prenesli z arheološkega najdišča (glej sl. 8.39).

Približno tretjino kolesa je odrezal stroj za kopanje jarkov neposredno pred odkritjem kolesa. Pozneje, ko smo kolo odkrili in ga skušali odlepiti od blatne podlage, se je še dodatno prelomilo na več delov. Ob tem se je najbolj poškodovala kolesna deska A1, katere del pri pestu se je odlomil in izgubil. Manj pomembne, toda opazne so tudi poškodbe, nastale zaradi uporabe orodja pri arheološkem izkopavanju, in na koncu manjša poškodba, dolga dober cm, ki smo jo povzročili na obodu kolesa

wear are, in large degree, consequences of this and are visible mainly on the outer surface of the wheel plank A2 (Fig. 8.40). Strongly worn edges of grooves for battens are probably a result of the same processes (Figs. 8.10b, 8.39b and 8.40). However, we should not forget that the wear at post-deposit processes occurred after centuries or millennia in water or wet floor, when chemical structure of wood was already drastically changed.

d) The fourth category of damages are so-called recent damages that occurred because of recent vegetation and, mainly, directly at the discovery of the wheel and while removing it from the archaeological site (see Fig. 8.39).

Directly before the discovery of the wheel, JCB cut off approximate one third of it. Later, when we tried to detach the wheel from a muddy base, it got damaged even more. Wheel plank A1 was the most damaged one, with part at the hub broken off and lost. Less important, but still noticeable, are also damages, which occurred at archaeological excavation and, finally, a short, only a few cm long scratch, that had to be done on the rim of the wheel in order to measure annual ring widths – on the rim of the wheel plank A1, where annual rings are visible in a cross-section (Fig. 8.39b). We took c. 1 cm<sup>3</sup> of wood from the wheel and the axle for the purposes of the radiocarbon analysis (Fig. 8.47).

#### 8.4.2 AXLE DAMAGE

Similarly as on the wheel, we can notice several damages on the axle. We classified them according to their origin.

a) Planned or unplanned changes/damages on surface that were done while making the axle: as expected, there are only a few damages on the axle. Longer cuts on end pieces a1 and a9 are most visible. We can also see short cuts (Fig. 8.41) and gullies between individual differently thick parts (e.g. Fig. 8.42); all damage was done at the handling of wood for the axle.

We do not know whether the axle was scorched similarly as assumed for the wheel. Axle is made of oak and its heartwood blackened after being deposited in wet ground for millennia, which makes visual judgement difficult.

b) There are some more recent damages: they mostly occurred at the discovery and lifting of the find and later research. As on the wheel, plants penetrated also through the axle (Fig. 8.43).

<sup>26</sup> Prim. s poglavjema 2 in 3 v tem zborniku.

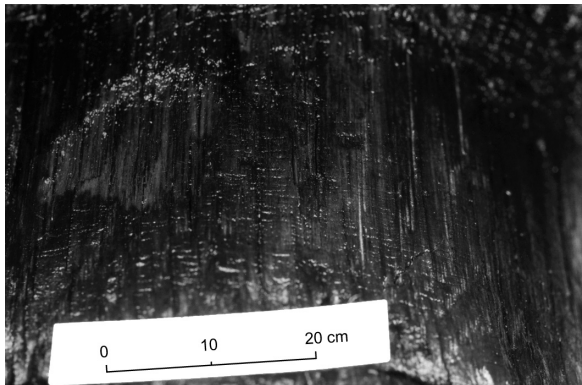
zaradi merjenja širin branik – na obodu kolesne deske A1, samo na mestu, kjer so branike vidne v prečnem prerezu (sl. 8.39b). Za radiokarbonsko analizo smo iz kolesa in osi odvzeli po 1 cm<sup>3</sup> lesa (sl. 8.47).

#### 8.4.2 POŠKODBE NA OSI

Podobno kot na kolesu smo tudi na osi opazili več poškodb, ki smo jih po izvoru razdelili v različne kategorije.

*a) Načrtne ali nenačrtne spremembe oz. poškodbe na površju, nastale pri izdelavi osi:* tovrstnih poškodb je na osi razmeroma malo, kar je pričakovano. Najvidnejše so daljše vreznine na koncih osi a1 in a9, opazni pa so tudi kratke zareze (sl. 8.41) in žlebovi med posameznimi različno debelimi deli (npr. sl. 8.42); vse je nastalo med obdelavo lesa za os.

Postavlja se vprašanje, ali je bila ožgana tudi os, podobno kot domnevamo, da je bilo ožgano kolo. Os je namreč narejena iz hrastovega lesa, katerega jedrovina je po tisočletjih v mokrih tleh počrnela, kar oteži vizualno presojo.



Sl. 8.41: Kratke zareze na odseku a4, nastale pri izdelavi osi. Foto: M. Pflaum.

Fig. 8.41: Short cuts in section a4, made during making of the wheel. Photo: M. Pflaum.

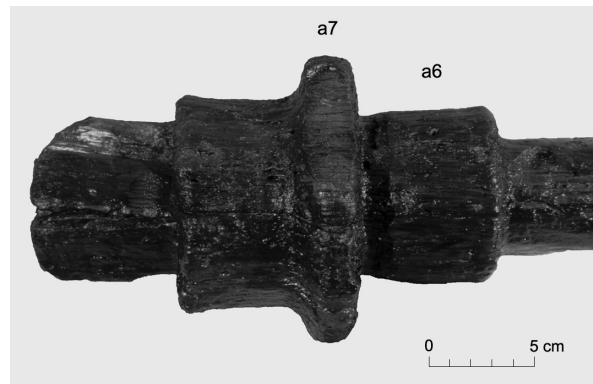
#### 8.4.3 MICROSCOPIC AND CHEMICAL CHANGES ON WOOD

Wood is basically a non-durable material and it repeatedly surprises us that it can last for several thousand years under certain circumstances. However, what kinds of changes appear on it after being underwater or in wet soil for millennia? Rather accurate data on changes of physical (e.g. density) and chemical properties of archaeological ash and oak wood from the Ljubljansko barje of comparable age to the wheel exist. 5000 years old archaeological ash wood has c. 6 times lower density as recent wood. Archaeological wood contains predominantly lignin (c. 70 %), while the proportions of cellulose and hemicelluloses are only c. 8 %. In contrary, recent ash wood contains c. 25 % lignin, 40 % cellulose and 35 % hemicelluloses.<sup>26</sup>

Changes of microscopic structure of archaeological wood are well investigated.<sup>27</sup> Under a microscope, we can see that the majority of wood-anatomical features are kept in archaeological wood (Figs. 8.44a, 8.44c). Cell

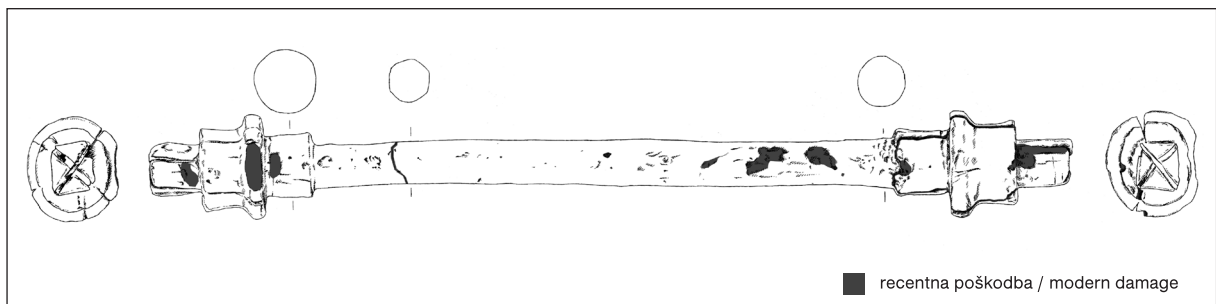
<sup>26</sup> Čufar, Gorišek, Tišler 2002.

<sup>27</sup> Čufar et al. 2008.



Sl. 8.42: Os. Stran A2 z žlebom med odsekoma a6 in a7. Foto: M. Zaplatil.

Fig. 8.42: Axle. Side A2 with a gully between sections a6 and a7. Photo: M. Zaplatil.



Sl. 8.43: Recentne poškodbe na osi. Risba: T. Korošec. Ni v merilu.

Fig. 8.43: Recent damages on the axle. Drawn by: T. Korošec. Not in scale.

b) *Nekoliko več je recentnih poškodb*: slednje so večinoma nastale pri odkrivanju oz. dvigovanju najdbe in poznejšem preučevanju. Tako kot na kolesu je bilo opaziti, da so si na nekaj mestih skozi os utrle pot rastline (sl. 8.43).

### 8.4.3 MIKROSKOPSKE IN KEMIJSKE SPREMEMBE NA LESU

Ker je les v bistvu netrajen material, nas vedno znova preseneča, da se v nekaterih okoliščinah lahko ohrani tudi več tisoč let. Ob tem se hkrati sprašujemo, kakšne spremembe je utrpel po tisočletjih pod vodo ali v mokrih tleh. Za arheološki les jesena in hrasta z Ljubljanskega barja primerljive starosti, kot je kolo, imamo na razpolago dokaj natančne podatke o spremembah fizikalnih (npr. gostote) in kemijskih lastnosti. 5000 let star arheološki les jesena ima približno 6-krat manjšo gostoto kot normalen les. V njem prevladuje lignin (pribl. 70 %), celuloze in hemiceluloz pa je le okoli 8 %, medtem

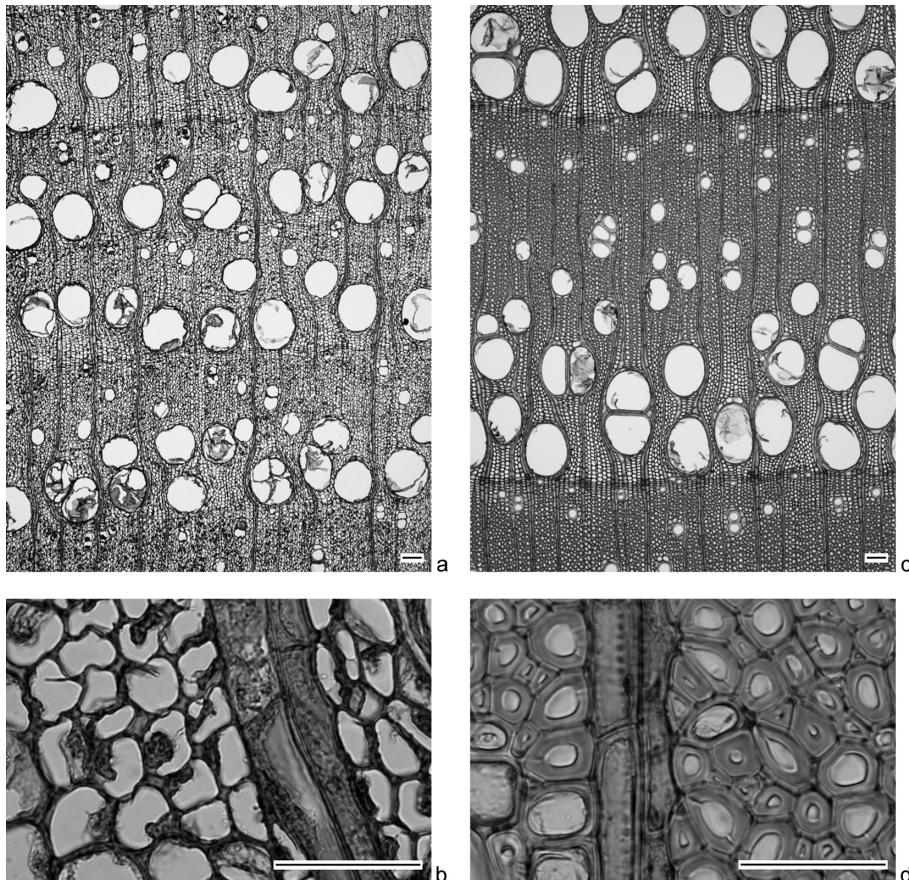
walls are much thinner in archaeological as in recent wood (Figs. 8.44b, 8.44d), which explains shrinkage of wood and reduction of its density. Decay of ash wood is generally greater as decay of oak heartwood.<sup>28</sup>

Although it was assumed for a long time that changes on archaeological wood are mostly a consequence of abiotic factors, recent findings show that changes are most probably caused by bacteria.<sup>29</sup> As long as archaeological wood is stored where preserved (underwater or in wet ground), bacteria decompose it very slowly, but they can completely deteriorate it in a few years after the excavation.<sup>30</sup> These findings are very important for suitable conservation and storage of the wheel and its axle.

<sup>28</sup> Čufar et al. 2008.

<sup>29</sup> Björdal, Nilsson, Daniel 1999; Klaassen 2008; Nilsson, Björdal 2008.

<sup>30</sup> Kim, Singh 2000.



Sl. 8.44: Mikroskopska slika zgradbe lesa arheološkega jesena, starega približno 5200 let (a, b), in normalnega lesa jesena (c, d). Pri arheološkem lesu so celične stene zelo tanke, lumini pa vsebujejo ostanke razkrojene celične stene (b). Pri normalnem lesu jesena je celična stena bistveno debelejša. Foto: M. Zupančič. Merilne daljice: 100 µm (a, c), 50 µm (b, d).

Fig. 8.44: Microphotograph of wood structure of c. 5200 years old archaeological ash wood (a, b) and of recent ash wood (c, d). Archaeological wood contains very thin cell walls and lumina contain remains of a decomposed cell wall (b). Cell walls are much thicker at recent ash wood. Photo: M. Zupančič. Scale bar: 100 µm (a, c), 50 µm (b, d).



ko normalen les jesena vsebuje približno 25 % lignina, 40 % celuloze in 35 % hemiceluloz.<sup>27</sup>

Dobro so raziskane tudi spremembe mikroskopske zgradbe arheološkega lesa.<sup>28</sup> Pod mikroskopom lahko vidimo, da je v njem ohranjena večina lesnoanatomskih znakov (sl. 8.44a, 8.44c), celične stene pa so bistveno tanjše kot pri lesu (sl. 8.44b, 8.44d), kar pojasnjuje veliko izgubo lesne mase in zmanjšanje gostote. Razkroj jesenovega lesa je v splošnem večji kot razkroj hrastove jedrovine.<sup>29</sup>

Čeprav je dolgo veljalo, da so spremembe na arheološkem lesu predvsem posledica abiotskih dejavnikov, v zadnjem času vse bolj ugotavljajo, da jih najverjetneje povzročajo bakterije.<sup>30</sup> Dokler arheološki les ostaja tam, kjer se je ohranil (pod vodo ali v mokrih tleh), ga bakterije razkrajajo zelo počasi, po izkopu pa ga lahko že v nekaj letih popolnoma razkrojijo.<sup>31</sup> To vse je zelo pomembno za ustrezno konzerviranje in hrambo kolesa ter osi.

## 8.5 DATIRANJE

Kolo z osjo smo datirali posredno in neposredno. Posredna datacija temelji na stratigrafski legi kolesa z osjo in na relativnih ter absolutnih datacijah naselbine. Os, na katero je bilo pritrjeno kolo, je ležala tik pod kulturno plastjo (sl. 8.5), kar kaže, da bi bila najdba lahko del ostankov s koliščarske naselbine. Slednje potrjujejo tudi spremljajoče arheološke najdbe, kot sta fragmenta dveh značilnih posod, ki sta bila najdena v bližini osi,<sup>32</sup> še posebej fragment lonca, ki je ležal poleg konca osi na strani A2 (sl. 8.45).

Tipološka analiza keramike je pokazala, da sodi koliščarska naselbina v horizont koliščarskih naselbin druge polovice 4. tisočletja pr. Kr.<sup>33</sup> Še največ analogij smo našli na bližnji Blatni Brezovici, v Notranjih Goricah in na Maharskem prekopu, na podlagi česar smo sklepali, da naselbine sodijo v isti kulturni horizont.<sup>34</sup> Slednje potrjujejo tudi dendrokronološke raziskave in radiokarbonsko datiranje.<sup>35</sup>

Natančnejše datiranje na splošno omogočata dendrokronološka in radiometrična metoda.

S pomočjo dendrokronološke metode<sup>36</sup> smo iz lesa, dokumentiranega med letoma 2002 in 2007, sestavili več kronologij širin branik, s pomočjo katerih smo postavili

## 8.5 DATING

We indirectly and directly dated the wheel with its axle. Indirect dating is based upon the wheel's and axle's stratigraphic position, relative and absolute dating of the settlement. The axle, on which the wheel was fixed, was deposited just under a cultural layer (Fig. 8.5). This indicates that the find and the pile-dwelling settlement could be contemporary. The latter can also be confirmed by accompanying archaeological finds, a couple of characteristic pottery fragments found in the vicinity of the axle,<sup>31</sup> and especially fragment of a pot, found beside the axle's end piece A2 (Fig. 8.45).

Typological analysis of pottery dated the pile-dwelling settlement to the horizon of pile-dwelling settlements of the second half of the 4<sup>th</sup> millennium BC.<sup>32</sup> Most analogies can be found at the nearby sites of Blatna Brezovica, Notranje Gorice and Maharski prekop. Consequently, we assumed that settlements form one cultural horizon.<sup>33</sup> Dendrochronological research and radiocarbon dating additionally confirmed this assumption.<sup>34</sup>

Dendrochronological and radiometric procedures enable even more detailed dating.

Several annual ring chronologies were produced with the help of dendrochronological procedure<sup>35</sup> and wood documented between 2002 and 2007. They helped us to place activities on the pile-dwelling settlement to a relative time frame. As chronologies were absolutely dated with the radiometric procedure, we combined the results of both procedures to date the finishing phase of the settlement to c. 3109 ± 12 cal BC, and found out that it was intensely settled since over 50 years earlier.

Both procedures, dendrochronological and radiometric, are suitable for dating of the wheel and the axle. However, they both have restraints, particularly as we wanted to date only two pieces of wood of different wood species. The axle contained only 44 annual rings, which is not enough for reliable dendrochronological dating. Therefore, we focused our attention mainly to the analysis of tree-ring widths of the wheel (plank A1), where we measured 77 of them.

We had difficulties at measuring tree-rings, because only in a part of the rim (e.g. Fig. 8.18) they were transversely cut. Less valuable wooden items are usually deep-frozen, the surface is smoothed with a very sharp blade and dried a bit before measuring tree-ring widths under a microscope. The wheel and the axle were unsuitable for such procedure, as we could not do any of the procedures listed above. In order to measure the tree-ring widths on the wheel, we smoothed a few centi-

<sup>27</sup> Čufar, Gorišek, Tišler 2002.

<sup>28</sup> Čufar et al. 2008.

<sup>29</sup> Čufar et al. 2008.

<sup>30</sup> Björdal, Nilsson, Daniel 1999; Klaassen 2008; Nilsson, Björdal 2008.

<sup>31</sup> Kim, Singh 2000.

<sup>32</sup> Glej poglavje 3 v tem zborniku: t. 3.1: 1,2.

<sup>33</sup> Glej poglavje 1 v tem zborniku.

<sup>34</sup> Glej poglavje 1.3 v tem zborniku.

<sup>35</sup> Glej poglavje 7 v tem zborniku.

<sup>36</sup> Glej poglavje 7 v tem zborniku.

<sup>31</sup> See Chapter 3 in this monograph: Pl. 3.1: 1,2.

<sup>32</sup> See Chapter 1 in this monograph.

<sup>33</sup> See Chapter 1.3 in this monograph.

<sup>34</sup> See Chapter 7 in this monograph.

<sup>35</sup> See Chapter 7 in this monograph.



Sl. 8.45: Fragment posode (glej poglavje 3 v tem zborniku: t. 3.1: 2), ki je ležal v sondi poleg osi (stran A2), med izkopavanjem J. Dirjeca. Foto: M. Turk.

Fig. 8.45: Pottery fragment (see Chapter 3 in this monograph: Pl. 3.1: 2), found in trench beside the axle (side A2), during excavation by J. Dirjec. Photo: M. Turk.

dogajanje na koliščarski naselbini v relativen časovni okvir. Ker so bile kronologije absolutno datirane z radiometrično metodo, smo s kombinacijo obeh metod konec naselbine datirali v leto  $3109 \pm 12$  pr. Kr. oz. nekaj let po tem, in ugotovili, da je intenzivna poselitev pred tem letom trajala več kot 50 let.

Tudi za datiranje kolesa in osi je primerna uporaba obeh metod, torej dendrokronološke in radiometrične, ki pa imata tudi svoje omejitve, še posebno zato, ker smo želeli datirati samo dva kosa lesa različnih lesnih vrst. Ker smo pri osi lahko izmerili samo 44 branik, kar je premalo za zanesljivo datiranje, smo se posvetili predvsem analizi širin branik pri kolesu (deski A1), kjer smo izmerili 77 branik.

Težave so nastopile že pri merjenju branik, saj so te prečno prerezane le na delu oboda kolesa (npr. sl. 8.18). Kadar merimo arheološki les manj dragocenih predmetov, ga običajno najprej globoko zamrznemo, nato z zelo ostrim rezilom zgladimo površino in jo pred merjenjem širin branik pod mikroskopom še nekoliko osušimo. Tak

metres of wood. Measuring was done by hand, without a measuring table and a computer (Fig. 8.46). Annual rings were hardly visible due to unsuitable orientation and smoothing of wood, so a possibility of measuring errors was larger, while finding and correcting them is not easy without any comparative material and suitable reference curves.

When all the measurements were done, we cross-dated the obtained tree-ring series with all available tree-ring chronologies from the settlement at Stare gmajne and other settlements at the Ljubljansko barje. However, statistically significant cross-dating of the wheel was not obtained.

The Accelerator Mass Spectrometry procedure (AMS), which requires 1 g of dry weight of wood for its analyses, was chosen for radiocarbon ( $^{14}\text{C}$ ) dating. C. 1 cm<sup>3</sup> large samples, with two annual rings each and 0.14 and 0.17 g of dry matter, were taken from the wheel and the axle (Fig. 8.47). The position of annual rings on samples and on the graph of tree-ring series were carefully noted.

Dendrochronologically registered samples of the wheel and the axle were sent to Vienna to the laboratory VERA - Vienna Environmental Research Accelerator<sup>36</sup> for radiocarbon dating. For radiocarbon dates see Tab. 8.1. The dates overlap with the age of the pile-dwelling settlement.<sup>37</sup> This confirms our assumption that the wheel was most probably made and used in the time of the younger period of the pile-dwelling settlement Stare gmajne.

## 8.6 CONCLUSION

Discovery of the wooden wheel and its axle at Stare gmajne is an important finding, not only in Slovenia but also in Europe and worldwide. As mentioned above, dating of the wheel and its axle overlaps with dating of the settlement, which suggests that the wheel and the axle were made and used contemporary with the existence of the settlement, during the younger settlement phase. Consequently, the wooden wheel is most probably c. 5150 years old<sup>38</sup> and it is among the oldest finds of this kind in Europe and worldwide.

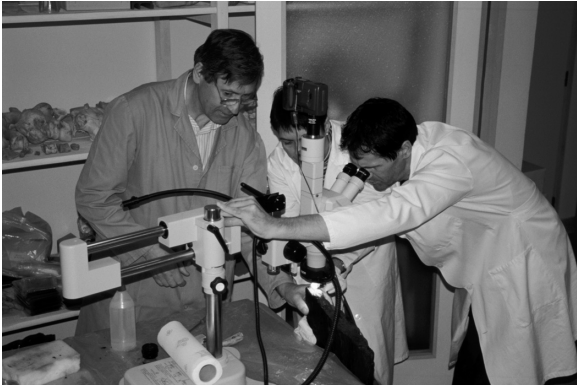
Research showed that the find was produced by a top-level prehistoric wheelwright who had the knowledge of wood and its characteristics and knew how to make wheels and carts. Considering the quality of the discovered wheel, this is not the only product of this kind made by the skilled prehistoric master. Depictions of carts, pottery models, ruts and routes that were in good condition show, that the invention of a cart very

<sup>36</sup> Institut für Radiumforschung und Kernphysik der Universität Wien.

<sup>37</sup> See Chapter 7 in this monograph.

<sup>38</sup> Compare with Chapter 7 in this monograph.





Sl. 8.46: Ekipe dendrokronološkega laboratorija Oddelka za lesarstvo BF pri merjenju širin branik na kolesu; z leve: P. Cunder, K. Čufar in M. Zupančič. Foto: M. Turk.

Fig. 8.46: The team of the Dendrochronological laboratory of the Department of Wood Technology, Biotechnical Faculty, is measuring tree-ring widths on the wheel; from left: P. Cunder, K. Čufar and M. Zupančič. Photo: M. Turk.

postopek pri kolesu in osi ni prišel v poštev, saj nismo mogli opraviti niti enega od naštetih korakov. Za merjenje širin branik pri kolesu smo na razdalji nekaj centimetrov nekoliko zgladili les. Merjenje smo opravili ročno, brez merilne mizice in računalnika (sl. 8.46). Ker so bile branike zaradi neustrezne orientacije in obdelave lesa slabo vidne, je bila večja verjetnost napak pri merjenju, njihovo iskanje in odprava pa sta brez primerjalnega materiala in ustreznih referenčnih krivulj težavna.

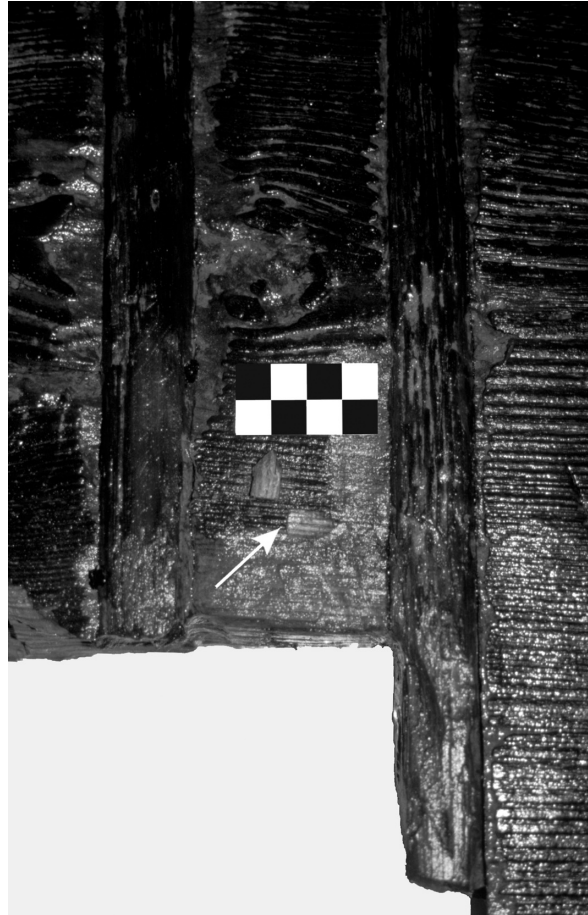
Ko so bile meritve opravljene, smo grafe sinhronizirali z vsemi razpoložljivimi kronologijami naselbine Stare gmajne in drugih naselbin na Ljubljanskem barju, vendar statistično zanesljivo relativno datiranje kolesa ni uspelo.

Za absolutno datacijo smo izbrali radiokarbonsko datiranje z metodo atomske masne spektroskopije (AMS), ki za analizo zahteva pod 1 g suhe snovi. Za datiranje smo iz kolesa (sl. 8.47) in osi odvzeli po 1 cm<sup>3</sup> velika vzorca, ki sta vsebovala po dve braniki in 0,14 oz. 0,17 g suhe snovi. Branike oz. njihovo lego na vzorcu oz. v grafu zaporedij širin branik smo prej natančno zabeležili.

Dendrokronološko protokolirana vzorca kolesa in osi smo poslali na radiokarbonsko datiranje na Dunaj v laboratorij VERA-Vienna Environmental Research Accelerator.<sup>37</sup> Radiokarbonski dataciji kolesa in osi sta podani v tabeli 8.1. Ugotovljena starost se ujema s starostjo koliščarske naselbine.<sup>38</sup> S tem je potrjena naša domneva, da je bilo kolo najverjetneje narejeno in uporabljano v času mlajšega dela koliščarske naselbine Stare gmajne.

<sup>37</sup> Institut für Radiumforschung und Kernphysik der Universität Wien.

<sup>38</sup> Glej poglavje 7 v tem zborniku.



Sl. 8.47: Kolesna deska A1. Mesto vzorčenja za radiokarbonsko datiranje. Foto: M. Turk.

Fig. 8.47: Wheel plate A1. Area of sampling for radiocarbon dating. Photo: M. Turk.

probably occurred some centuries before the wheel of Stare gmajne was made. However, the question whether it was invented in Mesopotamia or one or several places in Europe, stays unanswered.<sup>39</sup>

Nevertheless, the most important value of this find is that it is technologically advanced, above all, due to selection of wood, use, orientation and processing of the wood.

The hub is rectangular, which indicates that the wheel and its axle turned simultaneously. This is particularly suitable undercarriage of a two-wheeled cart<sup>40</sup> or a handcart. Similar finds are known from hilly areas of Central Europe (e.g. Switzerland and south-western Germany). Four-wheeled carts with fixed axles and circular hubs were used on European plains at that time. The latter indicates that four-wheeled carts were more

<sup>39</sup> See Schlichtherle 2006, 173–176.

<sup>40</sup> Schlichtherle 2006, 168–170.

Tab. 8.1: Radiokarbonski dataciji kolesa in osi. Datiranje je bilo opravljeno v dunajskem laboratoriju Vienna Environmental Research Accelerator pri Institut für Radiumforschung und Kernphysik der Universität Wien.

Tab. 8.1: Radiocarbon dates of the wheel and the axle. Dating was performed in the laboratory Vienna Environmental Research Accelerator at the Institut für Radiumforschung und Kernphysik der Universität Wien/Vienna.

Predmet Object	Lab. št. Lab. Nr.	$\delta^{13}\text{C}^*$ [‰]	$^{14}\text{C}$ -age* [BP]	Kalibrirana starost ** Calibrated age **
Kolo / Wheel	VERA-2560	-24,4 ± 2,6	4480 ± 25	3340 BC (90,0 %) 3080 BC 3070 BC (5,4 %) 3030 BC
Os / Axle	VERA-2561	-26,2 ± 0,6	4530 ± 35	3360 BC (95,4 %) 3090 BC

\*  $1\sigma$  - napaka / error

\*\* Datum, določen z uporabo kalibracijskega programa OxCal v okvirju  $2\sigma$  standardne napake, verjetnost posamezne datacije je označena v oklepaju. / Determined with the calibration program OxCal, data correspond to the  $2\sigma$  - confidence level, probability of the individual time periods in brackets.

## 8.6 SKLEP

Najdba lesenega kolesa in osi na Starih gmajnah je zagotovo pomembno odkritje ne le v slovenskem, temveč tudi evropskem oz. svetovnem merilu. Kot že rečeno, se datiranje kolesa in osi ujema s starostjo naselbine, kar nakazuje, da sta bila kolo in os narejena in uporabljana v času njenega obstoja, in to v obdobju njene mlajše poselitvene faze. Po teh ugotovitvah je leseno kolo najverjetneje staro približno 5150 let,<sup>39</sup> kar ga uvršča med najstarejše najdbe te vrste v Evropi in na svetu.

Raziskava je pokazala, da je najdbo naredil vrhunski prazgodovinski kolar, ki se je odlično spoznal na les, na njegove lastnosti ter tudi na izdelovanje koles in vozov. Glede na kakovost izdelave menimo, da kolo, ki smo ga našli, ni edini izdelek te vrste, ki ga je naredil prazgodovinski mojster. Upodobitve vozov, keramični modeli, kolesnice in urejene poti kažejo, da je do iznajdbe voza zelo verjetno prišlo nekaj stoletij pred izdelavo kolesa na Starih gmajnah. Ob tem vprašanje ostaja, ali v Mezopotamiji ali na enem ali več mestih v Evropi, še odprto.<sup>40</sup>

Kakor koli že, največja vrednost naše najdbe je njena tehniška dovršenost. Pri tem imamo v mislih predvsem izbiro lesa, njegovo uporabo, orientacijo in obdelavo.

Pesto je štirikotne oblike, kar kaže, da sta se kolo in os vrtela sočasno in da gre za rešitev, ki je primerna predvsem za podvozje dvokolesnega voza<sup>41</sup> oz. neke vrste cize. Najdbe podobnih koles in osi poznamo s hribovitih območij Srednje Evrope (npr. Švice in jugozahodne Nemčije). Ravninska Evropa tistega časa pa pozna štirikolesne vozove z nepremično osjo in pestom okrogle oblike v kolesu. Slednje je raziskovalce napeljalo na misel, da so bili štirikolesni vozovi primernejši za ravninske predele, dvokolesniki pa za uporabo v hribovitem svetu.<sup>42</sup>

Morda se zdi nenavadno, da smo na dele podvozja prazgodovinskega voza naleteli na kolišču Stare

suitable for flat terrain, while two-wheeled carts were the most suitable types for a hilly land.<sup>41</sup>

It perhaps seems unlikely that the undercarriage of a prehistoric cart was found at the Stare gmajne pile-dwelling at the Ljubljansko barje, as it is assumed that during the second half of the 4<sup>th</sup> millennium BC lake still existed.<sup>42</sup> Lake and cart do not interconnect somehow. However, we think that this is not the case at Stare gmajne. Furthermore, it seems important that we came across an undercarriage of, most probably, two-wheeler. Namely, the pile-dwelling settlement is located c. 700 m from the dry riverbank and was very probably erected in marsh next to the lake.<sup>43</sup> Wooden tracks were perhaps connecting it with a dry land. Wooden tracks have not yet been found at the Ljubljansko barje, but they are known elsewhere in Europe.<sup>44</sup>

Lake and marsh, in some areas, were covering a large area of plain, which is since the 19<sup>th</sup> century known as the Ljubljansko barje. Only hills in the hinterland, which are also the main geographical feature of central Slovenia,<sup>45</sup> stayed dry, and use of a two-wheeled cart seems logical in such a region.

<sup>39</sup> Prim. s poglavjem 7 v tem zborniku.

<sup>40</sup> Glej Schlichtherle 2006, 173–176.

<sup>41</sup> Schlichtherle 2006, 168–170.

<sup>42</sup> Npr. Schlichtherle 2002, sl. 30.

<sup>41</sup> E.g. Schlichtherle 2002, Fig. 40.

<sup>42</sup> E.g. Pavšič 1989; Velušček 2007; Velušček, Čufar 2008.

<sup>43</sup> See Chapters 2 and 3 in this monograph.

<sup>44</sup> E.g. Burmeister 2002; 2006; Hafner 2002; Heumüller 2002.

<sup>45</sup> See Perko, Orožen Adamič 2001.

gmajne na Ljubljanskem barju, kjer naj bi po teoriji v drugi polovici 4. tisočletja pr. Kr. še vedno bilo jezero.<sup>43</sup> Jezero in voz nekako ne gresta skupaj. Menimo, da v primeru najdbe s Starih gmajn vendarle ni tako. Še več, pomembno se zdi, da smo naleteli na podvozje zelo verjetno dvokolesnega voza. Koliščarska naselbina namreč leži približno 700 m od trdinskega brega in je bila zelo verjetno postavljena v močvirju ob jezeru.<sup>44</sup> S trdino so jo morda povezovala poti iz okroglic, oblic, plohov ali mostovži. Na Ljubljanskem barju takšne vrste poti sicer še nismo našli, poznamo pa jih z drugih območij Evrope.<sup>45</sup>

Jezero oz. na nekaterih območjih že močvirje je torej prekrivalo velik del ravnine, ki jo od 19. stoletja poznamo kot Ljubljansko barje. Kot trdinski svet je v zaledju koliščarjem preostalo v glavnem samo hribovje, kar je tudi glavna geografska značilnost osrednje Slovenije,<sup>46</sup> in v takšni pokrajini se zdi, kot omenjeno, uporaba dvokolesnega voza smiselna.

<sup>43</sup> Prim. Pavšič 1989; Velušček 2007; Velušček, Čufar 2008.

<sup>44</sup> Glej poglavji 2 in 3 v tem zborniku.

<sup>45</sup> Npr. Burmeister 2002; 2006; Hafner 2002; Heumüller 2002.

<sup>46</sup> Glej Perko, Orožen Adamič 2001.

# 9. DREVAKA S KOLIŠČARSKE NASELBINE STARE GMAJNE NA LJUBLJANSKEM BARJU

Anton VELUŠČEK, Dejan VERANIČ &  
Katarina ČUFAR

## Izvleček

V prispevku sta predstavljena hrastova drevaka s Starih gmajn. Gre za razmeroma dobro ohranjeni plovili s prečno ojačitvijo. Dendrokronološka analiza je pokazala, da oba čolna sodita h koliščarski naselbini, datacija drevaka 2 nakazuje, da je bil narejen in v uporabi ob koncu življenja v naselbini (okoli leta 3109 ± 12 pr. Kr.), drevak 1 pa je bil verjetno narejen približno 50 let prej.

**Ključne besede:** drevaka, dendrokronologija, kolišče, Stare gmajne, Ljubljansko barje, eneolitik.

## 9.1 UVOD

Plovba z drevaki je med najstarejšimi in najdlje uporabljanimi načini potovanja po vodi. Človek je že od davnine opazoval plavajoča drevesa na rekah. Ugotovil je tudi, da se s plavajočim objektom lahko upravlja, če je trden. Spoznal je, da mu takšno plovilo lahko koristi npr. pri ribolovu na dotlej nedostopnih krajih.<sup>1</sup> Vse to je verjetno vodilo k iznajdbi drevaka, ki ga je mogoče relativno hitro izdelati in je dokaj enostaven za plovbo.<sup>2</sup> Pri drevaku praviloma ni težav s tesnjenjem, montažo in strukturnimi okrepitevami, predvsem prečnimi, ki so iztesane kar iz izvornega debla.

Drevaki imajo na splošno visoko razmerje med dolžino in širino, zato je dolžinska stabilnost manj pomembna. Po drugi strani pa je zelo pomembna prečna stabilnost, saj je indeks razmerja med širino in višino običajno manjši od 2. Oblika koncev drevaka ima manj pomembno vlogo pri hidrostatici, a je toliko pomembnej-

<sup>1</sup> Woodman 2005, 3–4.

<sup>2</sup> Glej Arnold 1995, 161–181.

# 9. LOGBOATS FROM THE PILE-DWELLING SETTLEMENT STARE GMAJNE AT THE LJUBLJANSKO BARJE

Anton VELUŠČEK, Dejan VERANIČ &  
Katarina ČUFAR

## Abstract

In this chapter, we introduce two oak logboats from Stare gmajne. The comparatively well preserved vessels contain transverse reinforcements. Dendrochronological analysis showed that both logboats are contemporary to the pile-dwelling settlement; logboat 2 was made and used at the last stage of the settlement around 3109 ± 12 BC, while the logboat 1 was probably made c. 50 years earlier.

**Keywords:** logboats, dendrochronology, pile-dwelling, Stare gmajne, the Ljubljansko barje, Eneolithic.

## 9.1 INTRODUCTION

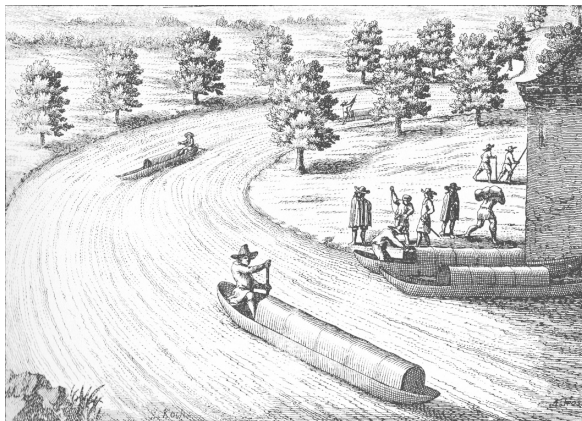
Sailing with logboats, made of a single trunk, is one of the oldest and the longest used ways of travelling by water. The sight of trees, floating upon the surface of the water, attracted attention since antiquity. People have realised that this kind of a floating object can be controlled, if stable. They also realised that such vessel is useful for e.g. fishing at previously inaccessible places.<sup>1</sup> All these reasons probably led to an invention of a logboat, which can be made relatively fast and is easy to navigate.<sup>2</sup> There are no problems with sealing, fitting and structural reinforcements, above all the transverse ones, which are hollowed out from the source trunk.

Logboats have generally a high ratio between length and width and that is why longitudinal stability is less important. However, transverse stability is crucial, as the ratio between width and height is usually less than 2. Shapes of logboat ends are less important at hydro-

<sup>1</sup> Woodman 2005, 3–4.

<sup>2</sup> See Arnold 1995, 161–181.





ša pri hidrodinamiki. Pri tem je pomembno, da plovilo povzroča čim manj valov in s tem pluje z manjšo porabo energije. Premci drevakov v obliki sulice imajo najoptimalnejši izpodriv vode in najmanjši upor.<sup>3</sup>

Po *Slovarju slovenskega knjižnega jezika* I, A–H, Ljubljana 1970, str. 494, je drevak preprost čoln iz enega debla. Podobno kot drugi jeziki tudi slovenščina pozna več imen zanj: drevak, brunik, izdolbenec oz. čoln izdolbenec itd.<sup>4</sup> V zadnjem času pa je predvsem med arheologi in muzealci postal priljubljen izraz *deblak*, kar naj bi po mnenju zagovornikov še najbolj ustrezalo temu, da gre za plovilo, narejeno iz enega debla.<sup>5</sup> Slovenci na Tržaškem tovrstno plovilo imenujejo *čupa*,<sup>6</sup> Nemci pa *der Einbaum*. Kakor koli že, domačini z Ljubljanskega barja takšno plovilo imenujejo drevak, zato smo se odločili, da ta uveljavljeni slovenski izraz ohranimo tudi v tem prispevku.

V drugi polovici 17. stoletja drevake z Ljubljanskega barja omenja J. V. Valvazor. V *Slavi vojvodine Kranjske* v opisu tovarnega prometa po Ljubljani piše: "Ljubljana nosi veliko ladij, in vsake vrste blago, tako, ki prihaja iz Italije, in tako, ki je namenjeno tja. Vozijo tako ponoči ko podnevi ne le z majhnimi, temveč tudi z velikimi ladjami. Male ladje so narejene iz enega samega drevesa, imajo pa lesene strehe, da se dá ponoči lepo mirno spati (zakaj v malih se navadno vozi ponoči) in pri dežju suh ostati"<sup>7</sup> (sl. 9.1). "..., mali (čolnarji; op. avtorjev) prevažajo samo osebe in drobno blago, a njih čoln je iz izvotljenega drevesa."<sup>8</sup> Na istem mestu Valvazor še poroča, da je imela Vrhnika 60 majhnih ladij oz. drevakov, Ljubljana, Ig, Iška Loka in Podpeč pa po 30.

Drevak kot arheološka najdba je bil odkrit na Ljubljanskem barju pred skoraj 200 leti. Med letoma 1826 in 1828 je bil namreč v Spodnjem Galjevcu na obrobju

Sl. 9.1: Plovba z drevaki po Ljubljani v 2. polovici 17. stoletja. Bakrorez iz *Slave vojvodine Kranjske* (Valvazor 1689, 27).

Fig. 9.1: Sailing with logboats on the Ljubljana in the 2<sup>nd</sup> half of the 17<sup>th</sup> century. Copperplate engraving from *Die Ehre deß Hertzogthums Crain* (Valvazor 1689, 27).

statics, but much more important at hydrodynamics. It is important that a vessel produces as little waves as possible and, consequently, navigates with smaller consumption of energy. Logboats, shaped as spears, have the most optimal water displacement and the smallest water resistance.<sup>3</sup>

According to the *Slovar slovenskega knjižnega jezika* I,<sup>4</sup> A–H, Ljubljana 1970, p. 494, a logboat is a simple vessel made of a single trunk. Similarly as other languages, also Slovenian uses several terms: *drevak*, *brunik*, *izdolbenec* or *čoln izdolbenec* etc.<sup>5</sup> *Deblak* is the most frequently used term among some archaeologists and people, working in museums, as it describes the vessel best; it is a vessel made of a single trunk.<sup>6</sup> Slovenes from the area of Trieste use the term *čupa*,<sup>7</sup> and Germans *der Einbaum*. Nevertheless, locals from the Ljubljansko barje use the term *drevak* to describe such vessel. That is why we decided to use this term in the Slovene text of this publication.

In the second half of the 17<sup>th</sup> century, J. V. Valvazor mentions logboats from the Ljubljansko barje. In his *Die Ehre deß Hertzogthums Crain* he describes transport of cargo on the Ljubljana: "The Ljubljana carries large boats and all kinds of goods, both, those from Italy and those being sent there. They sail by night and day, not only with small, but also with large ships. The small ships are made of a single tree and have wooden roofs so that sleeping aboard is peaceful at night (that is why the small boats usually sail by night) and one stays dry even in rain"<sup>8</sup> (Fig. 9.1). "..., small (boatmen; authors' comm.) only carry people and small goods, but their boat is made from a single hollowed out tree."<sup>9</sup> Here, Valvazor also mentions that Vrhnika owned 60 small ships or logboats, while Ljubljana, Ig, Iška Loka and Podpeč owned 30 each.

The first logboat (as an archaeological find) was discovered at the Ljubljansko barje almost 200 years ago. To be precise, an oak logboat was found at Spodnji Galjevec, on the outskirts of Ljubljana, between 1826 and 1828. It was c. 3 m long and c. 40 cm wide.<sup>10</sup>

<sup>3</sup> After Arnold 1995.

<sup>4</sup> Dictionary of Slovene formal language.

<sup>5</sup> See e.g. Lisjak 2004, 109; Erič 2008, 11, 12.

<sup>6</sup> Erič 2008, 12.

<sup>7</sup> E.g. Lisjak 2004, 131.

<sup>8</sup> Valvazor 1689, 28.

<sup>9</sup> Valvazor 1689, 264.

<sup>10</sup> Hochenwart 1838, 79; see Velušček 1997a, 8–9.

<sup>3</sup> Po Arnold 1995.

<sup>4</sup> Glej npr. Lisjak 2004, 109; Erič 2008, 11–12.

<sup>5</sup> Erič 2008, 12.

<sup>6</sup> Npr. Lisjak 2004, 131.

<sup>7</sup> Valvazor 1689, 28.

<sup>8</sup> Valvazor 1689, 264.



Ljubljane najden hrastov drevak, ki naj bi v dolžino meril okoli tri metre, v širino pa približno štirideset centimetrov.<sup>9</sup>

Po F. Hochenwartu so drevake z Ljubljanskega barja omenjali npr. K. Deschmann,<sup>10</sup> A. Müllner,<sup>11</sup> J. Novak,<sup>12</sup> W. Schmid<sup>13</sup> itd. Prvi, ki je opravil podrobnejši popis drevakov, je bil geograf A. Melik. V znamenitem delu o Ljubljanskem barju je zajel vse do tedaj znane najdbe drevakov.<sup>14</sup> Nato je minilo nekaj desetletij, dokler se tematike ni lotil D. Vuga, ki je od sedemdesetih let prejšnjega stoletja predvsem v reviji *Varstvo spomenikov* predstavljal novoodkrite drevake.<sup>15</sup>

Prvo popolno objavo drevaka z Ljubljanskega barja, z risbo, merami in tudi radiometrično datacijo, pa je šele leta 1990 pripravila B. Dirjec.<sup>16</sup> V reviji *Poročilo o raziskovanju paleolita, neolita in eneolita v Sloveniji* 18 je predstavila štiri novoodkrite drevake z različnih koncev Ljubljanskega barja.

Objavi Dirječeve je sledil zanimiv prispevek, v katerem je M. Erič<sup>17</sup> predstavil radiokarbonsko datirane drevake Slovenije. S čolni in drugimi plovili, najdenimi v Ljubljani, se je kasneje ukvarjal A. Gaspari.<sup>18</sup> Pomembno je tudi *Poročilo skupine za podvodno arheologijo* pri Zavodu za varstvo kulturne dediščine Slovenije o ladjah, deblakih, čolnicah in veslih z Ljubljanskega barja.<sup>19</sup>

Še pred približno 20 leti je bil med radiokarbonsko datiranimi plovili Ljubljanskega barja najstarejši drevak z ledine Za strugo pri Blatni Brezovici. Radiokarbonska datacija ( $3190 \pm 130$  uncal BP) ga uvršča v mlajši razdelek bronaste dobe,<sup>20</sup> torej v obdobje, ko kolišč na Ljubljanskem barju ni bilo več.<sup>21</sup>

Tako nizka starost za najstarejši drevak se zdi nenavadna in kaže, da koliščarskih čolnov na Ljubljanskem barju naj ne bi bilo. Izjemo bi pri tem predstavljal domnevno koliščarski drevak, ki ga je našel Deschmann,<sup>22</sup> a ni bil zanesljivo datiran. Če drevakov ne bi bilo, bi bile prigode s koliščarskimi oz. mostiščarskimi drevaki v trilogiji *Bobri* pisatelja J. Jalna plod čiste domišljije. Življenje brez drevakov v času koliščarjev pa bi bilo nenavadno, saj je takrat velik del Ljubljanskega barja prekrivalo jezero.<sup>23</sup>

After F. Hochenwart, the logboats from the Ljubljansko barje were mentioned by K. Deschmann,<sup>11</sup> A. Müllner,<sup>12</sup> J. Novak,<sup>13</sup> W. Schmid<sup>14</sup> etc. A geographer A. Melik was the first who listed a detailed inventory of logboats. In his famous publication, discussing the Ljubljansko barje, he listed all logboats discovered so far.<sup>15</sup> A few decades passed until, from the 70-ties of the former century onwards, D. Vuga has introduced new discoveries of logboats, mostly in the periodical *Varstvo spomenikov*.<sup>16</sup>

However, it was as late as 1990, when B. Dirjec published the first complete study of a logboat from the Ljubljansko barje, with drawings, measurements and radiometric date.<sup>17</sup> In *Poročilo o raziskovanju paleolita, neolita in eneolita v Sloveniji* 18, she introduced four newly discovered logboats from different areas of the Ljubljansko barje.

An interesting contribution by M. Erič,<sup>18</sup> where he introduced radiocarbon dated logboats of Slovenia, followed. Later, A. Gaspari got engaged in a study of logboats and other vessels found in the Ljubljana.<sup>19</sup> *Poročilo skupine za podvodno arheologijo*, published by the Institute for the protection of cultural heritage of Slovenia, discussing ships, logboats, boats and oars of the Ljubljansko barje, is also important.<sup>20</sup>

C. 20 years ago, a logboat from the Za strugo near Blatna Brezovica fallow was the oldest radiocarbon dated vessel from the Ljubljansko barje. The radiocarbon date ( $3190 \pm 130$  uncal BP) dates it to the late Bronze Age,<sup>21</sup> to period, when pile-dwellings were not existing anymore on the Ljubljansko barje.<sup>22</sup>

Such young age of the oldest logboat is unusual and it is indicating that there would be no pile-dwelling logboats at the Ljubljansko barje. The only exception here would be an alleged pile-dwelling logboat, found by Deschmann,<sup>23</sup> which was doubtfully dated. If there would be no logboats, the adventures with pile-dwelling logboats, described by J. Jalen in his *Bobri* (Beavers) trilogy, would only be a result of pure imagination. Life with no logboats would be unusual during the time of pile-dwellers, as a lake was covering most of the Ljubljansko barje at that time.<sup>24</sup>

<sup>9</sup> Hochenwart 1838, 79; glej Velušček 1997a, 8–9.

<sup>10</sup> 1878.

<sup>11</sup> 1892 itd.

<sup>12</sup> 1907.

<sup>13</sup> 1910.

<sup>14</sup> Melik 1946.

<sup>15</sup> Npr. Vuga 1977, 189–193; 1982, 163, sl. 34a itd.

<sup>16</sup> 1990.

<sup>17</sup> 1994.

<sup>18</sup> Npr. Gaspari, Erič 2000.

<sup>19</sup> Erič 2008.

<sup>20</sup> Dirjec 1990, 137.

<sup>21</sup> Prim. Velušček 2005a.

<sup>22</sup> 1878, 10.

<sup>23</sup> Glej npr. Velušček 2005a; Velušček, Čufar 2008.

<sup>11</sup> 1878.

<sup>12</sup> 1892 etc.

<sup>13</sup> 1907.

<sup>14</sup> 1910.

<sup>15</sup> Melik 1946.

<sup>16</sup> E.g. Vuga 1977, 189–193; 1982, 163, Fig. 34a etc.

<sup>17</sup> 1990.

<sup>18</sup> 1994.

<sup>19</sup> E.g. Gaspari, Erič 2000.

<sup>20</sup> Erič 2000.

<sup>21</sup> Dirjec 1990, 137.

<sup>22</sup> E.g. Velušček 2005a.

<sup>23</sup> 1878, 10.

<sup>24</sup> See e.g. Velušček 2005a; Velušček, Čufar 2008.

Šele z najnovejšimi raziskavami se slika jasni in stvari se postavljajo na svoje mesto. Najprej so se množila odkritja drevakov. Erič<sup>24</sup> npr. poroča, da je na Ljubljanskem barju znanih že več kot 60 tovrstnih plovil. Le peščica med njimi je radiokarbonsko ali absolutno datirana: pet jih je iz srednjega oz. novega veka, pet iz predrimskega in rimskega obdobja, eden iz železne dobe, dva iz bronaste in le trije ali štirje iz obdobja kolišč. Tako vsaj v zadnjem času na Ljubljanskem barju odkrivamo tudi koliščarske drevake.

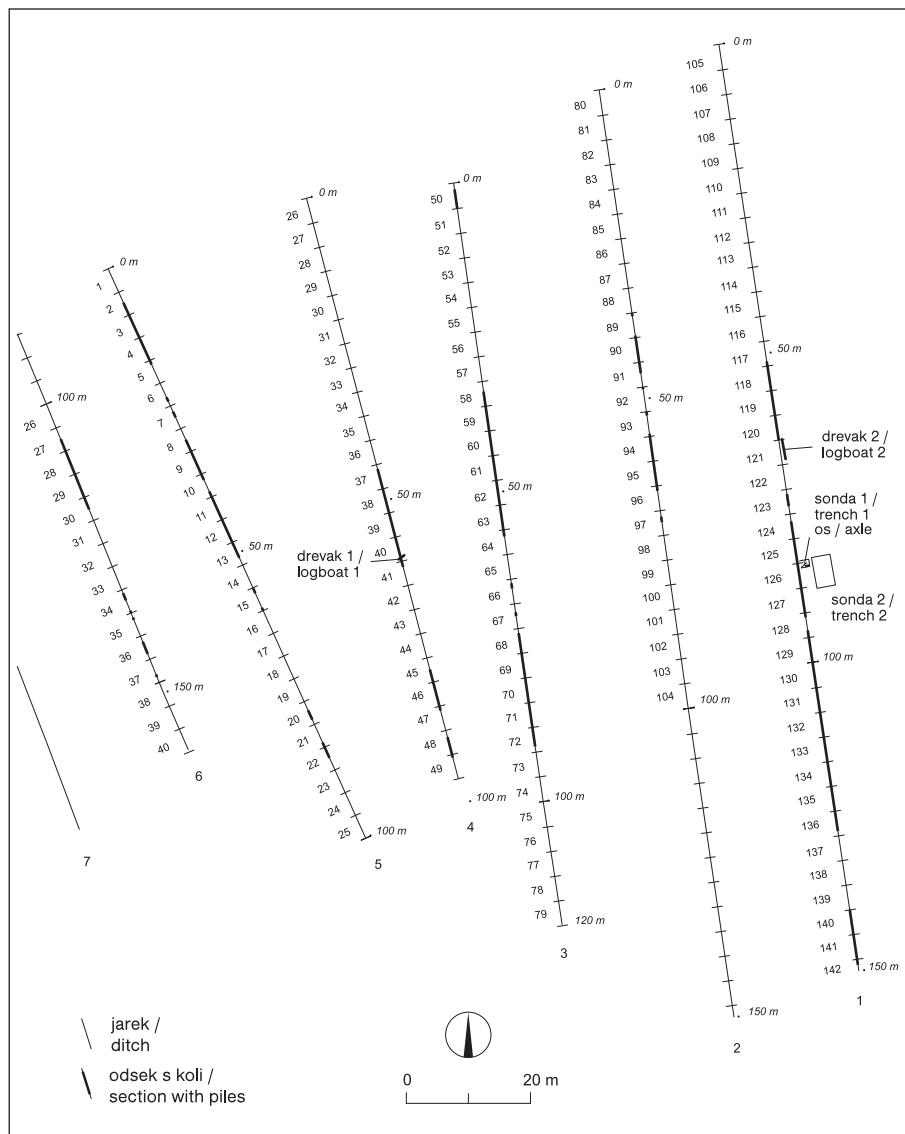
Prvi med njimi je bil drevak z najdišča Veliki mah. Za zdaj je najdba samo zabeležena in mesto odkritja označeno, ni pa še bila dokumentirana. Drevak se nahaja severovzhodno od osamelca Blatna Brezovica v neposredni bližini ostankov kolišča iz zelo verjetno 3. tisočletja

<sup>24</sup> 2008.

Only the latest researches help with clearer understanding of the logboats. Discoveries of logboats are more frequent now. Erič<sup>25</sup> claims that over 60 such vessels are known from the Ljubljansko barje so far. Only a handful of them were radiocarbon- or absolute dated: five of them date to the Middle and New Ages, five to the pre-Roman and Roman periods, one to the Iron Age, two to the Bronze Age and only three or four of them to the Pile-dwelling period. So, at least lately, we are discovering pile-dwelling logboats at the Ljubljansko barje.

The first one was a logboat from the site Veliki mah. The find is registered and place of its discovery is marked, but it has not been documented in details yet. The logboat lies to the northeast from the isolated knoll Blatna Brezovica and in direct vicinity of the remains of a

<sup>25</sup> 2008.



Sl. 9.2: Načrt vzhodnega dela koliščarske naselbine Stare gmajne z označenim mestom odkritij drevakov 1 in 2.

Fig. 9.2: Plan of the eastern part of the pile-dwelling settlement Stare gmajne with marked positions of logboats 1 and 2.

pr. Kr.<sup>25</sup> Pred nekaj leti je Erič<sup>26</sup> odvzel vzorec čolna za radiokarbonsko datiranje. Rezultat kaže, da dejansko gre za plovilo, ki je glede na radiokarbonski datum  $4210 \pm 40$  uncal BP lahko sočasno s koliščem.

Dve novi najdbi, ki dokazujeta, da so koliščarji za plovbo po jezeru dejansko uporabljali drevake, izvirata z območja koliščarske naselbine Stare gmajne. Gre za dobro ohranjena čolna, ki smo ju z dendrokronološko metodo umestili v časovni okvir koliščja. Že zaradi tega je smiselno, da ju predstavimo v posebnem prispevku.

## 9.2 DREVAKA S STARIH GMAJN

### 9.2.1 OPIS DREVAKA 1

Na prvi drevak smo naleteli v jarku 4, v odsekih 40 in 41 (sl. 9.2). Najdba leži prečno čez jarek v smeri jugozahod-severovzhod in je bila poškodovana ob kopanju ter kasnejšem čiščenju odvodnega jarka.

Ob odkritju je čoln ležal na polžarici oz. verjetneje v gyttji,<sup>27</sup> vsekakor pa pod kulturno plastjo (sl. 9.3).

Na dnu jarka je bil viden osrednji del čolna, ki smo ga tudi dokumentirali (sl. 9.4). Preostala konca sta ostala *in situ*. Zato o dolžini čolna ne moremo govoriti.

Dokumentirani del drevaka je bil dolg približno 1,5 m.

<sup>25</sup> Velušček 1997b, 211–212.

<sup>26</sup> 2008, 14.

<sup>27</sup> Prim. s poglavjem 2 v tem zborniku.

pile-dwelling, which probably dates to the 3<sup>rd</sup> millennium BC.<sup>26</sup> A few years ago, Erič<sup>27</sup> took a sample of the logboat for radiocarbon dating. Result shows that this vessel could actually be contemporary to the pile-dwelling, if we consider the radiocarbon date of  $4210 \pm 40$  uncal BP.

Two new finds, which prove that pile-dwellers actually used logboats, were found at the pile-dwelling settlement Stare gmajne. These are well-preserved logboats that were dendrochronologically dated as contemporary with the pile-dwelling. It is therefore understandable that we introduce them in a separate chapter.

## 9.2 TWO LOGBOATS FROM STARE GMAJNE

### 9.2.1 DESCRIPTION OF THE LOGBOAT 1

The first logboat was found in ditch 4, in sections/sectors 40 and 41 (Fig. 9.2). It lay transversely across the ditch, in southwest-northeast direction, and was damaged at digging and cleaning of the drainage ditch.

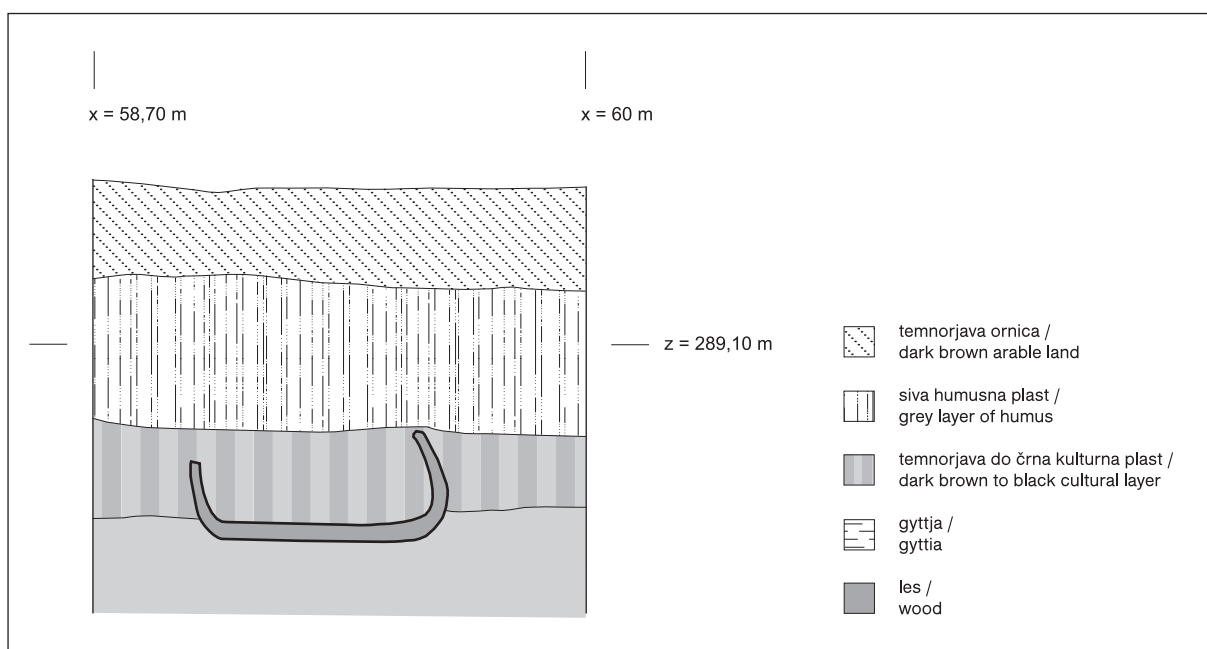
The logboat was situated on lake marl or, more probably, in gyttia,<sup>28</sup> under the cultural layer (Fig. 9.3).

Middle part of the logboat was discovered at the bottom of the ditch and was documented (Fig. 9.4). Both ends of the logboat stayed *in situ*. Length of the logboat is therefore unknown.

<sup>26</sup> Velušček 1997b, 211–212.

<sup>27</sup> 2008, 14.

<sup>28</sup> Compare with Chapter 2 in this monograph.



Sl. 9.3: Presek drevaka 1 v vzhodnem profilu jarka 4. Risba: T. Korošec. M = 1 : 20.

Fig. 9.3: Section of the logboat 1 in eastern profile of ditch 4. Drawn by: T. Korošec. Scale = 1 : 20.



Najširši obod stranic meri 68 cm. Prvotna širina čolna je bila odvisna od ukrivljenosti njegovih stranic, od obeh se je v prvotni višini delno ohranila le ena, široka 2–3 cm (sl. 9.3). Poškodbe stranic so nastale pri kopanju drenažnih jarkov. Sled uničenja se vidi tudi v osrednjem delu, kjer so stranice poškodovane v isti liniji kot poteka jarek (sl. 9.4). Določitev prvotne širine je otežena tudi zaradi deformacije stranic zaradi pritiska zemlje. Na to kažeta ohranjeni stranici ob vzhodnem profilu. Severna stranica se je rahlo odmaknila navzven, južna pa navznoter pod enakim kotom (sl. 9.3). Čoln je bil visok približno 30 cm glede na zunanje dno.

Širina dna, izmerjena na zunanji strani, je na vzhodni strani 55 cm. Na nasprotnem profilu se dno zoži na 35 cm. Dno je ravno po vsej dolžini in ob zahodnem profilu debelo približno 3 cm. Za centimeter oz. dva debelejše je na drugem koncu (sl. 9.3).

Edini notranji element v dokumentiranem delu čolna 1 je prečna ojačitev, ki se dviguje skoraj do polovice višine stranice (sl. 9.6b). Pri vrhu in na dnu je široka 17 cm, dolga približno 55 cm in visoka 10 cm. Po njeni sredini je iztesan 4-centimetrski utor.

Prečna ojačitev je počila, razpoka je nastala tudi v dnu drevaka, verjetno zaradi teže zemlje.

Drevak je bil narejen iz hrastovega debla.

Sl. 9.4: Pogled na drevak 1 v jarku 4. Foto: M. Turk.  
Fig. 9.4: The logboat 1 in ditch 4. Photo: M. Turk.



Sl. 9.5: Drevak 1 *in situ*. V bližini sta dva vertikalna kola, datirana v čas okoli 40 let pred koncem gradbenih aktivnosti v okviru hrastove kronologije SG-QUSP1. Posek kola št. 128 je datiran v leto 3150 ± 12 pr. Kr., posek kola št. 126 pa v leto 3149 ± 12 pr. Kr (glej poglavje 7.1.2.1 v tem zborniku). Risba: T. Korošec.

Fig. 9.5: The logboat 1 *in situ*. Two vertical piles nearby are dated to c. 40 years prior to termination of building activities, according to oak chronology SG-QUSP1. Felling of the pile no. 128 is dated to 3150 ± 12 BC. Felling of the pile no. 126 is dated to 3149 ± 12 BC (see chapter 7.1.2.1 in this monograph). Drawn by: T. Korošec.

The documented part of the logboat was c. 1.5 m long.

The logboat is 68 cm wide in its widest part. Initial width of the logboat depended upon the curvature of its sides. Initial height was partly kept only on one side, which is 2–3 cm wide (Fig. 9.3). Damages on the sides occurred while digging drainage ditches. Traces of destruction are also visible on the middle part of the logboat, where damages of the sides run parallel to the ditch (Fig. 9.4). Deformation of the sides, which is a consequence of pressure of the weight of the soil, presents still another problem in designation of primary width of the logboat. This can be seen at preserved sides in the eastern profile. The sides are slightly tilted under identical angle; the northern side outwards and the southern inwards (Fig. 9.3). The logboat was c. 30 cm high, considering the external bottom.

Width of the bottom is 55 cm and was measured on the eastern external side. The bottom narrows to 35 cm on the opposite profile. The logboat is flat-bottomed over the entire length and c. 3 cm thick in the western profile. At the eastern profile is a centimetre or two thicker (Fig. 9.3).

The only internal element in the documented part of the logboat 1 is a transverse reinforcement, rising up almost to half of the height of the logboat's sides (Fig. 9.6b). Top and bottom are 17 cm wide, c. 55 cm long and 10 cm high. A 4 cm wide groove runs in the middle.

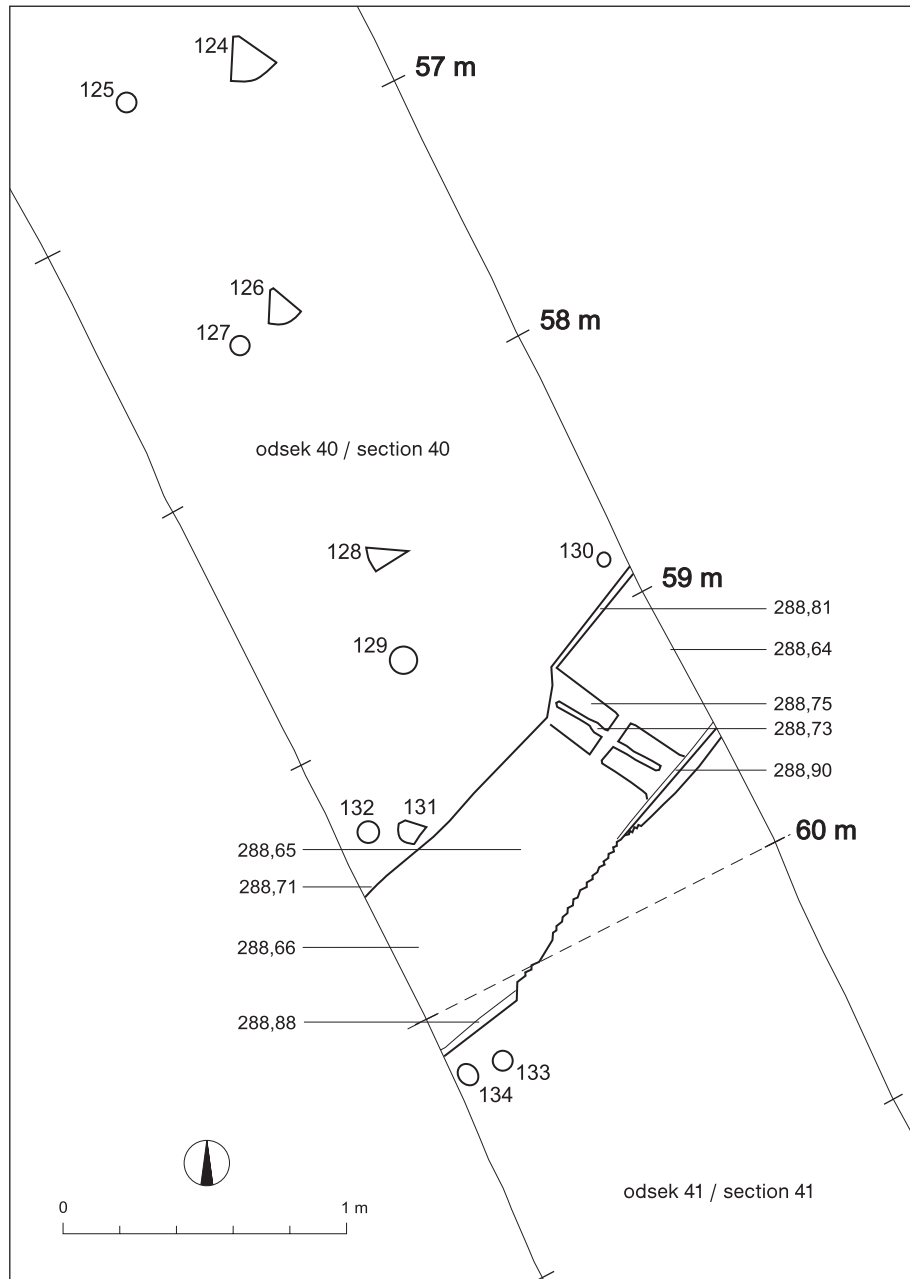
The transverse reinforcement burst and a crack is also visible in the bottom of the logboat. These damages are most probably a consequence of the pressure of the weight of the soil.

The logboat was made of oak trunk.



Sl. 9.6: Drevak 1. Pogled na prečno ojačitev z utorom ob vzhodnem profilu jarka (a) in detajl ob južni stranici čolna (b). Foto: M. Turk.

Fig. 9.6: Logboat 1. View on the transverse reinforcement with a groove at the eastern section of the ditch (a) and detail of the southern side of the logboat (b). Photo: M. Turk.

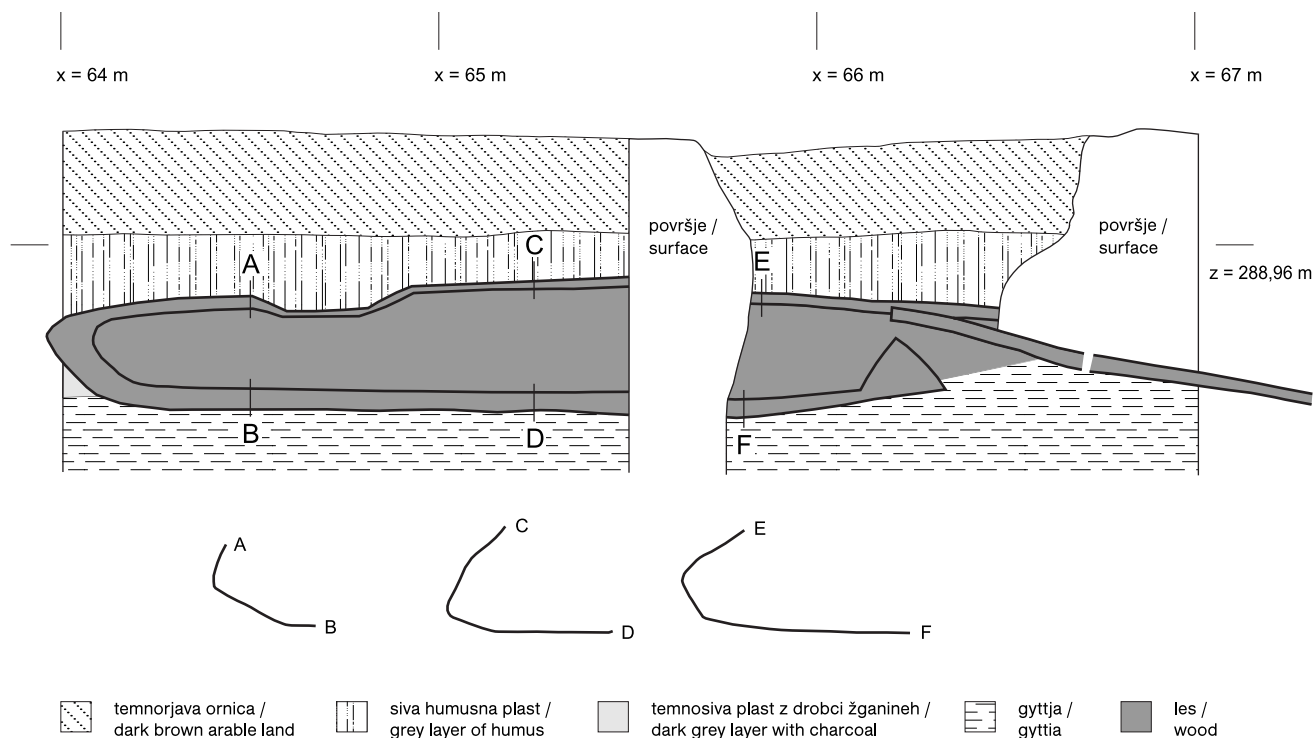


Sl. 9.5 / Fig. 9.5



Sl. 9.6 / Fig. 9.6





Sl. 9.7: Drevak 2 v vzhodnem profilu jarka 1. Risba: T. Korošec. M = 1 : 20.

Fig. 9.7: Logboat 2 in eastern profile of ditch 1. Drawn by: T. Korošec. Scale = 1 : 20.

### 9.2.2 OPIS DREVAKA 2

Drugi drevak je bil najden v jarku 1, na meji med odsekoma 120 in 121 (sl. 9.2). Ležal je skoraj vzporedno na odvodni jarek. Stroj za kopanje jarkov je drevaku posnel del premca oz. krme in večino odkrite stranice.

Ob odkritju je čoln ležal na polžarici oz. verjetneje v gyttji<sup>28</sup> pod slabo razpoznavno kulturno plastjo (sl. 9.7).

Dokumentirani del drevaka je meril v dolžino približno 3,30 m. Ugotovljena širina je na najširšem delu približno 55 cm. Prvotno je bil verjetno decimeter ali dva širši.

Notranja stranica je bila močno nagnjena v notranjost čolna. Širina stranice je bila pri vrhu 2–3 cm. Največja dokumentirana višina drevaka je 36 cm od zunanjšega dna (sl. 9.7). Ostanek zunanje stranice se je odlomil od dna, še preden ga je poškodoval stroj za kopanje jarkov.

Dno je ravno tik do konca, kjer prehaja skoraj pravokotno v stranico (glej sl. 9.7: E–F). Podobno kot pri drevaku 1 je tudi pri drevaku 2 vidna prečna ojačitev (sl.

<sup>28</sup> Prim. s poglavjem 2 v tem zborniku.

### 9.2.2 DESCRIPTION OF THE LOGBOAT 2

The second logboat was found in ditch 1, on the boundary between sections 120 and 121 (Fig. 9.2). It lay almost parallel to the drainage ditch. JCB damaged parts of the bow, the stern and the majority of the discovered side of the logboat.

The logboat was situated on lake marl or, more probably, in gyttja,<sup>29</sup> under hardly recognisable cultural layer (Fig. 9.7).

The documented part of the logboat was c. 3.30 m long. It was c. 55 cm wide at its widest part. It was probably a decimetre or two wider initially.

<sup>29</sup> Compare with Chapter 2 in this monograph.



Sl. 9.8: Pogled na ostanke drevaka 2 v jarku 1. Foto: M. Turk.  
Fig. 9.8: Remains of the logboat 2 in ditch 1. Photo: M. Turk.

9.8), ki pa je širša pri dnu in se oža proti vrhu. Visoka je med 10–12 cm in pri vrhu široka približno 10 cm. Na tem delu je čoln tudi najširši.

Tudi drevak 2 je bil narejen iz hrastovega debla.

### 9.2.3 PREČNA OJAČITEV

Oba drevaka s Starih gmajn imata na dnu prečno ojačitev (sl. 9.6 in 9.8), fran. *renfort transversal*.<sup>29</sup> Gre za pregrado, ki v širino presega dvakratno debelino dna drevaka, a je ožja od polovične višine stranic in je izdelana iz istega kosa lesa kot plovilo.

Ojačitve so delile plovilo v funkcionalne enote. Točna funkcija vsake enote verjetno ne bo nikoli znana. Kljub temu so bile prečne ojačitve ali masivnejše pregrade lahko uporabljene za oporo veslačem ali pa so služile kot sedeži.<sup>30</sup>

Pri drevakih lahko v prečni ojačitvi oz. tudi pri drugačnih vrstah pregrad najdemo utor, kakršen je npr. pri drevaku 1 s Starih gmajn (sl. 9.6). Vanj je bila morda vložena pregradna deska oz. nekakšna zapora. Gre za rešitev, ki je bila običajno postavljena na zadnjem delu drevaka in se v francoščini imenuje *arcasse*.<sup>31</sup> V primeru drevaka 1 s Starih gmajn (glej sl. 9.4) pa česa podobnega ne moremo trditi. Zdi se, da je eventualno vložena pregradna deska čoln delila na prekata.<sup>32</sup>

## 9.3 DENDROKRONOLOŠKA RAZISKAVA

Za dendrokronološko analizo smo iz vsakega drevaka odvzeli vzorec s prečnim prerezom na mestu s prečno ojačitvijo.

### 9.3.1 DREVAK 2

Najprej smo datirali drevak 2. Izmerili smo širine 77 branik. Njihovo zaporedje smo sinhronizirali s hrastovima kronologijama s Starih gmajn (SG-QUSP1) in z Velikega Otavnika Ib (VO6-QUSP1).

Zadnja branika čolna je bila datirana v relativno leto 152 (glej sl. 9.9) glede na hrastovo kronologijo s Starih gmajn (verzija kronologije SG24-999: OVL 77, GLK 62 %,  $t_{BP}$  7,2, program TSAP-Win) in Velikega Otavnika Ib (VO6-QUSP1: OVL 77, GLK 69 %,  $t_{BP}$  10,5, program TSAP-Win) (pri čemer je OVL – prekrivanje v letih, GLK – koeficient skladnosti, nem. *Gleichläufigkeit* (%),  $t_{BP}$  – t-vrednost po Baillie in Pilcherju). Zadnja branika čolna (relativno leto 152) je datirana v leto  $3134 \pm 12$

The internal side was strongly tilted towards the interior of the logboat. The side was 2–3 cm thick on top. The logboat is 36 cm high, measured from the external bottom (Fig. 9.7). Remains of the external side broke off the bottom before the damage by a JCB was done.

The logboat is flat-bottomed and slopes upwards to form an almost 90-degree angle with the sides (see Fig. 9.7: E–F). Similarly as the logboat 1, also the logboat 2 has a transverse reinforcement (Fig. 9.8). It is wider at the bottom and narrows upwards. It is 10–12 cm high and c. 10 cm wide on the top. The logboat is widest on this part.

The logboat 2 is also made of oak trunk.

### 9.2.3 TRANSVERSE REINFORCEMENT

Both logboats from Stare gmajne have bottom with transverse reinforcements (Fig. 9.6 and 9.8), so-called *renfort transversal* in French.<sup>30</sup> Transverse reinforcement is a barrier/partition, over twice as thick as the bottom of the logboat, but narrower as half of the height of sides. It is made from the same piece of wood as the logboat itself.

Reinforcements were dividing vessels to several functional units. We will probably never know exact functions of each unit. Transverse reinforcements or substantial partitions could be used as a support for rowers or as seats.<sup>31</sup>

Transverse reinforcement or different types of partitions sometimes have a groove running in the middle, like the one at e.g. the logboat 1 from Stare gmajne (Fig. 9.6). Blockade or some kind of partition plank was perhaps fixed into it. It was usually fixed on the stern of a logboat, so-called *arcasse* in French.<sup>32</sup> We cannot claim this in the case of the logboat 1 from Stare gmajne (see Fig. 9.4). Here, it looks like, that a partition plank perhaps divided the logboat into two units.<sup>33</sup>

## 9.3 DENDROCHRONOLOGICAL RESEARCH

Samples for dendrochronological research were taken from both logboats. This was done with cross-section on the area with transverse reinforcement.

### 9.3.1 THE LOGBOAT 2

The logboat 2 was dated first. Widths of 77 annual rings were measured. Their sequence was synchronised with oak chronologies from Stare gmajne (SG-QUSP1) and Veliki Otavnik Ib (VO6-QUSP1).

<sup>29</sup> Po Arnold 1996, 130.

<sup>30</sup> Rasmussen 1953, 18, 26, sl. 8.

<sup>31</sup> Arnold 1996, 58–59, 128.

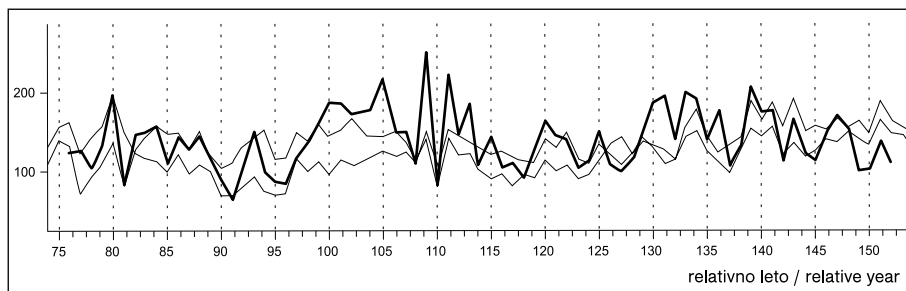
<sup>32</sup> Prim. z Arnold 1995, 85: Warnsdorf.

<sup>30</sup> After Arnold 1996, 130.

<sup>31</sup> Rasmussen 1953, 18, 26, Fig. 8.

<sup>32</sup> Arnold 1996, 58–59, 128.

<sup>33</sup> Compare with Arnold 1995, 85: Warnsdorf.



Sl. 9.9: Zaporedje širin branik drevaka 2 (poudarjena krivulja) v sinhronem položaju s hrastovo kronologijo Starih gmajn SG-QUSP1 in Velikega Otavnika Ib VO6-QUSP1. Zadnja branika čolna je datirana (relativno leto 152) v leto  $3134 \pm 12$  pr. Kr., čoln pa je bil narejen nekoliko kasneje, o čemer pričajo na mestu merjenja manjkajoče branike, ki so bile odstranjene pri obdelavi lesa.

Fig. 9.9: The logboat 2 annual-ring width sequence (emphasised curve), synchronized with oak chronologies from Stare gmajne SG-QUSP1 and Veliki Otavnik Ib VO6-QUSP1. The last annual ring of the logboat is dated to  $3134 \pm 12$  BC (relative year 152). Several peripheral annual rings were missing, which suggests that the logboat was made later. These annual rings were removed at woodworking.

pr. Kr., čoln pa je bil narejen nekoliko pozneje, o čemer pričajo na mestu merjenja manjkajoče branike, ki so bile odstranjene pri obdelavi lesa. Za oceno datuma poseka drevesa in izdelave čolna je treba  $3134 \pm 12$  pr. Kr. dodati še domnevno število manjkajočih branik na periferiji. Ker manjka beljava moramo, temu datumu prišteti vsaj 15 branik, kar drevak po starosti z veliko verjetnostjo umešča v desetletje pred koncem gradbenih aktivnosti na kolišču Stare gmajne.<sup>33</sup>

### 9.3.2 DREVAK 1

Datiranje drevaka 1 je bilo težavnejše, saj smo ga datirali šele potem, ko smo sestavili kronologijo Velikega Otavnika Ib (VO6-QUSP1). Zadnjo braniko drevaka 1 smo datirali v leto  $3211 \pm 12$  pr. Kr. (relativno leto 79). Statistični parametri datacije na kronologijo Velikega Otavnika Ib (verzijo kronologije VO6-903) so: OVL 81, GLK 69 %,  $t_{BP}$  6,3. Tudi pri drevaku 1 ni bila ohranjena beljava, iz grafa zaporedij širin branik pa sklepamo, da je lahko manjkalo več deset branik, zato moramo relativnemu datumu prišteti več kot 20 branik, kar ga časovno umešča relativno okoli leta 3190 pr. Kr. ali še kasneje, to pa se ujema z začetkom mlajšega dela poselitve na Starih gmajnah.

Ujemanje z drugimi sočasnimi kronologijami ni bilo statistično značilno. Slednje je običajen problem, kadar moramo datirati vzorec enega samega debla. Vseeno lahko zaporedja širin branik obeh čolnov umestimo v čas glede na druge kronologije na Ljubljanskem barju (sl. 9.11).

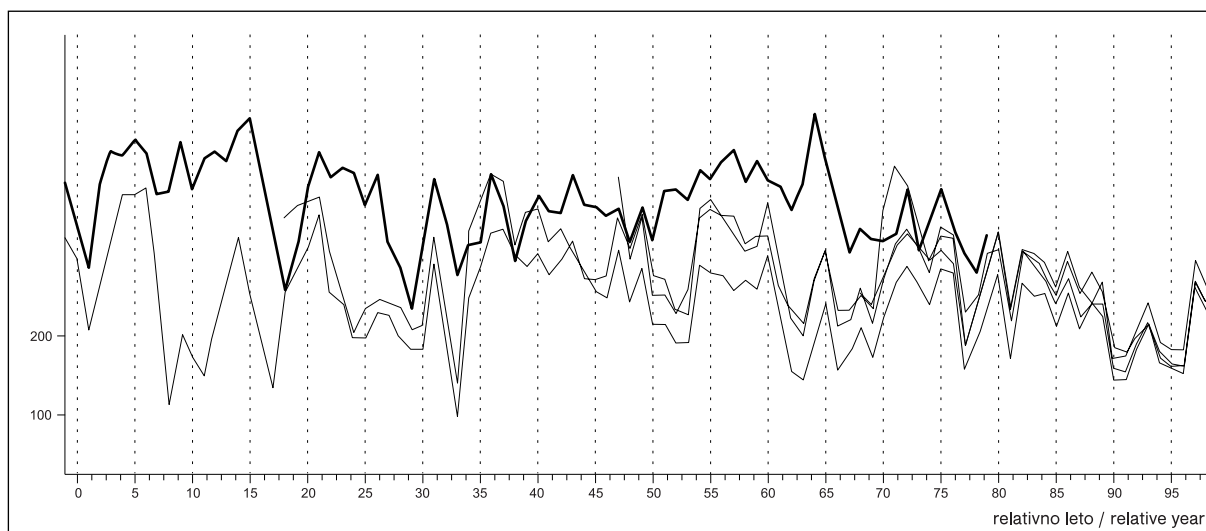
The logboat's last annual ring was dated (see Fig. 9.9) with oak chronology from Stare gmajne (chronology SG24-999: OVL 77, GLK of 62 %,  $t_{BP}$  7.2, TSAP-Win programme) and Veliki Otavnik Ib (VO6-QUSP1: OVL 77, GLK of 69 %,  $t_{BP}$  10.5, TSAP-Win programme); OVL – the overlapping of tree-ring chronologies in years, GLK – a coefficient of agreement, Ger. *Gleichläufigkeit* (%),  $t_{BP}$  – the t-value after Baillie and Pilcher. The logboat's last annual ring is dated to  $3134 \pm 12$  BC. Several peripheral annual rings were missing, which suggests that the logboat was made somewhat later. The missing peripheral annual rings were removed at woodworking. Sapwood is missing and we therefore have to add at least 15 years to 3134 BC to obtain the actual date of tree felling and construction of the logboat. This, most probably, places the making of the logboat to c. 3120 BC, i.e. a decade before the termination of building activities at the pile-dwelling Stare gmajne.<sup>34</sup>

### 9.3.2 THE LOGBOAT 1

Dating of the logboat 1 was more difficult, because we were only able to date it after we made a chronology of Veliki Otavnik Ib (VO6-QUSP1). The last annual ring of the logboat 1 was dated to  $3211 \pm 12$  BC. Statistical parameters to the chronology of Veliki Otavnik Ib (VO6-903) are: OVL 81, GLK of 69 %,  $t_{BP}$  6.3. As at the logboat 2, sapwood was not preserved. However, the pattern of tree-ring sequences shows that more than ten tree-rings are missing. We therefore have to add more than 20 years to the obtained date, which places the logboat to c. 3190 BC or later, which corresponds with the beginning of the younger phase of the settlement at Stare gmajne.

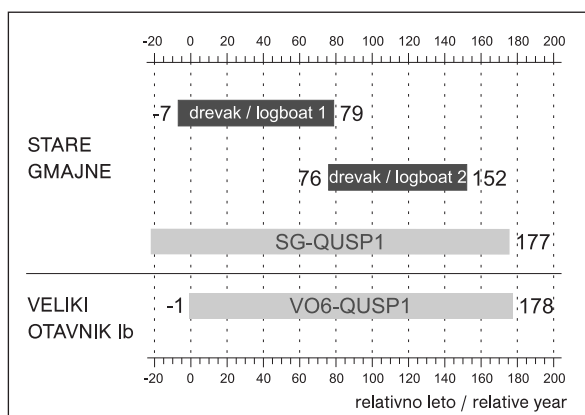
<sup>33</sup> Glej poglavje 7 v tem zborniku.

<sup>34</sup> See Chapter 7 in this monograph.



Sl. 9.10: Zaporedje širin branik drevaka 1 (poudarjena krivulja) v sinhronem položaju z različnimi verzijami hrastove kronologije Velikega Otavnika Ib. Zadnja branika čolna (relativno leto 79) je datirana v leto  $3211 \pm 12$  pr. Kr., čoln pa je bil narejen vsaj 20 let kasneje, o čemer pričajo manjkajoče branike na mestu merjenja.

Fig. 9.10: The logboat 1 annual-ring width sequence (emphasised curve), synchronized with different versions of oak chronology of Large Otavnik Ib. The last annual ring of the logboat is dated to  $3211 \pm 12$  BC (relative year 79). The logboat was made at least 20 years later, because several annual rings were removed.



Sl. 9.11: Sinhronizacija drevakov 1 in 2 s hrastovima kronologijama s Starih gmajn (SG-QUSP1) ter Velikega Otavnika Ib (VO6-QUSP1). Relativno leto 177 predstavlja leto  $3109 \pm 12$  pr. Kr.

Fig. 9.11: Synchronization (i.e. cross-dating) of the logboats 1 and 2 with oak chronologies from Stare gmajne (SG-QUSP1) and Veliki Otavnik Ib (VO6-QUSP1). Relative year 177 corresponds with  $3109 \pm 12$  BC.

## 9.4 SKLEPI

Drevaka, najdena na Starih gmajnah, sta bila izdelana in v uporabi v času obstoja naselbine. To smo predpostavljali že ob njunem odkritju, saj smo ju našli v bližini ostankov naselja (drevak 1 leži dobesedno med koli).

Overlapping with other contemporary chronologies was not statistically significant. Low agreement is usual when we want to date a sample from one trunk. Still, tree-ring series from both logboats can be placed in time with the help of other chronologies constructed for the Ljubljansko barje (Fig. 9.11).

## 9.4 CONCLUSIONS

The two logboats, found at Stare gmajne, were made and used in time of existence of the settlement. We were already assuming this at their discovery; we found them in the vicinity of remains of the settlement (logboat 1 lies literally between piles).

The logboat 1 dates to the initial period of the last settlement phase, while the logboat 2 dates to the end of the last settlement phase at Stare gmajne. Both logboats date to the 32<sup>nd</sup> century BC. This is important, because, together with the ones described, only three pile-dwelling logboats have so far been discovered on the Ljubljansko barje; all the rest found and dated logboats from the Ljubljansko barje are younger.

Logboats from Stare gmajne are made of oak trunks. Transverse reinforcements are preserved on both logboats. The logboat 1 has a groove carved into the reinforcement (Fig. 9.6), perhaps for a partition plank.

Drevak 1 je iz začetnega obdobja mlajše poselitve, drevak 2 pa iz zadnjega obdobja poselitve na Starih gmajnah, torej sodita v 32. stoletje pr. Kr. Ugotovitev je pomembna zato, ker so bili do sedaj na Ljubljanskem barju skupaj z opisanimi najdeni le trije koliščarski drevaki, vsi ostali do sedaj odkriti in datirani drevaki z Ljubljanskega barja pa so mlajši.

Drevaka s Starih gmajn sta narejena iz hrastovih debel. V obeh je ohranjena prečna ojačitev. Drevak 1 ima v ojačitev izdolben utor (*sl. 9.6*), morda za pregradno desko.



# 10. NOVOODKRITE LESENE NAJDBE S STARIH GMAJN PRI VERDU

Tjaša TOLAR & Martin ZUPANČIČ

## Izvleček

Arheološke raziskave na koliščarski naselbini Stare gmajne pri Verdu na Ljubljanskem barju so med letoma 2004 in 2007 prinesle nova odkritja lesenih predmetov. V letu 2004 je bil najden ostanek toporišča, zasajen v kamniti sekiri, izdelan iz lesa dreva (*Cornus* sp.). V sondi iz leta 2006 sta bila najdena dva lesena artefakta, v celoti ohranjen otroški lok iz lesa tise (*Taxus baccata*) in lesen ročaj iz lesa dreva (*Cornus* sp.). V letu 2007 pa je bil najden še nekoliko daljši ostanek toporišča iz lesa jesena (*Fraxinus* sp.), zasajenega v sekiro iz rogovja.

Predmeti zaradi izbire in uporabe lesa potrjujejo, da so ljudje pred več kot 5000 leti dobro poznali lastnosti lesa in da so ga znali optimalno izbrati in uporabiti.

**Ključne besede:** lesene najdbe, determinacija, Stare gmajne, Ljubljansko barje, eneolitik.

## 10.1 UVOD

Arheološke raziskave na koliščarski naselbini Stare gmajne pri Verdu na Ljubljanskem barju so med letoma 2004 in 2007 prinesle nova odkritja lesenih predmetov. V letu 2004 je bilo najdeno delno ohranjeno toporišče, zasajeno v kamnito kladivasto sekiro (sl. 10.1).<sup>1</sup> V sondi iz leta 2006 sta bila najdena dva lesena artefakta, v celoti ohranjen otroški lok (sl. 10.9) in lesen ročaj (sl. 10.5). V letu 2007 pa je bil najden še nekoliko daljši ostanek lesenega toporišča, zasajenega v sekiro iz rogovja (sl. 10.3).

V Sloveniji so lesene najdbe na arheoloških najdiščih praviloma zelo redke, saj so več tisoč let stari organski materiali, tudi les, podvrženi razgradnji in razpadu, če niso ležali v anoksičnem, ekstremno vlažnem, suhem ali hladnem okolju.<sup>2</sup> Kakor koli že, gre za najdbe, ki so vsekakor zelo zanimive kot arheološki artefakti, za boljše razumevanje preteklosti pa je dobro vedeti, iz katerih vrst

<sup>1</sup> Glej Tolar, Čufar, Velušček 2008

<sup>2</sup> Čufar et al. 2008, 56.

# 10. NEWLY DISCOVERED WOODEN FINDS FROM STARE GMAJNE NEAR VERD

Tjaša TOLAR & Martin ZUPANČIČ

## Abstract

Between 2004 in 2007, archaeological researches of the pile-dwelling settlement Stare gmajne near Verd at the Ljubljansko barje, revealed new discoveries of wooden objects. In 2004, remains of a handle made of cornel (*Cornus* sp.) were found in a shaft-hole of a stone axe. Two wooden artefacts were found in trench in 2006; entirely preserved children's bow of yew (*Taxus baccata*) and cornel handle (*Cornus* sp.). In 2007, somewhat longer fragment of a handle made of ash (*Fraxinus* sp.) was found in a shaft-hole of an antler axe.

With the choice and use of wood, these finds confirm that over 5000 years ago people had good knowledge of wood properties and knew how to optimally choose and use different species of wood.

**Keywords:** wooden finds, determination, Stare gmajne, Ljubljansko barje, Eneolithic.

## 10.1 INTRODUCTION

Between 2004 and 2007, archaeological research of the pile-dwelling settlement Stare gmajne near Verd at the Ljubljansko barje, produced new discoveries of wooden objects. In 2004, partly preserved handle was found in a shaft-hole of a stone shaft-hole axe (Fig. 10.1).<sup>1</sup> Two wooden artefacts, entirely preserved children's bow (Fig. 10.9) and a wooden handle (Fig. 10.5), were found in trench examined in 2006. In 2007, somewhat longer fragment of a wooden handle in a shaft-hole of an antler axe was discovered (Fig. 10.3).

Wooden finds rarely occur at archaeological sites in Slovenia as over thousands of years organic materials, also wood, subjected to decomposition and decay, if these were not preserved in anoxic, extremely damp, dry or cold environment.<sup>2</sup> These are finds that are very interesting as archaeological artefacts; however, for bet-

<sup>1</sup> See Tolar, Čufar, Velušček 2008.

<sup>2</sup> Čufar et al. 2008, 56.

lesa so bile narejene. Zato smo preiskali les omenjenih štirih lesenih predmetov z Ljubljanskega barja.

S kolišč z Ljubljanskega barja doslej še ni bilo raziskanih veliko podobnih najdb.<sup>3</sup> Med njimi je vsekakor najprej treba omeniti prazgodovinsko kolo, katerega analiza je pokazala, da je izdelano iz jesenovega lesa, z letvami iz hrastovega lesa, enako kot tudi pripadajoča os.<sup>4</sup> Znano je, da so za vesla uporabljali hrastov<sup>5</sup> in tudi bukov les.<sup>6</sup> Prazgodovinski drevaki so velikokrat izdelani iz hrastovega lesa,<sup>7</sup> medtem ko so prazgodovinski loki pogosto izdelani iz izjemno prožnega lesa tise.<sup>8</sup>

Številne raziskave lesenih toporišč različnih vrst sekir z npr. švicarskih kolišč so pokazale, da so za izdelavo tovrstnih predmetov večinoma uporabljali jesenov les.<sup>9</sup> To ni presenetljivo, saj les jesena slovi po dobri udarni žilavosti in je zato primeren za obremenitve, ki nastajajo pri uporabi sekire.

## 10.2 RAZISKAVA

### 10.2.1 OPIS LESENIH NAJDB

V raziskavo smo dobili tri različno ohranjene mokre ostanke lesenih držajev (glej *sl. 10.1, 10.3* in *10.5*), dva ostanka toporišč dveh različnih sekir, kamnite in iz rogovja (*sl. 10.1* in *10.3*), ter en v celoti ohranjen lesen ročaj (*sl. 10.5*) s kolišča Stare gmajne na Ljubljanskem barju. Leta 2006 je bil v sondi 2 odkrit tudi otroški lok (*sl. 10.9*).

0,97 kg težka kamnita kladivasta sekira z delno ohranjenim toporiščem (*sl. 10.1*) je narejena iz kamnine, katere izvor je iskati zunaj ozemlja današnje Slovenije.<sup>10</sup> Odlomek toporišča meri v dolžino 4,6 cm in ima premer 2,1 cm.

0,22 kg težka sekira z delno ohranjenim toporiščem (*sl. 10.3*) je narejena iz rogovja jelena,<sup>11</sup> ki je bil značilen prebivalec v tedanji pokrajini. Odlomek toporišča meri v dolžino 24 cm in ima premer 1,7 cm.

V celoti ohranjen leseni ročaj (*sl. 10.5*) meri v dolžino 10 cm in ima premer 3,3 cm. Najdba je izredno zanimiva, saj ne gre za npr. toporišče kamnitega bodala ali noža, temveč za oprijemalni del, ki se nadaljuje v leseno toporišče premera 2 cm (glej *sl. 10.7*).

<sup>3</sup> Greif 1997, 46.

<sup>4</sup> Velušček 2002a, 53 in poglavje 8 v tem zborniku.

<sup>5</sup> Bregant 1974a, 15.

<sup>6</sup> K. Čufar, osebna komunikacija.

<sup>7</sup> Npr. Dirjec 1990, 136 s; Erič 1994, 76; glej še poglavje 9 v tem zborniku.

<sup>8</sup> Npr. Velušček 2004b, 43.

<sup>9</sup> Npr. Schweingruber 1965, 157 ss; Stotzer, Schweingruber, Šebek 1976, 13 ss; Hochuli 2000, 187; Leuzinger 2002a, 76 ss.

<sup>10</sup> Tolar, Čufar, Velušček 2008; glej še poglavje 12 v tem zborniku.

<sup>11</sup> Poglavje 14 v tem zborniku.

ter understanding of the past we would need to know what kind of wood they were made of. That is why we examined wood of the four mentioned wooden objects found at the Ljubljansko barje.

Only a few analogous finds from the Ljubljansko barje pile-dwellings were examined to date.<sup>3</sup> Among them, a prehistoric wheel has to be mentioned, analysis of which showed that it was made of ash, with oak cross-bars and axle.<sup>4</sup> It is known that oak<sup>5</sup> and beech<sup>6</sup> were used for making oars. Prehistoric logboats were often made of oak,<sup>7</sup> while prehistoric bows were frequently made of an exceptionally flexible yew.<sup>8</sup>

Examinations of wooden handles of different types of axes from the Swiss pile-dwellings, for example, showed that ash was commonly used for making such objects.<sup>9</sup> This is not astonishing, because ash wood is known for its high impact strength and is therefore suitable for axe.

## 10.2 RESEARCH

### 10.2.1 DESCRIPTION OF WOODEN FINDS

We received three wet fragments of wooden handles for further research (see *Figs. 10.1, 10.3* and *10.5*). They were found at the Stare gmajne pile-dwelling at the Ljubljansko barje. Each was in a different state of preservation. These were two fragments of handles from two axes, one stone and the other one antler (*Figs. 10.1* and *10.3*), and one entirely preserved wooden handle (*Fig. 10.5*). In 2006, also a children's bow (*Fig. 10.9*) was discovered in trench 2.

The stone shaft-hole axe with the partly preserved handle (*Fig. 10.1*) weighed 0.97 kg and was made of rock, not native in Slovenia.<sup>10</sup> The fragment of the handle is 4.6 cm long with a diameter of 2.1 cm.

The deer's antler axe<sup>11</sup> with the partly preserved handle (*Fig. 10.3*) weighed 0.22 kg; deer was common in the area at that time. Fragment of the handle is 24 cm long with a diameter of 1.7 cm.

The entirely preserved wooden handle (*Fig. 10.5*) is 10 cm long with a diameter of 3.3 cm. The find is extremely interesting, as it is not only a handle of a stone dagger or a knife, for example, but a grip that extends to a wooden helve like object with a diameter of 2 cm (see *Fig. 10.7*).

<sup>3</sup> Greif 1997, 46.

<sup>4</sup> Velušček 2002a, 53; see also Chapter 8 in this monograph.

<sup>5</sup> Bregant 1974a, 15.

<sup>6</sup> K. Čufar, pers. comm.

<sup>7</sup> E.g. Dirjec 1990, 136; Erič 1994, 76; see also Chapter 9 in this monograph.

<sup>8</sup> E.g. Velušček 2004b, 43.

<sup>9</sup> E.g. Schweingruber 1965, 157; Stotzer, Schweingruber, Šebek 1976, 13; Hochuli 2000, 187; Leuzinger 2002a, 76.

<sup>10</sup> Tolar, Čufar, Velušček 2008; see also Chapter 12 in this monograph.

<sup>11</sup> See Chapter 14 in this monograph.

64,4 cm dolg lok (*sl. 10.9*) po mnenju A. Veluščka<sup>12</sup> sodi med otroške loke, ki so za razliko od lokov za odrasle, krajši, tanjši in narejeni iz slabše veje. Lok, primeren za lov, naj bi bil dolg med 145 in 170 cm.<sup>13</sup>

Kljub visoki starosti je les vseh štirih najdb razmeroma dobro ohranjen, kolikor to dopušča lega v mokrih in ilovnatih barjanskih tleh.

## 10.2.2 METODE DE LA

Za identifikacijo lesa smo uporabili makroskopske in mikroskopske metode. Makroskopske temeljijo na anatomskih znakih, ki jih vidimo s prostim očesom ali z lupo.<sup>14</sup> Za opazovanje pod lupo smo moker arheološki les najprej zamrznili, nato smo mu zgladili površine treh anatomskih ravnin. Za mikroskopsko preiskavo smo naredili tanke preparate.

Za svetlobno mikroskopijo smo vzorec arheološkega lesa velikosti  $0,5 \times 0,5 \times 1$  cm vklopili v polietilen glikol (PEG) 1500. Les smo prepajali v vodnih raztopinah PEG z naraščajočimi koncentracijami (20 %, 50 %, 75 % in 100 %) pri temperaturi 60 °C. Ko je bilo prepajanje končano, smo vzorec posušili na zraku pri sobni temperaturi. Nato smo s pomočjo drsnega mikrotoma Leica SM 2000R z mikrotomskim nožem odrezali rezine lesa prečnega, radialnega in tangencialnega prereza, debelin 20 µm. Presežni PEG smo odstranili z vodo, rezine lesa pa obarvali z vodnimi raztopinami barvil safranin in astra modro, dehidrirali v etanolu naraščajočih koncentracij (50 %, 70 % in 95 %) ter rezine položili na objektna stekla, vklopili v euparal in prekrili s krovni stekli. Za opazovanje smo uporabili svetlobni mikroskop Nikon Eclipse E800, fotografiranje pa smo opravili s pripadajočim digitalnim fotoaparatom Nikon Coolpix 995.

Za določitev vrste lesa smo uporabili ključne za makroskopsko in mikroskopsko identifikacijo lesa<sup>15</sup> ter preparate recentnega lesa iz lastne referenčne zbirke.

## 10.3 REZULTATI IN DISKUSIJA

### 10.3.1 ODLOMEK TOPORIŠČA KAMNITE SEKIRE

Makroskopska identifikacija raziskovanega odlomka lesa toporišča kamnite kladivaste sekire ni bila mogoča, mikroskopski pregled pa je nakazal, da gre za les dreva ali pušpana, ki imata podobno zgradbo.<sup>16</sup>

<sup>12</sup> Poglavje 3.2.2.1 v tem zborniku: *sl. 3.29*.

<sup>13</sup> Velušček 2004b, 44.

<sup>14</sup> Čufar, Zupančič 2000, 48.

<sup>15</sup> Schweingruber 1990; Torelli 1991; H. G. Richter in M. J. Dallwitz, *Commercial timbers: descriptions, illustrations, identification and information retrieval*. Računalniški program – ključ za določanje komercialnih lesnih vrst INTKEY 2002.

<sup>16</sup> Glej Tolar, Čufar, Velušček 2008.

According to A. Velušček,<sup>12</sup> the 64.4 cm long bow (*Fig. 10.9*), is a children's bow; unlike the bows used by adults, the children's ones are shorter, thinner and made of poor quality branches. Bow, suitable for hunting, should be c. 145–170 cm long.<sup>13</sup>

Despite their considerable age, wood of all four fragments is comparatively well preserved, due to moist and loamy soil of the Barje floor.

## 10.2.2 METHODOLOGY

Macroscopic and microscopic methods were used to identify the wood. Macroscopic methods are based on anatomical signs that we can see with naked eye or lens.<sup>14</sup> For examination under a magnifying glass, the wet archaeological wood was first frozen and then the surfaces of three anatomic planes were smoothed. Thin slides were then prepared for microscopic examination.

For light microscopy we placed a sample of the archaeological wood measuring:  $0.5 \times 0.5 \times 1$  cm in polyethylene glycol (PEG) 1500. The wood was impregnated with aqueous solutions PEG with incremental concentrations (20 %, 50 %, 75 % and 100 %) at 60 °C. When the infiltration was finished, the sample was dried in the open at room temperature. Then with the help of a Leica SM 2000R sliding microtome thin segments were cut of cross, radial, and tangential sections, 20 µm thick. Excess PEG was then removed with water, segments of wood were painted with aqueous solutions of pigments safranin and astra blue, dehydrated in ethanol of incremental concentrations (50 %, 70 % and 95 %) and positioned on glass slides, mounted in Euparal and covered with cover glass. Observations were made using a Nikon Eclipse E800 light microscope, and photographs were taken with the corresponding digital camera Nikon Coolpix 995.

Keys for the macroscopic and microscopic identification of wood<sup>15</sup> and slides of modern wood from our own reference collection were utilized to determine the type of wood.

## 10.3 RESULTS AND DISCUSSION

### 10.3.1 FRAGMENT OF THE HANDLE OF THE STONE AXE

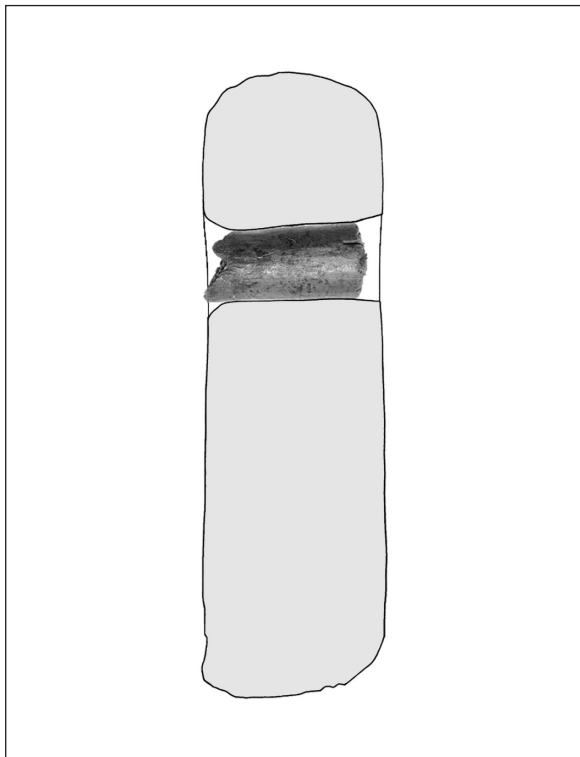
Macroscopic identification of the wooden fragment of the handle of the stone shaft-hole axe was impossible,

<sup>12</sup> Chapter 3.2.2.1 in this monograph: *Fig. 3.29*.

<sup>13</sup> Velušček 2004b, 44.

<sup>14</sup> Čufar, Zupančič 2000, 48.

<sup>15</sup> Schweingruber 1990; Torelli 1991; H. G. Richter in M. J. Dallwitz, *Commercial timbers: descriptions, illustrations, identification and information retrieval*. Computer programme INTKEY 2002.



Sl. 10.1: Stare gmajne, jarek 12, 2004. Odlomek lesenega toporišča v kladivasti sekiri (glej še t. 3.14: 1,2). Foto: T. Tolar; risba: T. Korošec. M = 1 : 2.

Fig. 10.1: Stare gmajne, ditch 12, 2004. Part of the wooden handle in the shaft-hole of the axe (see also Pl. 3.14: 1,2). Photo: T. Tolar; drawn by: T. Korošec. Scale = 1 : 2.

Za podrobnejšo določitev smo najprej pregledali mikroskopske preparate lesa rumenega in rdečega dreva ter navadnega pušpana iz dendrološko določenih dreves oz. grmov iz lastne referenčne zbirke, nato pa smo jih primerjali z opisi v virih Schweingruber<sup>17</sup> in Torelli.<sup>18</sup> Računalniški ključ INTKEY<sup>19</sup> je vseboval samo opis pušpana.

Na podlagi anatomskih znakov, predvsem premerov trahej in števila prečk v lestvičastih perforacijah ter tipa heterogenega traku, smo potrdili, da je bilo toporišče kladivaste sekire narejeno iz lesa dreva (*Cornus* sp.) (glej sl. 10.2).

Les dreva ima visoko gostoto, do 1000 kg/m<sup>3</sup>, zato je posledično trden, trd in žilav.<sup>20</sup> Zaradi fine teksture (majhnih trahej) in visoke gostote ga je mogoče zelo gladko obdelati. Navedene lastnosti so optimalne za les, ki ga želimo uporabiti za držaje težjih orodij.

but the microscopic examination hinted that it was made of cornel or boxwood, which are similar.<sup>16</sup>

To make a more detailed determination, we first examined microscopic slides of the wood of dogwood, cornel and common box from dendrologically determined trees or bushes, and then compared them to descriptions in the basic reference sources of Schweingruber<sup>17</sup> and Torelli,<sup>18</sup> while the computer key INTKEY<sup>19</sup> contained only a description of boxwood.

Based on anatomic features, particularly the measured dimensions of the vessels and the number of bars in the scalariform perforations and the type of heterogeneous rays, it was established that the handle of the shaft-hole axe was made from cornel or dogwood (*Cornus* sp.) (see Fig. 10.2).

Cornel wood has a high to exceptionally high density to 1000 kg/m<sup>3</sup> and is consequently hard, solid, and strong.<sup>20</sup> It can be worked very smoothly due to fine texture (small vessels) and high density. These properties are optimal for wood intended to be used for the handle of a tool.

### 10.3.2 REMAINS OF THE HANDLE OF THE ANTLER AXE

Macroscopic and microscopic examination of the fragment indicated ash (*Fraxinus* sp.) (see Fig. 10.4), which was commonly used for making handles.

Ash wood has an average density ( $\rho_0$ ) of 650 kg/m<sup>3</sup> and is comparatively hard, solid and tough. Ash is a wood species with the highest dynamical strength in the present day commercially used European species of wood. Moreover, ash trees, growing in suitable habitats, have wide annual rings and are therefore, due to their strength, extremely appropriate for making tool handles.<sup>21</sup>

### 10.3.3 WOODEN HANDLE

The macroscopic identification of the examined wooden artefact was impossible as insufficient anatomic features could be seen because exceptionally appealing, smooth treatment of wood, and the juvenile nature of the sample- the wood of the handle also contained pith (see Figs. 10.5 and 10.7). However, microscopic examination (see Fig. 10.6) confirmed that it is cornel (*Cornus* sp.). Peripheral part of the handle was superficially showing different characteristics (darker colour) as the central part (see Fig. 10.7). We

<sup>17</sup> 1990.

<sup>18</sup> 1991.

<sup>19</sup> Richter, Dallwitz 2002 (op. 15).

<sup>20</sup> Horvat 1959, 245.

<sup>16</sup> See Tolar, Čufar, Velušček 2008.

<sup>17</sup> 1990.

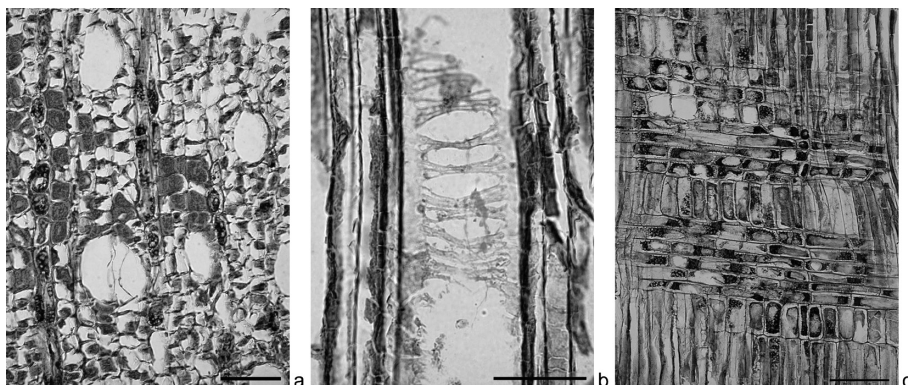
<sup>18</sup> 1991.

<sup>19</sup> Richter, Dallwitz 2002 (footnote 15).

<sup>20</sup> Horvat 1959, 245.

<sup>21</sup> Čufar 2006, 52, 74 f, 164.





Sl. 10.2: Mikroskopska zgradba lesa dreva (*Cornus* sp.) iz toporišča kamnite sekire: a) difuzno porozen les z več kot 30  $\mu\text{m}$  velikimi porami, b) lestvičaste perforacije z več kot 20 prečkami, c) heterogeno trakovno tkivo z več vrstami pokončnih robnih celic. Foto: M. Zupančič. Merilna daljica = 50  $\mu\text{m}$ .

Fig. 10.2: Microscopic structure of cornel (*Cornus* sp.) from the handle of the stone shaft-hole axe: a) diffuse porous wood with pores over 30  $\mu\text{m}$  in size, b) scalariform perforations with more than 20 bars, c) heterogeneous ray tissue with several types of marginal upright cells. Photo: M. Zupančič. Scale bar = 50  $\mu\text{m}$ .

### 10.3.2 OSTANEK TOPORIŠČA SEKIRE IZ ROGOVJA

Makroskopski in mikroskopski pregled koščka lesa toporišča sekire iz rogovja je pokazal, da gre za les jesena (*Fraxinus* sp.) (glej sl. 10.4), ki spada med pogosto uporabljene les za izdelavo držajev.

Les jesena ima srednjo gostoto (ro) 650  $\text{kg}/\text{m}^3$  ter je razmeroma trd, trden in žilav. Jesenovina spada med lesne vrste z najvišjo dinamično trdnostjo med danes komercialno uporabljanimi evropskimi lesnimi vrstami. Poleg tega ima les jesenovih dreves, ki so rasla na dobrih rastiščih, široke branike in je po trdnosti izredno primeren za izdelavo držajev orodij.<sup>21</sup>

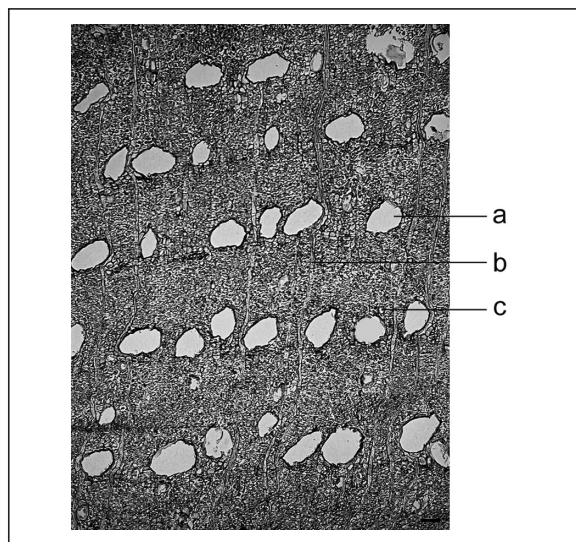
<sup>21</sup> Čufar 2006, 52, 74 s, 164.



Sl. 10.3: Stare gmajne, sonda 3, 2007. Ostanek lesenega toporišča v sekiri iz rogovja. Foto: T. Tolar. Premer toporišča = 1,7 cm.

Fig. 10.3: Stare gmajne, trench 3, 2007. Remains of the wooden handle in the shaft-hole of the antler axe. Photo: T. Tolar. Handle's diameter = 1.7 cm.

therefore wanted to find out, if the wood in the centre of the handle, could be hafted wooden tool and of a different origin as the handle itself. That is why the analysis of wood was made on the central part and transition of wood from the presumed hafted tool to the handle was checked. Analysis showed that it is also cornel. Assumption of the hafted wooden tool, that was unfortunately not preserved, was rejected on the



Sl. 10.4: Mikroskopska zgradba lesa jesena (*Fraxinus* sp.) iz toporišča sekire iz rogovja. Les je venčasto porozen (a), ima ozke trakove (b), mestoma je viden pičel ali vazicentričen aksialni parenhim okoli trahej (c). Foto: M. Zupančič. Merilna daljica = 50  $\mu\text{m}$ .

Fig. 10.4: Microscopic structure of ash (*Fraxinus* sp.) handle of the antler axe. The wood is ring-porous (a), has narrow rays (b), scanty or vazicentric axial parenchyma surrounding vessels (c). Photo: M. Zupančič. Scale bar = 50  $\mu\text{m}$ .

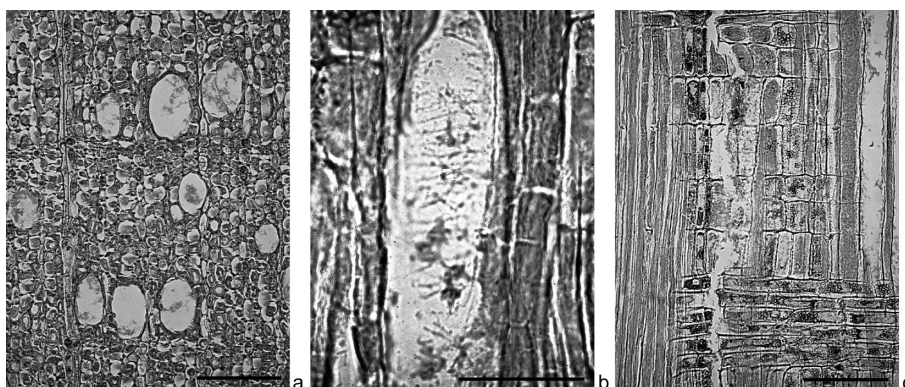




Sl. 10.5: Stare gmajne, sonda 2, 2006. Lesen ročaj. Foto: T. Tolar. Dl. = 10 cm.

Fig. 10.5: Stare gmajne, trench 2, 2006. Wooden handle. Photo: T. Tolar. Length = 10 cm.

basis of detailed comparison of annual rings and rays from presumed hafted tool (brighter, broken central part) with detailed examination of the handle (darker peripheral part). Transition of annual rings and rays from the central to peripheral part, i.e. handle, is explicit (Fig. 10.8). This confirms that the central part, i.e. “hafted wooden tool”, was made simultaneously and from the same piece of wood as the handle/grip of the unknown wooden tool.



Sl. 10.6: Mikroskopska zgradba lesa ročaja iz dreva (*Cornus* sp.): a) difuzno porozen les z več kot 30  $\mu\text{m}$  velikimi porami, b) lestvičaste perforacije z več kot 20 prečkami, c) heterogeno trakovno tkivo z več vrstami pokončnih robnih celic. Foto: M. Zupančič. Merilna daljica = 50  $\mu\text{m}$  (sl. 10.6b) in 100  $\mu\text{m}$  (sl. 10.6a in 10.6c).

Fig. 10.6: Microscopic structure of cornel wood (*Cornus* sp.) from the handle: a) diffuse porous wood with over 30  $\mu\text{m}$  large vessels, b) scalariform perforations with more than 20 bars, c) heterogeneous ray tissue with several types of marginal upright cells. Photo: M. Zupančič. Scale bar = 50  $\mu\text{m}$  (Fig. 10.6b) and 100  $\mu\text{m}$  (Figs. 10.6a and 10.6c).

### 10.3.3 LESEN ROČAJ

Zaradi izjemno lepe, gladke obdelave lesa ter juvenilnosti vzorca – les ročaja je vseboval tudi stržen (glej sl. 10.5 in 10.7), zanesljiva makroskopska identifikacija raziskovanega lesenega artefakta ni bila možna, mikroskopski pregled (glej sl. 10.6) pa je potrdil, da gre za les dreva (*Cornus* sp.). Ker je periferni del ročaja na prvi pogled izkazoval drugačne lastnosti (temnejša barva) od sredinskega dela (glej sl. 10.7), smo želeli ugotoviti, ali je les v sredini ročaja, ki je na videz tak, da bi lahko predstavljal

Sl. 10.7: Pogled lesenega ročaja v prečnem prerezu, kjer opazimo svetlejši sredinski del, ki bi lahko predstavljal nasajeno orodje, in stržen v njem. Foto: T. Tolar.

Fig. 10.7: Wooden handle in cross-section, with noticeable brighter central part that could represent hafted tool, and the pith within. Photo: T. Tolar.



nasajeno leseno orodje, drugega izvora kot sam ročaj. Zato smo tudi na njem opravili analizo lesa in preverili prehod lesa iz domnevnega nasajenega orodja v ročaj. Analiza je pokazala, da gre za isti les, torej les drena. Domnevo o morebitnem nasajenem lesenem orodju, ki žal ni bilo ohranjeno, smo zavrnila z natančnim pregledom poteka branik in trakov iz domnevnega nasajenega orodja (svetlejšega, odlomljenega sredinskega dela) v ročaj (temnejši periferni del). Prehod branik in trakov iz sredinskega dela v periferni, ki predstavlja ročaj, namreč izrazito sledi in se nadaljuje (sl. 10.8), kar je zanesljiv dokaz, da je bil sredinski del, ki bi lahko predstavljal nasajeno leseno orodje, narejen sočasno in iz istega kosa lesa kot sam ročaj oz. oprijemalni del neznanega lesenega orodja.

### 10.3.4 LOK

Makroskopski pregled lesa loka je takoj pokazal, da gre za les iglavcev. Da bi ugotovili vrsto, smo morali tudi v tem primeru izdelati mikroskopski preparat in iskati specifične anatomske znake. Ozke branike s temnim in ozkim kasnim lesom, odsotnost smolnih kanalov ter prisotnost helikalnih (spiralnih) odebelitev v traheidah potrjujejo (glej sl. 10.10), da gre za les tise (*Taxus baccata*).<sup>22</sup>

Les tise ima srednjo gostoto (ro)  $640 \text{ kg/m}^3$ <sup>23</sup> in spada med iglavce z višjo gostoto, trdnostjo in trdoto. Poleg tega je les tudi žilav in elastičen, odporen na atmosferske vplive in naravno trajen. Mogoče ga je odlično obdelati. Les tise je tako med najprimernejšimi za izdelavo lokov.

Pričujoča raziskava potrjuje predhodne ugotovitve, da so bili koliščarji z Ljubljanskega barja dobri poznavalci lastnosti lesa različnih drevesnih vrst.<sup>24</sup> Tako so na primer pri dendrokronoloških raziskavah lesa ugotovili, da so za vertikalne kole, na katerih so stale stavbe, najraje uporabljali jesenovino in hrastovino, ki imata dobre mehanske lastnosti, hrast pa tudi odporno jedrovino. Les jelše in drugih lesnih vrst (npr. topola, vrbe, bukve, belega gabra, javorja, bresta idr.) pa so praviloma uporabili šele, ko je jesenovine in hrastovine v bližini kolišč začelo primanjkovati.<sup>25</sup> Tudi s palinološkimi raziskavami prazgodovinskih naselbin z Ljubljanskega barja je bila večkrat dokazana selektivna uporaba specifične drevesne vegetacije (predvsem hrasta in jesena).<sup>26</sup> Druge lesne vrste, kot sta npr. leska in jelša, so bile večkrat zastopane kot ogljeni ostanke, torej uporabljene kot gorivo.<sup>27</sup>

<sup>22</sup> Torelli 1991, 21.

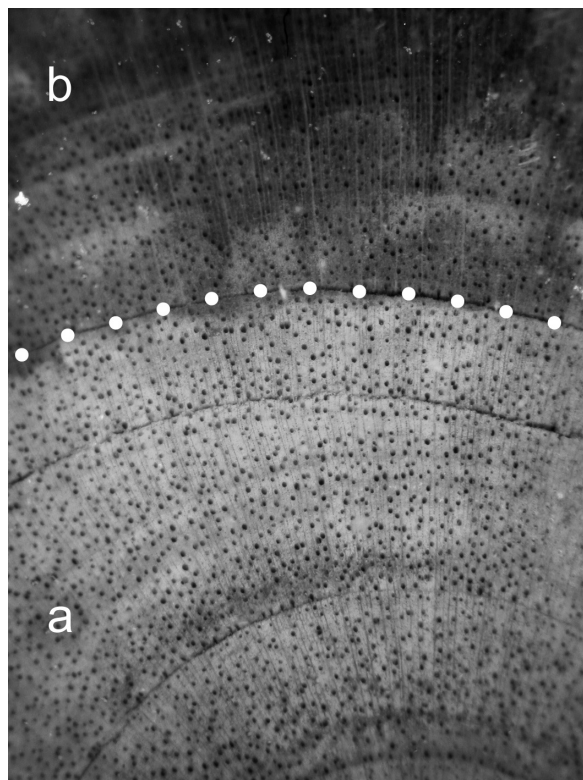
<sup>23</sup> Wagenführ 1996, 145

<sup>24</sup> Npr. Velušček et al. 2004, 44; Tolar, Čufar, Velušček 2008; Jeraj, Velušček, Jacomet 2009.

<sup>25</sup> Npr. Čufar, Levanič, Velušček 1997, 21; 1998, 81; Velušček, Čufar 2003, 126.

<sup>26</sup> Npr. Culiberg, Šercelj 1991, 254.

<sup>27</sup> Npr. Jeraj 2004, 60.



Sl. 10.8: Ročaj; branike in trakovi iz sredinskega dela orodja (a) prehajajo v periferni ročajni del (b). Foto: M. Zupančič.

Fig. 10.8: Handle; annual rings and rays in the central part of the tool (a) proceed to peripheral part of the handle (b). Photo: M. Zupančič.

### 10.3.4 BOW

Macroscopic examination of the wood from the bow identified a conifer. To determine the species we had to make microscopic slide once again and look for specific anatomic features. Narrow annual rings with dark and narrow late wood, absence of resin canals and occurrence of helical (spiral) thickenings in tracheids (see Fig. 10.10) confirm that it is yew (*Taxus baccata*).<sup>22</sup>

Yew wood has an average density (ro) of  $640 \text{ kg/m}^3$ <sup>23</sup> and it is classified as conifer with higher density, strength and hardness. Moreover, the wood is also tough, elastic, resistant to environmental conditions and is naturally durable. It is excellent to work with. Yew wood is therefore highly appreciated for bow making.

This research confirms preliminary findings that the pile-dwellers from the Ljubljansko barje had great knowledge of various wood properties.<sup>24</sup> For example, dendrochronological researches of wood showed that vertical piles, on which the structures were built, were

<sup>22</sup> Torelli 1991, 21.

<sup>23</sup> Wagenführ 1996, 145.

<sup>24</sup> E.g. Velušček et al. 2004, 44; Tolar, Čufar, Velušček 2008; Jeraj, Velušček, Jacomet 2009.





Sl. 10.9: Stare gmajne, sonda 2, 2006. Otroški lok. Foto: T. Tolar.  
Fig. 10.9: Stare gmajne, trench 2, 2006. Children's bow. Photo: T. Tolar.



Sl. 10.10: Mikroskopska zgradba lesa loka iz tise (*Taxus baccata*). Vidne so traheide z deloma ohranjenimi helikalnimi (spiralnimi) odebelitvami (a) in kupresoidne piknje v križnih poljih (b). Foto: M. Zupančič. Merilna daljica = 50  $\mu$ m.

Fig. 10.10: Microscopic structure of yew wood (*Taxus baccata*) from the bow. Traheids with partly preserved helical (spiral) thickenings (a) and cupressoid pits in cross-fields (b). Photo: M. Zupančič. Scale bar = 50  $\mu$ m.

## 10.4 SKLEP

Kot že večkrat doslej smo znova potrdili ugotovitve, da so bili koliščarji z Ljubljanskega barja dobri poznavalci lastnosti lesa različnih drevesnih vrst in da so les znali optimalno uporabljati.<sup>28</sup>

Trije raziskani leseni predmeti to potrjujejo, saj je bil vsak od njih narejen iz lesa, ki je bil optimalno izbran za določen namen glede na njegove specifične lastnosti.

Drenovo toporišče skoraj 1 kg težke kamnite kladivaste sekire (sl. 10.1), s komaj dvocentimetrskim ušesom, in ročaj (sl. 10.5) sta bila narejena iz izjemno dobro izbranega lesa, saj dren po gostoti in trdnostnih lastnostih praviloma presega vse naše danes uporabljane

<sup>28</sup> Npr. Velušček et al. 2004, 44; Tolar, Čufar, Velušček 2008; Jeraj, Velušček, Jacomet 2009.

mostly of ash and oak, which have excellent mechanical properties, oak also possesses a resistant pith. Alder and other wood species (e.g. poplar, willow, beech, hornbeam, maple, elm) were used only when there were not enough ash and oak in the vicinity of pile-dwellings.<sup>25</sup> Selective pressure on specific tree flora (mostly oak and ash) of the Ljubljansko barje was proven once more with palynological examinations of prehistoric settlements.<sup>26</sup> Other wood species, such as hazel and alder, were often present as burnt remains, hence used as fuel.<sup>27</sup>

## 10.4 CONCLUSION

We confirmed, yet again, preliminary findings that the pile-dwellers from the Ljubljansko barje had great knowledge of various wood properties, and they knew how to use wood optimally.<sup>28</sup>

Three investigated wooden objects are confirming this, as each of them was made of wood, optimally chosen for particular use, considering its specific characteristics.

Cornel haft of the stone shaft-hole axe (Fig. 10.1), weighing almost 1 kg, with a shaft-hole of barely two centimetres in diameter, and its handle (Fig. 10.5), were made of exceptionally well chosen wood. Cornel is the most dense and solid in comparison to modern commercial wood species, also ash, beech and hornbeam, which are used for making tool handles today. Unique characteristics of cornel are also known in contemporary wood industry. However, specimens of slowly growing ash are not achieving sufficient dimensions and they do not contain enough wood for mass use.

Also ash wood handle from the lighter antler axe, weighing 0.22 kg (Fig. 10.3), shows very reasonable

<sup>25</sup> E.g. Čufar, Levanič, Velušček 1997, 21; 1998, 81; Velušček, Čufar 2003, 126.

<sup>26</sup> E.g. Culiberg, Šercelj 1991, 254.

<sup>27</sup> E.g. Jeraj 2004, 60.

<sup>28</sup> E.g. Velušček et al. 2004, 44; Tolar, Čufar, Velušček 2008; Jeraj, Velušček, Jacomet 2009.

komercialne lesne vrste, tudi jesen, bukev in beli gaber, ki jih uporabljamo za držaje orodij. Izstopajoče lastnosti dreva so znane tudi v sodobnem lesarstvu, vendar primerki počasi rastočega dreva ne dosegajo zadostnih dimenzij in ne dajejo dovolj lesa za njegovo množično uporabo.

Tudi jesenov držaj za precej lažjo, 0,22 kg težko sekiro iz rogovja (*sl. 10.3*) kaže na zelo smiselno izbiro lesa. Jesenov les, ki je prožen in ima visoko dinamično trdnost, je danes pri nas najpogosteje uporabljan les za izdelavo športnih orodij in lesenih držajev za različna orodja.

Uporaba tisovine za lok (*sl. 10.9*), čeprav samo otroški, ki je bil namenjen igri in učenju, je bila najboljša možna izbira. Les tise so množično uporabljali za loke v preteklih obdobjih, v srednjem veku pa je velika poraba lesa za loke in samostrele povzročila njeno skorajšnje izumrtje. Zato je tisa še danes v slovenskih gozdovih zelo redka in spada med zavarovane rastlinske vrste.<sup>29</sup> Da ima tisa odličen les za loke, pa so očitno vedeli že koliščarji pred več kot 5000 leti.

choice of wood. Ash wood is elastic and has high dynamic strength. It is therefore the most often used wood for making sport equipment and various tool handles in Slovenia today.

Use of yew for making the bow (*Fig. 10.9*), although only children's, used for play and learning, was best possible choice. Yew wood was massively used for making bows in the past, while the consumption of yew for making bows and crossbows during the Middle Ages lead to its imminent extinction. That is why yew is very rare in Slovene forests to this day and it is a protected plant species.<sup>29</sup> Over 5000 years ago, pile-dwellers were already aware that yew possesses excellent wood for making bows.

<sup>29</sup> Brus 2005, 117.

<sup>29</sup> Brus 2005, 117.





# 11. ANALIZE POVRŠJA TALILNIH POSOD S STARIH GMAJN NA LJUBLJANSKEM BARJU

Zoran MILIĆ & Anton VELUŠČEK

## Izvleček

Analizirani so ostanki ene in ene v celoti ohranjene talilne posode s koliščarske naselbine Stare gmajne na Ljubljanskem barju. Prva posoda je iz gline, medtem ko je druga iz kamna. Na notranjih stenah obeh posod so sledovi bakra, kar dokazuje, da sta bili uporabljani v metalurškem procesu.

**Ključne besede:** talilni posodi, XRF, Stare gmajne, Ljubljansko barje, 4. tisočletje pr. Kr.

## 11.1 UVOD

Že dalj časa je znano, da so se koliščarji z Ljubljanskega barja ukvarjali z metalurgijo bakra, in to predvsem v 3. tisočletju pr. Kr.<sup>1</sup> V zadnjih nekaj letih pa nova arheološka odkritja dokazujejo, da gre za proces, ki se je začel najmanj v 4. tisočletju pr. Kr.<sup>2</sup>

V prispevku bomo predstavili rezultate analiz, ki so bile opravljene na dveh zelo verjetno talilnih posodah z arheološkega najdišča oz. s koliščarske naselbine Stare gmajne na Ljubljanskem barju. Najdbi sodita v čas druge polovice 4. tisočletja pr. Kr.<sup>3</sup>

Namen analize je bil ugotoviti morebitno prisotnost bakra in s tem domnevo, da so v posodah talili baker oz. njegove zlitine. Vse analize smo opravili v laboratoriju Narodnega muzeja Slovenije v Ljubljani.

## 11.2 METODA IN MATERIAL

### 11.2.1 METODA

Analize so bile opravljene z metodo EDS XRF. Pri tem smo uporabili napravo X-Ray Analyzer Model PEDUZO 01/Am/Sip-250, ki so jo za nas izdelali na inštitutu Jožefa Stefana v Ljubljani.

<sup>1</sup> Npr. Durman 1983; Trampuž Orel, Heath 2008.

<sup>2</sup> Npr. Velušček 2004f; Gleirscher 2007.

<sup>3</sup> Glej poglavji 3 in 7 v tem zborniku.

# 11. ANALYSES OF SURFACE OF CRUCIBLES FROM STARE GMAJNE AT THE LJUBLJANSKO BARJE

Zoran MILIĆ & Anton VELUŠČEK

## Abstract

Remains of two crucibles from the pile-dwelling settlement Stare gmajne at the Ljubljansko barje were analysed. One of the pots was entirely preserved. One pot was made of clay and the other one of stone. Traces of copper were found on internal walls of both pots, proving, that they were used in a metallurgical process.

**Keywords:** crucibles, XRF, Stare gmajne, Ljubljansko barje, 4<sup>th</sup> millennium BC.

## 11.1 INTRODUCTION

It is known for a long time that the pile-dwellers from the Ljubljansko barje were engaged in metallurgy of copper, which was widely practiced in the 3<sup>rd</sup> millennium BC.<sup>1</sup> Moreover, recent archaeological discoveries prove that we need to seek the beginnings of this process at least in the 4<sup>th</sup> millennium BC.<sup>2</sup>

In this paper, we will introduce results of the analyses applied for study of two probable crucibles from the archaeological site/pile-dwelling settlement Stare gmajne at the Ljubljansko barje. The finds date to the second half of the 4<sup>th</sup> millennium BC.<sup>3</sup>

Analyses were done in order to find possible presence of copper and to, consequently, suppose that the pots were used for melting of copper/copper alloys. All analyses were performed in the laboratories of the National Museum of Slovenia in Ljubljana.

## 11.2 PROCEDURE AND MATERIAL

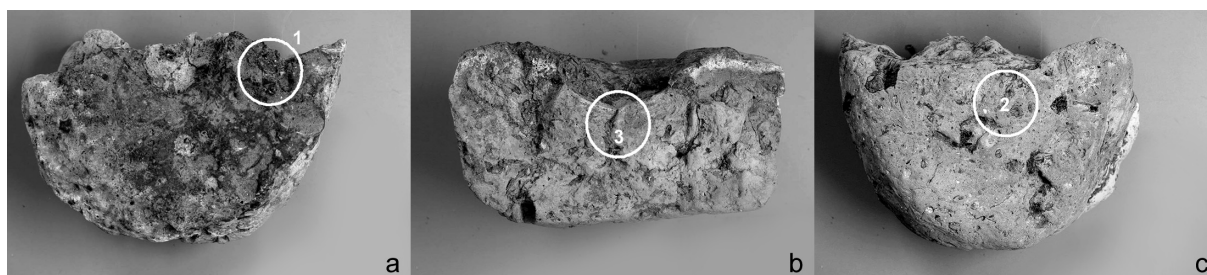
### 11.2.1 PROCEDURE

Analyses were done using the EDS XRF method. They were performed using an X-Ray Analyzer Model

<sup>1</sup> E.g. Durman 1983; Trampuž Orel, Heath 2008.

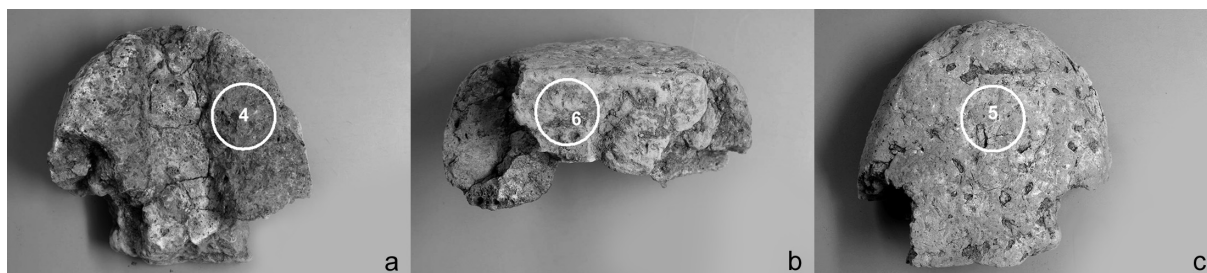
<sup>2</sup> E.g. Velušček 2004f; Gleirscher 2007.

<sup>3</sup> See Chapters 3 and 7 in this monograph.



Sl. 11.1a-c: Čelni fragment glinaste talilne posode z označenimi analiziranimi mesti – zgoraj (1), prelom (3) in spodaj (2). Foto: Z. Milič.

Fig. 11.1a-c: Fragment of the clay crucible with marked analysed areas – rim (1), fracture (3) and base (2). Photo: Z. Milič.



Sl. 11.2a-c: Fragment glinaste talilne posode pri izlivu z označenimi analiziranimi mesti – zgoraj (4), prelom (6) in spodaj (5). Foto: Z. Milič.

Fig. 11.2a-c: Fragment of the clay crucible at the spout with marked analysed areas – rim (4), fracture (6) and base (5). Photo: Z. Milič.

Zaradi heterogenosti vzorcev in neugodne geometrije so analize kvalitativne. Ker gre za kvalitativno analizo, smo vrednosti podali v *counts per second* (c/s), torej v intenziteti energije za posamezni element.

#### 11.2.1.1 FRAGMENTA GLINASTE POSODE

Odlomka glinaste posode sta sestavna dela skoraj v celoti ohranjene posode, ki je bila najdena na Starih gmajnah v jarku 13, odsek 24.<sup>4</sup>

Analizirali smo oba fragmenta. Zaradi geometrije vzorca nismo mogli analizirati dna posode, temveč samo njen zgornji rob ter prelom. Analizirali pa smo tudi dno z zunanje strani. Vse tri analize smo ponovili na vsakem fragmentu. Podatke smo podali v *tabeli 11.1*.

Povsod smo pričakovali baker razen na zunanjem dnu posode. Prisotnost elementov na zunanjem dnu je treba odšteti od ostalih vrednosti za zgornji rob in prelom.

#### 11.2.1.2 KAMNITA POSODA

Kamnita posoda je bila najdena na Starih gmajnah pri sondiranju v sondi 3, v njenem južnem profilu

PEDUZO 01/Am/Sip-250, which was made at the Jožef Stefan Institute in Ljubljana.

As the samples were unhomogenous and the geometry was inconvenient, the analyses are qualitative. Consequently, the values were measured in counts per second (c/s), i.e. in energy intensity.

#### 11.2.1.1 FRAGMENTS OF CLAY POT

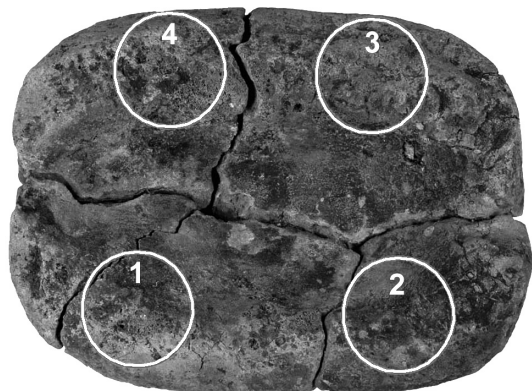
The two fragments of clay pot present component parts of an almost entirely preserved pot, found at Stare gmajne, in ditch 13, section/sector 24.<sup>4</sup>

We analysed both fragments. We were not able to analyse the base of the pot due to geometry of the sample. Therefore, we only analysed its rim and fracture. We also analysed the external surface of the base. All three analyses were done on each fragment, with data shown on *Tab. 11.1*.

We expected to find copper over the entire surface except for the external surface of the base. The elements present on the external surface of the base have to be deducted from the values measured on the rim and fracture.

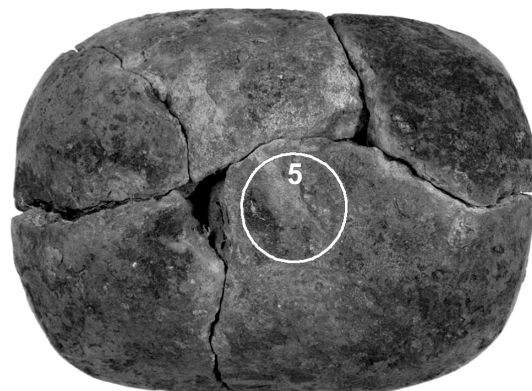
<sup>4</sup> Glej poglavje 3 v tem zborniku: *t. 3.19*: 15.

<sup>4</sup> See Chapter 3 in this monograph: *Pl. 3.19*: 15.



Sl. 11.3: Zgornja stran kamnite talilne posode z označenimi analiziranimi mesti (1-4). Foto: Z. Milić.

Fig. 11.3: Top part of the stone crucible with marked analysed area (1-4). Photo: Z. Milić.



Sl. 11.4: Spodnja stran kamnite talilne posode z označenim analiziranim mestom (5). Foto: Z. Milić.

Fig. 11.4: Bottom part of the stone crucible with marked analysed area (5). Photo: Z. Milić.

na dnu kulturne plasti.<sup>5</sup> Analiza kamnine je pokazala, da gre za kremenasto glinasti muljevec, najverjetneje lokalnega izvora.<sup>6</sup>

Ob odkritju je bila posoda prelomljena na pet delov in kasneje zlepljena v celoto. Podobno kot pri glinasti tudi pri kamniti posodi zaradi geometrije vzorca nismo mogli analizirati dna, temveč samo njen rob. Analizirali pa smo dno z zunanje strani. Podatke smo podali v tabeli 11.2. Povsod smo pričakovali baker razen na zunanjem delu dna posode. To mesto smo označili z vzorcem 5 in je služilo kot primerjalna analiza za ostale štiri.

## 11.3 REZULTATI IN DISKUSIJA

### 11.3.1 FRAGMENTA GLINASTE POSODE

Rezultati kvalitativnih analiz kažejo (tab. 11.1), da je baker (Cu) prisoten na robu glinaste posode. Na zgornjem robu posode, ki je mestoma rahlo obarvan zeleno (sl. 11.1a: 1 in 11.2a: 4), je prisotnost bakra večja kot na prelomu, torej v globini posode, kamor je baker med taljenjem proniknil (sl. 11.1b: 3). Bakra na spodnjem zunanjem dnu nismo zasledili (sl. 11.1c: 2 in 11.2c: 5). Prisotnost bakra potrjuje domnevo, da so v talilni posodi talili baker oz. morebiti tudi njegove zlitine.

Železo (Fe) je močnejše prisotno na zgornjem robu posode, manj pa drugje. Železo na zgornjem robu izhaja delno iz okolja (zemlja na zunanjem dnu posode – sl. 11.1c: 2 in 11.2c: 5), delno pa iz procesa taljenja.

Srebro (Ag), cirkonij (Zr), rubidij (Rb) in stroncij (Sr) so najbolj prisotni v zemlji na zunanjem dnu posode.

### 11.2.1.2 STONE POT

A stone pot was found at Stare gmajne, at sample trenching in trench 3, i.e. in its southern profile at the bottom of the cultural layer.<sup>5</sup> The analysis of rock showed that it is a quartz-feldspathic siltite, and it is most probably of a local origin.<sup>6</sup>

At the discovery, the pot was fragmented into five parts, which were later glued to form a complete pot. As with the clay pot, also the geometry of the sample of the stone pot did not allow us to make an analysis of the base. Therefore, only analysis of its rim was done. However, we analysed the external surface of the base. Data are shown on Tab. 11.2. We expected to find copper on the entire surface, except for the external surface of the base. This area was labelled as sample 5 and used to serve as a comparative analysis to the other four samples.

## 11.3 RESULTS AND DISCUSSION

### 11.3.1 FRAGMENTS OF THE CLAY POT

The results of qualitative analyses show (Tab. 11.1) presence of copper (Cu) on the rim of the clay pot. Parts of the rim are slightly green (Figs. 11.1a: 1 and 11.2a: 4) with higher concentration of copper as on the fracture, i.e. where copper oozed through while melting (Fig. 11.1b: 3). We did not trace copper on the external surface of the base (Figs. 11.1c: 2 and 11.2c: 5). Presence of copper confirms an assumption that crucibles were used to melt copper and perhaps also copper alloys.

<sup>5</sup> Glej poglavje 3.2.2.2 v tem zborniku: sl. 3.39.

<sup>6</sup> Glej poglavje 12 v tem zborniku.

<sup>5</sup> See Chapter 3.2.2.2 in this monograph: Fig. 3.39.

<sup>6</sup> See Chapter 12 in this monograph.

Tab. 11.1: Rezultati kvalitativne analize fragmentov glinaste talilne posode, podani z intenziteto energije za posamezni element v counts per second (c/s).

Tab. 11.1: Results of qualitative analysis of fragments of the clay crucible in energy intensity per unit concentration, measured in counts per second (c/s).

VZORCEC SAMPLE	mesto spot	Fe c/s	Cu c/s	Ag c/s	Zr c/s	Rb c/s	Sr c/s
Sl. / Fig. 11.1a	zgoraj / top 1	2,967	14,289	0,282	0,030		
Sl. / Fig. 11.1b	prelom / fracture 3	1,084	0,516	0,258	0,157	0,024	0,022
Sl. / Fig. 11.1c	spodaj / bottom 2	1,347		0,373	0,215	0,041	0,029
Sl. / Fig. 11.2a	zgoraj / top 4	4,175	7,558	0,291	0,082		0,012
Sl. / Fig. 11.2b	prelom / fracture 6	1,040		0,309	0,136	0,080	0,012
Sl. / Fig. 11.2c	spodaj / bottom 5	1,328		0,377	0,227	0,039	0,031

de. Manjše količine teh elementov smo zaznali tudi na zgornjem robu in prelomu, vendar gre za kontaminacijo z okoliško zemljo.

### 11.3.2 KAMNITA POSODA

Rezultati kvalitativnih analiz kažejo (tab. 11.2), da je baker (Cu) prisoten povsod na robu posode in v zelo majhni količini tudi na zunanem dnu. Prisotnost bakra potrjuje domnevo, da so v talilni posodi talili baker oz. morebiti tudi njegove zlitine.

Železo (Fe) je močneje prisotno na zgornjem robu posode, manj pa na zunanem dnu. Železo na zgornjem robu izhaja delno iz okolja (zemlja na zunanem dnu posode - sl. 11.4: 5), delno pa iz procesa taljenja.

Cirkonij (Zr) in srebro (Ag) sta prisotna v enakih količinah povsod, kar navaja na dejstvo, da obe kovini izvirata iz zemlje, s katero je obloženo zunanje dno posode in je kontaminiran zgornji rob.

Tab. 11.2: Rezultati kvalitativne analize kamnite talilne posode, podani z intenziteto energije za posamezni element v counts per second (c/s).

Tab. 11.2: Results of qualitative analysis of stone crucible passed with intensity of energy for individual element in counts per second (c/s).

VZOREC / SAMPLE	Fe c/s	Cu c/s	Zr c/s	Ag c/s
Sl. / Fig. 11.3: 1	2,021	4,506	0,141	0,341
Sl. / Fig. 11.3: 2	2,047	1,931	0,239	0,380
Sl. / Fig. 11.3: 3	1,343	0,803	0,213	0,341
Sl. / Fig. 11.3: 4	1,698	0,978	0,261	0,368
Sl. / Fig. 11.4: 5	1,103	0,429	0,293	0,410

Iron (Fe) is present on the rim and, in small amounts, elsewhere on the surface. Presence of iron on the rim can partly be explained with the elements surrounding the pot (soil on the external surface of the base - Figs. 11.1c: 2 and 11.2c: 5) and partly with the process of melting.

Silver (Ag), zirconium (Zr), rubidium (Rb) and strontium (Sr) are the most frequent elements in the soil-clad external surface of the base. Smaller amounts of these elements are also present on the rim and fracture; however, this is a result of contamination with surrounding soil.

### 11.3.2 STONE POT

Results of qualitative analyses show (Tab. 11.2) that copper (Cu) is present over the entire rim of the pot and, in small amounts, also on the external surface of the base. Presence of copper confirms an assumption that crucible was used to melt copper and perhaps also copper alloys.

Iron (Fe) is present on the rim and, in small amounts, on the external surface of the base. Presence of iron on the rim can partly be explained with the elements surrounding the pot (soil on the external surface of the base - Fig. 11.4: 5) and partly with the process of melting.

Zirconium (Zr) and silver (Ag) are, in equal amounts, present over the entire pot. This confirms that both metals originate from the soil-clad external surface of the base, which also contaminated the rim of the pot.

## 11.4 SKLEP

Kvalitativna analiza dveh posod s koliščarske naselbine Stare gmajne je pokazala, da sta najdbi bili v stiku z bakrom oz. morebiti tudi z njegovimi zlitinami. Rezultati analiziranih mest na posameznih delih posod so pokazali, da gre v obeh primerih najverjetneje za talilni posodi, ki sta bili uporabljani v metalurškem procesu.

Analizirani najdbi tako ponovno dokazujeta, da so se koliščarji na Ljubljanskem barju že v 4. tisočletju pr. Kr. nedvomno ukvarjali z metalurgijo bakra.

## 11.4 CONCLUSION

Qualitative analysis of the two pots from the pile-dwelling settlement Stare gmajne confirmed that the finds were in contact with copper or perhaps also with copper alloys. Results of analysed individual parts of pots demonstrated that both objects are most likely crucibles that were used in a metallurgical process.

Analysed finds are proving yet again, that the pile-dwellers from the Ljubljansko barje were doubtless engaged in metallurgy of copper as early as the 4<sup>th</sup> millennium BC.





## 12. SCAMBI E STRATEGIE DI APPROVVIGIONAMENTO NEL LJUBLJANSKO BARJE DEL IV MILLENNIO a.C. DEDOTTI DALLO STUDIO ARCHEOMETRICO DI MANUFATTI IN PIETRA

Federico BERNARDINI, Emanuela MONTAGNARI KOKELJ, Gabriella DEMARCHI & Antonio ALBERTI

### Riassunto

Vengono presentati i risultati dello studio archeometrico di quasi cinquanta manufatti in pietra – soprattutto lame d'ascia ed asce forate – provenienti dal letto della Ljubljanica e da alcuni siti del Ljubljansko barje riferibili alla seconda metà del IV millennio a.C. tra cui Stare gmajne. La gran parte dei materiali è costituita da una serie di litologie di provenienza locale o vicina, tra cui soprattutto tufi e tuffiti, affioranti nella Slovenia settentrionale ma presenti anche nei depositi alluvionali della Sava a poca distanza dai siti di rinvenimento. Nello stesso tempo alcuni gruppi di manufatti in rocce importate – come lame d'ascia in HP metaofiolite dall'Italia nord-occidentale, asce forate in serpentinite ed in metaultramafite provenienti rispettivamente dall'Austria centrale e da una località ancora da identificare forse in posizione più orientale – documentano il ruolo centrale di mediazione tra il mondo padano nord-orientale e quello danubiano, le Alpi Orientali e i Balcani svolto dal Ljubljansko barje nel IV millennio a.C..

**Parole chiave:** manufatti in pietra, analisi archeometriche, strategie di approvvigionamento, scambi, Ljubljansko barje, IV millennio a.C..

### Abstract

We present results of archaeometrical research of almost 50 stone tools – mostly flat and shaft-hole axes – originating from the bed of the Ljubljanica and several sites of Ljubljansko barje, including Stare gmajne, dating to the second half of the 4<sup>th</sup> millennium BC. The majority of finds shows exploitation of local raw materials. Tuffs and tuffites, which occur in the area of northern Slovenia and in gravel deposits of the Sava not far from the Barje, can be found among them. The assemblage also includes a group of tools made of imported rocks, such as flat axes made of HP metaophiolites from north-western Italy, shaft-hole axes made of serpentinites and metaultramafites, which respectively are likely to originate from central Austria and from a still unknown area, probably located more to the East. These finds indicate that the Ljubljansko barje played a key role as a mediation place between the Po lowland and the Danubian area and between the Eastern Alps and the Balkans in the 4<sup>th</sup> millennium BC.

**Keywords:** stone tools, archaeometrical analyses, raw materials procurement strategies, exchange, Ljubljansko barje, 4<sup>th</sup> millennium BC.

## 12. IZMENJAVA IN OSKRBOVALNE STRATEGIJE NA LJUBLJANSKEM BARJU V 4. TISOČLETJU PR. KR. NA PODLAGI ARHEOMETRIČNIH RAZISKAV KAMNITIH ORODIJ

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### Izleček

Predstavljeni so rezultati arheometričnih raziskav skoraj 50 kamnitih orodij – predvsem ploščatih in kladivastih sekir –, ki izvirajo iz struge Ljubljanice in nekaterih najdišč na Ljubljanskem barju, med katerimi so tudi Stare gmajne, ki jih datiramo v drugo polovico 4. tisočletja pr. Kr. Večina najdb predstavlja edinstveno litološko serijo lokalnega izvora. Med njimi so tufi in tuffiti, ki jih najdemo na območju severne Slovenije in tudi v prodnatih nanosih Save nedaleč od Barja. V zbirki je najti tudi skupine orodij iz uvoženih kamnin, kot so ploščate sekire iz HP-metaofiolitov iz severozahodne Italije, kladivaste sekire iz serpentinitov in metaultramafitov, ki izvirajo iz osrednje Avstrije in z nekega še neugotovljenega, verjetno nekoliko bolj vzhodno ležečega območja. Te najdbe kažejo na osrednjo vlogo Ljubljanskega barja kot posrednika med Padsko nižino in Podonavjem ter med Vzhodnimi Alpami in Balkanom v 4. tisočletju pr. Kr.

**Ključne besede:** kamnita orodja, arheometrične analize, preskrbovalne strategije, izmenjava, Ljubljansko barje, 4. tisočletje pr. Kr.

## 12.1 INTRODUZIONE

Vengono presentati i risultati dello studio archeometrico di quarantasei manufatti in pietra levigata e scheggiata provenienti da alcuni siti del Ljubljansko barje, in gran parte riferibili alla seconda metà del IV millennio a.C., e dal letto del fiume Ljubljanica in un tratto prossimo al sito di Hočevarica.

Sono stati studiati quarantuno manufatti in pietra levigata: un probabile crogiolo per la fusione del rame, due asce forate, una lastra di roccia usata come mola, una lama d'ascia e due coti provenienti da Stare gmajne, un'ascia forata frammentaria da Notranje Gorice, una cote da Blatna Brezovica, uno scalpello da Spodnje mostišče e trentuno manufatti raccolti nel letto della Ljubljanica, tra cui venti lame d'ascia, sette asce forate, due scalpelli, una cote e un probabile peso. Inoltre è stata effettuata un'indagine preliminare su cinque manufatti in pietra scheggiata provenienti da Stare gmajne e Blatna Brezovica.

I materiali della Ljubljanica sono già stati oggetto di una recente pubblicazione<sup>1</sup> ma vengono qui riconsiderati, ampliando lo studio a manufatti in pietra provenienti da altri siti della piana di Lubiana, nel tentativo di ricostruire un quadro delle strategie di approvvigionamento delle materie prime litiche in questo territorio durante il IV millennio a.C..

## 12.2 TIPOLOGIA

### 12.2.1 MANUFATTI IN PIETRA LEVIGATA

#### 12.2.1.1 LAME D'ASCIA

Le lame d'ascia studiate sono state in gran parte raccolte nel letto della Ljubljanica in un tratto del fiume prossimo al sito di Hočevarica (*Fig. 12.10*: L2-L4, L6, L7; *12.12*: L15, L44, L46-L48; *12.13*: L49-L53; *12.14*: L55-L59, L61) con l'eccezione di un manufatto proveniente da Stare gmajne (*Fig. 12.9*: Sg5). Si tratta di tredici strumenti interi, cinque frammenti prossimali e due distali. La gran parte dei reperti ha caratteristiche tipologiche comuni: forma subrettangolare massiccia di notevoli dimensioni con una sezione ovale o più spesso rettangolare e un tallone squadrato.<sup>2</sup> La quasi totalità delle lame presenta taglianti con evidenti tracce d'usura, testimonianza del loro carattere di oggetti funzionali, probabilmente impiegati in attività di carpenteria. Il reperto L55 (*Fig. 12.14*: L55), pur appartenendo a questo gruppo, ha la parte distale rilavorata probabilmente a seguito della rottura del tagliente in modo da poter essere riutilizzato forse come martello.

<sup>1</sup> Bernardini et al. 2006-2007.

<sup>2</sup> Bernardini et al. 2006-2007.

## 12.1 UVOD

Predstavljani so rezultati arheometričnih raziskav 46 glajenih kamnitih orodij in orodij na odbitkih, ki izvirajo z najdišč na Ljubljanskem barju, v večini pripisanih drugi polovici 4. tisočletja pr. Kr., in iz struge Ljubljanice na odseku v bližini Hočevarice.

Preučevanih je bilo 41 glajenih kamnitih orodij: (verjetno) talilna posoda, dve kladivasti sekiri, kamnita plošča, ki se je uporabljala kot žrmlje, ploščata sekira in dva brusa, ki izvirajo s Starih gmajn, fragment kladivaste sekire z Notranjih Goric, brus z Blatne Brezovice, dleto s Spodnjega mostišča in 31 orodij iz struge Ljubljanice, med katerimi je 20 ploščatih in 7 kladivastih sekir, dve dleti, en brus in verjetno utež. Poleg tega je bila opravljena preliminarna raziskava tudi 5 orodij na odbitkih, ki izvirajo s Starih gmajn in Blatne Brezovice.

Čeprav so bile najdbe iz Ljubljanice nedavno že objavljene,<sup>1</sup> jih tukaj ponovno obravnavamo ter študijo razširjamo na kamnita orodja z nekaterih drugih najdišč Ljubljanskega barja, da bi lahko rekonstruirali strategije pridobivanja surovin na tem območju v 4. tisočletju pr. Kr.

## 12.2 TIPOLOGIJA

### 12.2.1 GLAJENA KAMNITA ORODJA

#### 12.2.1.1 PLOŠČATE SEKIRE

Preučevane ploščate sekire izvirajo v glavnem iz struge Ljubljanice, z odseka, ki je blizu najdišču Hočevarica (*sl. 12.10*: L2-L4, L6, L7; *12.12*: L15, L44, L46-L48; *12.13*: L49-L53; *12.14*: L55-L59, L61). Izjema je le sekira s Starih gmajn (*sl. 12.9*: Sg5).

Nabor najdb obsega 13 celih, 5 proksimalnih in 2 distalna fragmenta orodij. Večina najdb je tipološko podobnih: skoraj pravokotna masivna oblika znatne dimenzije, z ovalnim ali pogosteje štirioglatim presekom in talonom.<sup>2</sup> Večino sekir predstavljajo rezila z vidnimi sledovi uporabe, kar priča o njihovi funkciji, verjetno v tesarstvu. Najdba L55 (*sl. 12.14*: L55), ki sicer tudi pripada tej skupini, ima verjetno zaradi predhodnega preloma rezila distalni del preoblikovan na način, da je pri ponovni uporabi služila kot kladivo. Za takšna orodja najdemo analogije med glajenimi kamnitimi orodji drugje po Sloveniji.<sup>3</sup> Od severnoitalijanskih, za katera je značilna uporaba HP-metaofiolitov, njihov pojav pa lahko postavimo v bakreno dobo v povezavi z uvedbo vmesnika

<sup>1</sup> Bernardini et al. 2006-2007.

<sup>2</sup> Bernardini et al. 2006-2007.

<sup>3</sup> Lubšina-Tušek 1993, 136, t. 5: 17; 158, t. 27: 4.

Tali strumenti trovano confronti in altre industrie in pietra levigata della Slovenia,<sup>3</sup> mentre si distinguono nettamente da quelle – dominate dal vasto impiego di HP metaofioliti – dell'Italia settentrionale,<sup>4</sup> dove forme rettangolari, in genere di dimensioni assai più ridotte di quelle attestate in Slovenia, iniziano a diffondersi a partire dall'età del Rame in connessione con l'introduzione dell'immanicatura indiretta con elemento intermedio in corno di cervo.<sup>5</sup>

Una piccola lama d'ascia (*Fig. 12.14: L61*) ha una morfologia diversa dal resto dei reperti: ha un corpo appiattito di forma trapezoidale con un tagliente curvo intaccato da microfratture da usura, superfici laterali ben distinte e una sezione trasversale subrettangolare. Tutte le superfici sono ben levigate con evidenti strie di levigatura. La forma insolita di quest'ascia induce a ritenere che si tratti del risultato della rilavorazione di un manufatto precedentemente rotto, forse un'ascia forata vista la materia prima di cui è costituita (vedi oltre).

Vanno inoltre segnalate due piccole lame dalle comuni caratteristiche tipologiche: corpo appiattito di forma triangolare con lati distinti e sezione subrettangolare (*Fig. 12.9: Sg5; 12.10: L7*). Le superfici sono perfettamente levigate con l'eccezione di quelle laterali che presentano tracce di picchiettatura, più evidenti e dense in uno dei reperti (*Fig. 12.10: L7*). In un caso, il tagliente, arcuato inclinato, è molto affilato e privo di tracce d'uso tranne forse una ridotta frattura larga pochi mm; nell'altro, lo stesso elemento morfologico ha una forma arcuata con numerose microfratture dai margini arrotondati. Queste asce trovano precisi confronti nelle industrie in pietra levigata dell'Italia settentrionale, ottenute in gran parte da HP metaofioliti provenienti dall'Italia nord-occidentale.<sup>6</sup>

#### 12.2.1.2 ASCE SCALPELLO

Tra i reperti studiati figurano solo tre strumenti di questo tipo, uno da Spodnje mostišča<sup>7</sup> e due dalla Ljubljana (*Fig. 12.12: L45; 12.13: L54*). I reperti provenienti da quest'ultima località sono accomunati da dimensioni e morfologia simili. Hanno infatti un corpo subtrapezoidale massiccio che, partendo da un tallone squadrato, si restringe verso il tagliente, breve e di forma rettilinea o leggermente curva. Le sezioni trasversali sono ovali o piano-convessi. Le superfici distali sono ben levigate mentre tracce di picchiettatura coprono le altre parti dei manufatti. È interessante notare che il tallone

<sup>3</sup> Lubšina-Tušek 1993, 136, Tav. 5: 17; 158, Tav. 27: 4.

<sup>4</sup> D'Amico et al. 2004.

<sup>5</sup> De Marinis 1996, 176.

<sup>6</sup> D'Amico et al. 2004; D'Amico 2005; Pétrequin et al. 2005; 2006; D'Amico, Starnini 2006a; per quanto riguarda il Friuli-Venezia Giulia vedi D'Amico et al. 1997; Pessina, D'Amico 1999; Bernardini et al. 2006–2007.

<sup>7</sup> Inedita.

oz. nastavka iz jelenovega roga,<sup>4</sup> se jasno razlikujejo,<sup>5</sup> saj so precej večjih dimenzij.

Majhna ploščata sekira (*sl. 12.14: L61*) je nekoliko drugačne oblike kot ostale: telo je sploščeno in trapezoidne oblike, rezilo je od uporabe razpokano, stranski ploskvi sta dobro poudarjeni, prečni presek je skoraj pravokotne oblike. Vse ploskve so dobro zglajene, opazne so lise. Nenavadna oblika sekire kaže, da gre za predelano zlomljeno orodje; glede na surovino se zdi, da je šlo sprva za kladivasto sekuro (glej naprej).

Opozarjamo tudi na dve majhni ploščati in tipološko podobni sekiri (*sl. 12.9: Sg5; 12.10: L7*): sploščeno telo je trikotne oblike, robova sta poudarjena, presek je skoraj pravokoten, ploskve so odlično zglajene, z izjemo stranskih, kjer so dobro vidni sledovi pikčanja oz. tolčenja, in to na enem orodju bolj kot na drugem (*sl. 12.10: L7*). V prvem primeru je izbočeno nesimetrično rezilo precej naostreno in brez sledov uporabe, izvemši verjetno nekaj milimetrov dolgo razpoko; za drugo je značilna izbočena oblika s številnimi mikropoškodbami z zaobljenimi robovi. Omenjeni sekiri imata odlične analogije med glajenimi severnoitalijanskimi sekirami, ki so večinoma iz HP-metaofiolitov in izvirajo iz severozahodne Italije.<sup>6</sup>

#### 12.2.1.2 DLETA

Med preučevanimi najdbami lahko samo tri orodja uvrstimo med dleta: eno je s Spodnjega mostišča,<sup>7</sup> dve sta iz Ljubljane (*sl. 12.12: L45; 12.13: L54*).

Najdbi iz Ljubljane družijo podobna oblika in velikost: masivno telo trapezoidne oblike, ki se od talona s štirikotnim presekom zožuje v smeri proti kratkemu, ravnemu ali rahlo ukrivljenemu rezilu. Prečni presek je ovalen oz. planokonvexen. Distalne ploskve so dobro zglajene, sledovi pikčanja pa pokrivajo preostale površine orodij. Kot zanimivost, talon enega izmed orodij je gladek in bleščeč, kar je verjetno posledica drgnjenja ob toporišče ali manj verjetno nekega posebnega načina uporabe. Dleto s Spodnjega mostišča je, nasprotno, skoraj pravokotne oblike ovalnega preseka, talon je štirioglat, rezilo izbočeno, prekinjeno z majhnimi poškodbami od uporabe.

Obravnavana orodja se razlikujejo od t. i. čevljarskih dlet, ki so verjetno podonavsko-balkanskega izvora in se kot taka odkrivajo v kontekstih začetnega neolitika severovzhodne Italije: na furlanskem najdišču Sammar-denchia pri Vidmu<sup>8</sup> ali v Jami v Zavodu na Tržaškem

<sup>4</sup> De Marinis 1996, 176.

<sup>5</sup> D'Amico et al. 2004.

<sup>6</sup> D'Amico et al. 2004; D'Amico 2005; Pétrequin et al. 2005; 2006; D'Amico, Starnini 2006a; za Furlanijo-Juljsko krajino glej D'Amico et al. 1997; Pessina, D'Amico 1999; Bernardini et al. 2006–2007.

<sup>7</sup> Neobjavljeno.

<sup>8</sup> Pessina, D'Amico 1999, 48, sl. 22: 101,292.

di uno dei reperti ha un aspetto particolarmente liscio e lucente, dovuto probabilmente allo sfregamento dello stesso all'interno dell'immanicatura o, meno probabilmente, ad un suo particolare utilizzo. Lo scalpello da Spodnje mostišče ha invece un corpo subrettangolare con sezione ovale, tallone squadrato e tagliente arcuato interrotto da piccole fratture da usura.

Questi strumenti differiscono dagli scalpelli a cuneo da calzolaio di probabile provenienza danubiano-balcanica come quelli rinvenuti in contesti del primo Neolitico dell'Italia nord-orientale a Sammardenchia nella pianura friulana<sup>8</sup> o nella grotta della Tartaruga nel Carso triestino.<sup>9</sup> Essi sono costituiti da rocce a grana finissima e frattura concoide (silexite nel caso dei reperti di Sammardenchia, ovvero una roccia derivata da cineriti acide) ed hanno una tipica sezione a D. Si distinguono anche dal punto di vista tecnologico visto che venivano prodotti tramite scheggiatura e successiva levigatura, senza alcun intervento intermedio di picchiettatura a causa delle proprietà simili alla selce della materia prima.

I reperti sloveni sono diversi e appaiono piuttosto come una variante particolare delle lame d'ascia di grandi dimensioni, adottata per svolgere lavori di precisione grazie alle dimensioni ridotte del tagliente.

### 12.2.1.3 ASCE FORATE

Tra i reperti studiati due provengono da Stare gmajne (*Fig. 12.9: Sg6, Sg7*) e sette dalla Ljubljana (*Fig. 12.10: L1, L5; 12.11: L8, L9, L11, L12, L14*). Un frammento mediano di ascia forata, pubblicato tra quelli delle palafitte di Deschmann,<sup>10</sup> può essere attribuito con sicurezza a Notranje Gorice grazie al riconoscimento dello stesso tra i materiali pubblicati in Schmid.<sup>11</sup> Sebbene tale reperto sia stato già studiato da D'Amico,<sup>12</sup> viene inserito nel presente contributo perché contribuisce ad approfondire la conoscenza delle materie prime litiche utilizzate nel Ljubljansko barje nel IV millennio a.C..

L'ascia forata integra proveniente da Stare gmajne è di notevoli dimensioni e presenta una forma particolare: ha un corpo massiccio allungato di forma subtriangolare con tallone arrotondato e una peculiare sezione biconcava. In prospettiva laterale ha una forma subrettangolare con tagliente arcuato inclinato. Il foro è posto in posizione prossimale (*Fig. 12.8: sinistra; 12.9: Sg7*). Il frammento mediano proveniente da Notranje Gorice è quasi identico all'ascia sopra descritta sia in termini morfologici che dimensionali. Questa forma doveva essere comune nei siti del Ljubljansko barje visto che anche altri reperti

krasu.<sup>9</sup> Slednja dleta so narejena iz zelo drobnozrnatih kamnin školjkastega preloma (sileksiti v primeru najdb iz Sammardenchie oz. kamnina, ki izvira iz kislih cineritov) in izkazujejo značilen presek v obliki črke D. Razlikujejo se tudi po tehnologiji izdelave. Tako poznamo orodja, ki niso bila vse od lomljenja do glajenja podvržena pikčanju, in to zaradi tega, ker je surovina zanje po lastnostih podobna rožencu.

Slovenske najdbe so drugačne, so bolj posebna različica velikih ploščatih sekir, ki so zaradi krajših rezil primerne za opravila, ki zahtevajo večjo natančnost.

### 12.2.1.3 KLADIVASTE SEKIRE

Med preučevanimi najdbami 2 izvirata s Starih gmajn (*Fig. 12.9: Sg6, Sg7*) in 7 iz Ljubljane (*sl. 12.10: L1, L5; 12.11: L8, L9, L11, L12, L14*).

Fragment sredinskega dela kladivaste sekire, ki je objavljen med gradivom z Dežmanovih kolišč,<sup>10</sup> lahko z gotovostjo pripišemo Notranjim Goricam, saj je prepoznano med najdbami, ki jih objavlja Schmid.<sup>11</sup> Čeprav je to najdbo preučil že D'Amico,<sup>12</sup> jo vključujemo v našo študijo, saj prispeva k bolj poglobljenemu vedenju o kamninah, ki so se v 4. tisočletju pr. Kr. uporabljale na Ljubljanskem barju.

V celoti ohranjena kladivasta sekira s Starih gmajn je precej velika in ima posebno obliko. Njeno telo je masivno in podaljšano v skoraj trikotno obliko. Talon je zaobljen in nenavadnega bikonkavnega preseka. V pogledu s strani ima skoraj pravokotno obliko, z izbočenim nesimetričnim rezilom. Uho je zastavljeno na proksimalnem delu (*sl. 12.8: levo; 12.9: Sg7*).

Fragment sredinskega dela kladivaste sekire z Notranjih Goric je skoraj identičen ravnokar opisani sekiri tako v morfološkem smislu kot tudi po velikosti. Gre za obliko, ki je bila pogosta na Ljubljanskem barju, saj tudi druge najdbe z Notranjih Goric kažejo enake morfološke značilnosti.<sup>13</sup> Nekatere primerjave lahko najdemo tudi med orodji, ki jih poznamo iz severovzhodne Slovenije,<sup>14</sup> čeprav njihovo zanesljivost zmanjšujeta kakovost risb ter odsotnost petrografskih podatkov in vsaj makroskopske determinacije.

Dve sekiri iz Ljubljane (*sl. 12.11: L9, L12*) sta na frontalnem delu ozki in bikonveksni, medtem ko sta na lateralni strani skoraj pravokotne oblike; tudi fragmentarno ohranjeno orodje L11 (*sl. 12.11*) verjetno kaže podobne morfološke značilnosti. Gre za obliko, ki v Furlaniji-Juljski krajini<sup>15</sup> ni znana, je pa zelo podobna

<sup>9</sup> Cannarella, Redivo 1978-1981, sl. 11: 3,4.

<sup>10</sup> Korošec, Korošec 1969, t. 78: 6.

<sup>11</sup> 1910, sl. 9: 8.

<sup>12</sup> D'Amico, Montagnari Kokelj, v tisku.

<sup>13</sup> Schmid 1910, sl. 9.

<sup>14</sup> Lubšina-Tušek 1993, t. 5: 4; 8: 15; 14: 17; 24: 1.

<sup>15</sup> Peloi 1996-1997, 124-125.

<sup>8</sup> Pessina, D'Amico 1999, 48, Fig. 22: 101,292.

<sup>9</sup> Cannarella, Redivo 1978-1981, Fig. 11: 3,4.

<sup>10</sup> Korošec, Korošec 1969, Tav. 78: 6.

<sup>11</sup> 1910, Fig. 9: 8.

<sup>12</sup> D'Amico, Montagnari Kokelj, in corso di stampa.



da Notranje Gorice hanno la medesima morfologia.<sup>13</sup> Anche tra i manufatti scoperti in Slovenia nord-orientale possono essere trovati alcuni confronti sebbene la qualità dei disegni e l'assenza di ogni indicazione petrografica limitino la loro affidabilità<sup>14</sup> in assenza almeno di un riconoscimento macroscopico.

Due delle asce scoperte nella Ljubljana (*Fig. 12.II: L9, L12*) in prospettiva frontale sono strette e biconvesse, mentre in quella laterale hanno una forma subrettangolare; anche il manufatto frammentario L11 (*Fig. 12.II*) doveva probabilmente presentare una morfologia simile. Questa forma, non attestata in Friuli-Venezia Giulia,<sup>15</sup> è del tutto simile a quella di un manufatto rinvenuto nei pressi di Töplitsch in Carinzia.<sup>16</sup> Le altre quattro asce forate provenienti dal fiume che attraversa il Ljubljansko barje mostrano una notevole varietà morfologica.<sup>17</sup>

#### 12.2.1.4 COTI

Tra i materiali studiati vi sono quattro coti: due da Stare gmajne (*Fig. 12.9: Sg8, Sg10*), una da Blatna Brezovica (*Fig. 12.9: BB3*) e una dalla Ljubljana (*Fig. 12.II: L13*). Presentano tutte una forma allungata con un foro bipiramidale posto a un'estremità, realizzato probabilmente con un perforatore pieno. È da sottolineare che sulla superficie del manufatto di Blatna Brezovica sono visibili, anche a occhio nudo, piccole chiazze con lucentezza metallica, con ogni probabilità legate all'utilizzo della cote. D'altronde i dati emersi dalle ricerche condotte a Hočevarica documentano lo sviluppo di attività metallurgiche nel Ljubljansko barje già dalla prima metà del IV millennio a.C..<sup>18</sup>

#### 12.2.1.5 ALTRI REPERTI

Deve essere infine ricordato un oggetto proveniente dalla Ljubljana di forma triangolare con alcune tacche nella parte centrale dei margini, interpretabile forse come un peso (*Fig. 12.I4: L60*), e una lastra usata probabilmente come una mola, scoperta a Stare gmajne.

### 12.2.2 MANUFATTI IN PIETRA SCHEGGIATA

Sono stati selezionati cinque manufatti in pietra scheggiata provenienti da Stare gmajne e Blatna Bre-

<sup>13</sup> Schmid 1910, Fig. 9.

<sup>14</sup> Lubšina-Tušek 1993, Tav. 5: 4; 8: 15; 14: 17; 24: 1.

<sup>15</sup> Peloi 1996-1997, 124-125.

<sup>16</sup> Piccottini 1977, 291; Vahlkampff 1979, 7-8, Fig. 1; von Uslar 1991, 251.

<sup>17</sup> Per una loro descrizione dettagliata si rimanda a Bernardini et al. 2006-2007.

<sup>18</sup> Velušček, Greif 1998; Velušček 2004a.

orodju iz okolice Töplitscha na Koroškem.<sup>16</sup> Preostale 4 kladivaste sekire, ki tudi izvirajo iz Ljubljane, kažejo na precejšno morfološko variabilnost.<sup>17</sup>

#### 12.2.1.4 BRUSI

Med preučevanim gradivom najdemo 4 bruse: 2 s Starih gmajn (*sl. 12.9: Sg8, Sg10*), 1 z Blatne Brezovice (*sl. 12.9: BB3*) in 1 iz Ljubljane (*sl. 12.II: L13*). Vsi so podolgovate oblike ter z bipiramidalnim ušesom, ki je postavljeno na enem koncu in ki je bilo verjetno narejeno s topim vrtalcem. Treba je poudariti, da so na površju orodja z Blatne Brezovice tudi s prostim očesom vidne majhne lise kovinskega sijaja, ki so zelo verjetno povezane z uporabo brusa. Navsezadnje podatki s Hočevarice kažejo na lokalni razvoj metalurgije že v prvi polovici 4. tisočletja pr. Kr.<sup>18</sup>

#### 12.2.1.5 OSTALE NAJDBE

Ob koncu velja omeniti tudi v Ljubljani najden predmet trikotne oblike in z zarezi na lateralnih robovih (*sl. 12.I4: L60*), ki je morda služil kot utež, ter na kamnito ploščo s Starih gmajn, verjetno uporabljeno kot žrmlje.

### 12.2.2 ORODJA NAREJENA NA ODBITKIH

Izbrali smo 5 orodij, narejenih na odbitkih, s Starih gmajn in Blatne Brezovice, da bi naredili preliminarne analize surovinske sestave. Dejansko ne gre za prava orodja, temveč preprosto za odbitke. Treba je tudi poudariti, da je bila za velik del industrije na odbitkih z omenjenih dveh najdišč uporabljena surovina sivozelene barve, ki je podobna analiziranim vzorcem.

## 12.3 LITOLOGIJA IN MOŽNA IZVORNA OBMOČJA

Preučevani vzorci, litologija, možna izvorna območja in uporabljene analitske metode so predstavljeni na *tab. 12.1*. Opis surovinske sestave glajenih kamnitih orodij iz Ljubljane podajajo Bernardini et al.<sup>19</sup> Definicija piroklastičnih kamnin temelji na klasifikaciji, ki jo predlaga Schmid.<sup>20</sup>

<sup>16</sup> Piccottini 1977, 291; Vahlkampff 1979, 7-8, sl. 1; von Uslar 1991, 251.

<sup>17</sup> Njihov podrobnejši opis najdemo pri Bernardini et al. 2006-2007.

<sup>18</sup> Velušček, Greif 1998; Velušček 2004a.

<sup>19</sup> 2006-2007.

<sup>20</sup> 1981.

zovica per poter effettuare un'analisi preliminare delle materie prime impiegate. Non si tratta di strumenti ma di semplici schegge. La gran parte dell'industria in pietra scheggiata dei siti sopraccitati è costituita da una materia prima di colore grigio verde simile a quella dei campioni selezionati per l'analisi.

## 12.3 LITOLOGIA E PROBABILI PROVENIENZE

I campioni studiati, la litologia, le possibili provenienze e i metodi analitici impiegati sono indicati in *Tab. 12.1*. Per la descrizione delle materie prime dei materiali in pietra levigata provenienti dalla Ljubljana si rimanda a Bernardini et al.<sup>19</sup> La definizione delle rocce piroclastiche si basa sulla classificazione proposta da Schmid.<sup>20</sup>

### 12.3.1 MATERIE PRIME DI PROVENIENZA LOCALE O VICINA

I dati raccolti indicano un ampio utilizzo di materie prime locali, la cui area di provenienza più probabile è di seguito indicata in via preliminare soprattutto su base bibliografica, sebbene sarebbe necessario uno studio più dettagliato per definirne l'origine con maggiore precisione.

Tra gli strumenti in pietra levigata prevalgono in maniera netta tufi e tufiti, affioranti in Slovenia settentrionale,<sup>21</sup> ma presenti anche nei depositi alluvionali della Sava a brevissima distanza dal Ljubljansko barje (*Fig. 12.1*).<sup>22</sup> Due lame d'ascia, costituite rispettivamente da una spilita e un cheratofiro, dovrebbero avere una provenienza analoga.<sup>23</sup>

Uno solo dei reperti analizzati è costituito da una fillade sericitica, la cui origine va probabilmente ricercata nelle formazioni carbonifere e permiane, affioranti a nord del Ljubljansko barje.<sup>24</sup> Un campione raccolto in affioramento lungo la Sava immediatamente a nord di Lubiana mostra infatti caratteristiche mineralogiche e tessiturali del tutto simili allo strumento in questione (*Fig. 12.2*).

Per altri manufatti, non analizzati in sezione sottile, la definizione litologica è meno sicura. Si tratta per lo più di campioni costituiti da rocce carbonatiche, siltiti o tufi cineritici, difficilmente distinguibili con sicurezza senza analisi più approfondite.

<sup>19</sup> 2006–2007.

<sup>20</sup> 1981.

<sup>21</sup> Mioč, Žnidarčič 1983; Premru 1983; Komac 2005.

<sup>22</sup> Bernardini et al. 2006–2007.

<sup>23</sup> Bernardini et al. 2006–2007.

<sup>24</sup> Grad, Ferjančič 1983; Premru 1983; Pamić, Jurković 2002; Komac 2005.

### 12.3.1 SUROVINSKA SESTAVA LOKALNIH KAMNIN

Pridobljeni podatki kažejo na znatno uporabo lokalnih kamnin. Preliminarne podatke o njihovem najverjetnejšem izvornem območju smo pridobili iz literature. Za natančnejšo določitev nahajališč pa bi bila potrebna bolj poglobljena analiza.

Med glajenimi orodji prevladujejo tufi in tufiti, ki jih najdemo v severni Sloveniji,<sup>21</sup> prisotni pa so tudi v prodnati nanosih Save nedaleč stran od Ljubljanskega barja (*sl. 12.1*).<sup>22</sup> Dve ploščati sekiri, od katerih je prva iz spilita, druga pa iz keratofirja, sta verjetno podobnega izvora.<sup>23</sup>

Samo ena izmed preučevnih najdb je narejena iz sericitnega filita, katerega izvor gre verjetno iskati v karbonsko-permskih skladih, ki jih najdemo severno od Ljubljanskega barja.<sup>24</sup> Vzorec, ki je bil pobran na Savi severno od Ljubljane, kaže podobno mineraloško sestavo in teksturo kot preučevano orodje (*sl. 12.2*).

Za ostala orodja je določitev surovine, ker nismo preučevali zbruskov, manj zanesljiva. Gre predvsem za vzorce iz karbonatnih kamnin, muljevcev ali cineritnih tufov, ki jih težko razlikujemo brez poglobljene analize.

Za industrijo na odbitkih so bile opravljene analize na majhnem številu orodij, ki pa vendarle kažejo na uporabo piroklastičnih kamnin, med katerimi je najti predvsem cineritne tufe (*sl. 12.1*).

### 12.3.2 HP-METAOFIOLITI

Samo dve majhni ploščati sekiri (*sl. 12.9*: Sg5; *12.10*: L7) sta narejeni iz severozahodnoitalijanskih HP-metaofiolitov. Ugotovljeno je izkoriščanje bodisi primarnih bodisi sekundarnih nahajališč teh značilnih litoloških tipov.<sup>25</sup>

### 12.3.3 SERPENTINITI

Med preučevanimi orodji so iz serpentinita narejene 4 kladivaste in 2 ploščati sekiri, ki izvirajo iz Ljubljane. Mineraloško-petrografska študija vzorcev iz Slovenije je pokazala na veliko podobnost s kladivastimi sekirami iz serpentinita, najdenimi v Furlaniji-Juljski krajini in Istri. Omenjene najdbe so na splošno verjetno iz antogoritskega serpentinita srednje do fine zrnatosti, različnih količin magnetita v obliki lokaliziranih mikrogranulotov

<sup>21</sup> Mioč, Žnidarčič 1983; Premru 1983; Komac 2005.

<sup>22</sup> Bernardini et al. 2006–2007.

<sup>23</sup> Bernardini et al. 2006–2007.

<sup>24</sup> Grad, Ferjančič 1983; Premru 1983; Pamić, Jurković 2002; Komac 2005.

<sup>25</sup> D'Amico et al. 2004; D'Amico, Starnini 2006a; Pêtrequin et al. 2006.

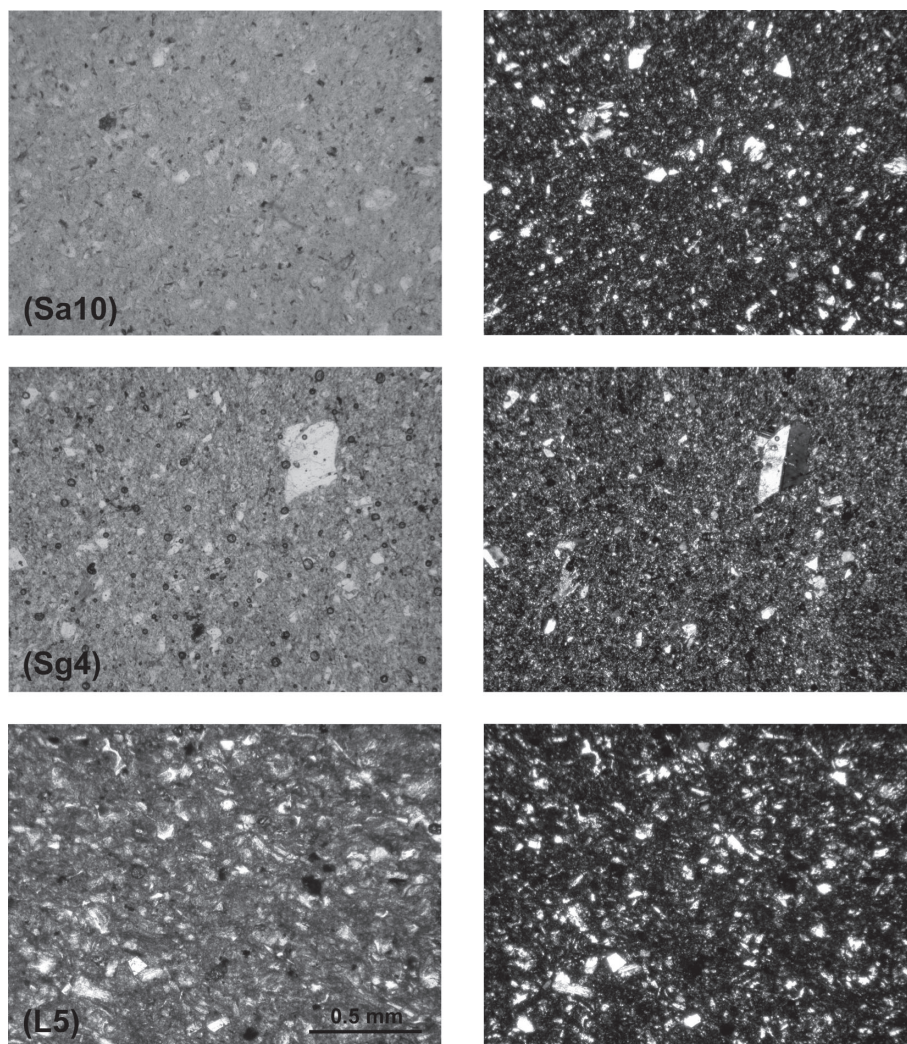


Fig. 12.1: Microfotografie di campioni prelevati da un ciottolo fluviale raccolto lungo la Sava nei pressi di Lubiana (Sa10), da un manufatto in pietra scheggiata proveniente da Stare gmajne (Sg4) e da un'ascia forata raccolta nei pressi del sito di Hočevarica (L5). Tutti i campioni sono tufi cineritici con caratteristiche mineralogiche-petrografiche simili: grana finissima con frammenti submillimetrici di minerali silicici immersi in una matrice criptocristallina; immagini a sinistra con IN, quelle a destra con NX.  
 Sl. 12.1: Mikrofotografije vzorcev: prodnik iz Save v bližini Ljubljane (Sa10), odbitek s Starih gmajn (Sg4) in kladivasta sekira iz bližine Hočevarice (L5). Vse vzorce uvrščamo k cineritnim tufom in imajo podobne mineraloško-petrografske značilnosti: najfinejša zrnatost s submilimetrskimi silikatnimi minerali, katerih struktura je kriptokristalna; slike na levi z IN, tiste na desni z NX.

Per le industrie in pietra scheggiata le analisi preliminari condotte su un esiguo gruppo di reperti indicano, anche in questo caso, l'utilizzo prevalente di rocce piroclastiche, sebbene si assista ad una selezione di litotipi a grana particolarmente fine e a frattura concoide, tra cui soprattutto tufi cineritici (Fig. 12.1).

### 12.3.2 HP METAOFIOLITI

Solo due lame d'ascia di piccole dimensioni sono costituite da HP metaofioliti, provenienti dall'Italia nord-occidentale (Fig. 12.9: Sg5; 12.10: L7). È documentato

ali kot nepravilni agregati ter s pogostnimi ostanki klinopiroksena.<sup>26</sup>

Glede na razprostranjenost kladivastih sekir tega litološkega tipa, ki so v Furlaniji in na Ljubljanskem barju številčnejše kot v južnih območjih *Caput Adriae*, in ob upoštevanju komparativnega pristopa, ki se ga držijo tudi drugi raziskovalci obravnavane problematike,<sup>27</sup> smo izvorno območje iskali v Vzhodnih Alpah. Vzorčeni so bili najpomembnejši izdanki serpentinitov na tem območju (sl. 12.3): ultramafični kompleks pri Slovenski

<sup>26</sup> D'Amico et al. 1997, 419; 2001; Bernardini et al. 2006-2007.

<sup>27</sup> Majerowicz et al. 2000; Skoczylas et al. 2000.



Tab. 12.1: Composizione litologica e possibili provenienze dei manufatti studiati. XRD: X ray diffraction, OM: optical microscopy.

Tab. 12.1: Litološka sestava in možna izvorna območja preučevanih orodij. XRD: rentgenska difrakcija, OM: optična mikroskopija.

CAMPIONE VZOREC	SITO NAJDIŠČE	TIPOLOGIA TIPOLOGIJA	LITOLOGIA LITOLOGIJA	PROVENIENZA IZVOR	METODOLOGIA ANALITICA ANALITSKA METODA
Sg1	Stare gmajne	scheggia odbitek	tufo cineritico cineritni tuf	locale o vicina lokalni	OM
Sg2	Stare gmajne	scheggia odbitek	tufo cineritico cineritni tuf	locale o vicina lokalni	OM
Sg3	Stare gmajne	mola žrmlje	fillade sericitica sericitni filit	locale o vicina lokalni	XRD, OM
Sg4	Stare gmajne	scheggia odbitek	tufo cineritico cineritni tuf	locale o vicina lokalni	OM
Sg5	Stare gmajne	lama d'ascia ploščata sekira	giada o eclogite žad ali eklogit	Italia NW SZ Italija	stereomicroscopia; XRD su superficie stereomikroskopija; XRD na površini
Sg6	Stare gmajne	ascia forata kladivasta sekira	metaultramafite metaultramafit	Alpi Orientali? Vzhodne Alpe?	XRD
Sg7	Stare gmajne	ascia forata kladivasta sekira	metaultramafite metaultramafit	Alpi Orientali? Vzhodne Alpe?	XRD
Sg8	Stare gmajne	cote brus	calcare impuro (con quarzo) / nečisti apnenec (s kremenom)	locale o vicina lokalni	XRD
Sg9	Stare gmajne	crogiolo talilna posoda	siltite quarzo-feldspatico kremenasto glinasti muljevec	locale o vicina lokalni	XRD
Sg10	Stare gmajne	cote brus	siltite o tufo cineritico quarzo-feldspatico con clorite / muljevec ali cineritni kremenasto glinasti tuf s kloritom	locale o vicina lokalni	XRD
BB1	Blatna Brezovica	scheggia odbitek	tufo cineritico cineritni tuf	locale o vicina lokalni	OM
BB2	Blatna Brezovica	scheggia odbitek	tufo cineritico fine drobnozrnati cineritni tuf	locale o vicina lokalni	OM
BB3	Blatna Brezovica	cote brus	siltite o tufo cineritico quarzo-feldspatico muljevec ali cineritni kremenasto glinasti tuf	locale o vicina lokalni	XRD
SM1	Spodnje mostišče	ascia scalpello dleto	tufo o tufite quarzo- feldspatico / tuf ali kremenasto glinasti tufit	locale o vicina lokalni	XRD
NG1	Notranje Gorice	ascia forata kladivasta sekira	metaultramafite metaultramafit	Alpi Orientali? Vzhodne Alpe?	OM
L1	Ljubljana	ascia forata kladivasta sekira	roccia carbonatica karbonatna kamnina	locale o vicina lokalni	stereomicroscopia; test con acido stereomikroskopija; test s kislino
L2	Ljubljana	lama d'ascia ploščata sekira	tufo o tufite tuf ali tufit	locale o vicina lokalni	stereomicroscopia stereomikroskopija
L3	Ljubljana	lama d'ascia ploščata sekira	tufo fine drobnozrnati tuf	locale o vicina lokalni	XRD, OM
L4	Ljubljana	lama d'ascia ploščata sekira	tufo o tufite tuf ali tufit	locale o vicina lokalni	stereomicroscopia stereomikroskopija
L5	Ljubljana	ascia forata kladivasta sekira	tufo fine drobnozrnati tuf	locale o vicina lokalni	XRD, OM
L6	Ljubljana	lama d'ascia ploščata sekira	tufo cineritico cineritni tuf	locale o vicina lokalni	XRD, OM
L7	Ljubljana	lama d'ascia ploščata sekira	giada žad	Italia NW SZ Italija	stereomicroscopia; XRD su superficie / stereomikroskopija; XRD na površini
L8	Ljubljana	ascia forata kladivasta sekira	serpentinite serpentin	Alti Tauri (Austria)? Visoke Ture (Avstrija)?	XRD, OM

CAMPIONE VZOREC	SITO NAJDIŠČE	TIPOLOGIA TIPOLOGIJA	LITOLOGIA LITOLOGIJA	PROVENIENZA IZVOR	METODOLOGIA ANALITICA ANALITSKA METODA
L9	Ljubljana	ascia forata kladivasta sekira	serpentine serpentin	Alti Tauri (Austria)? Visoke Ture (Avstrija)?	XRD su superficie XRD na površini
L11	Ljubljana	ascia forata kladivasta sekira	serpentine serpentin	Alti Tauri (Austria)? Visoke Ture (Avstrija)?	XRD, OM
L12	Ljubljana	ascia forata kladivasta sekira	serpentine serpentin	Alti Tauri (Austria)? Visoke Ture (Avstrija)?	XRD, OM
L13	Ljubljana	cote brus	argillite tufacea tufska glina	locale o vicina lokalni	XRD, OM
L14	Ljubljana	ascia forata? kladivasta sekira?	roccia carbonatica karbonatna kamnina	locale o vicina lokalni	stereomicroscopia; test con acido stereomikroskopija; test s kislino
L15	Ljubljana	lama d'ascia? ploščata sekira?	roccia carbonatica karbonatna kamnina	locale o vicina lokalni	stereomicroscopia; test con acido stereomikroskopija; test s kislino
L44	Ljubljana	lama d'ascia? ploščata sekira?	tufo cineritico cineritni tuf	locale o vicina lokalni	XRD, OM
L45	Ljubljana	ascia scalpello dleto	tufo o tufite tuf ali tufit	locale o vicina lokalni	stereomicroscopia stereomikroskopija
L46	Ljubljana	lama d'ascia ploščata sekira	tufo o tufite tuf ali tufit	locale o vicina lokalni	stereomicroscopia stereomikroskopija
L47	Ljubljana	lama d'ascia ploščata sekira	serpentine serpentin	Alti Tauri (Austria)? Visoke Ture (Avstrija)?	XRD, OM
L48	Ljubljana	lama d'ascia ploščata sekira	arenaria tufacea tufski peščenjak	locale o vicina lokalni	XRD, OM
L49	Ljubljana	lama d'ascia ploščata sekira	tufo litico cristallino grossolano / debeložrnati kristalasti litični tuf	locale o vicina lokalni	XRD, OM
L50	Ljubljana	lama d'ascia ploščata sekira	arenaria tufacea tufski peščenjak	locale o vicina lokalni	XRD, OM
L51	Ljubljana	lama d'ascia ploščata sekira	tufo o tufite tuf ali tufit	locale o vicina lokalni	stereomicroscopia stereomikroskopija
L52	Ljubljana	lama d'ascia ploščata sekira	tufo cristallino grossolano debeložrnati kristalasti tuf	locale o vicina lokalni	XRD, OM
L53	Ljubljana	lama d'ascia ploščata sekira	argillite tufacea tufska glina	locale o vicina lokalni	XRD, OM
L54	Ljubljana	ascia scalpello dleto	tufo grossolano debeložrnati tuf	locale o vicina lokalni	XRD, OM
L55	Ljubljana	martello kladivo	tufo grossolano debeložrnati tuf	locale o vicina lokalni	XRD, OM
L56	Ljubljana	lama d'ascia ploščata sekira	arenaria tufacea tufski peščenjak	locale o vicina lokalni	XRD, OM
L57	Ljubljana	lama d'ascia ploščata sekira	spilite spilit	locale o vicina lokalni	XRD, OM
L59	Ljubljana	lama d'ascia ploščata sekira	cheratofiro keratofir	locale o vicina lokalni	XRD, OM
L60	Ljubljana	peso? utež?	arenaria tufacea tufski peščenjak	locale o vicina lokalni	XRD, OM
L61	Ljubljana	lama d'ascia ploščata sekira	serpentine serpentin	Alti Tauri (Austria)? Visoke Ture (Avstrija)?	XRD, OM



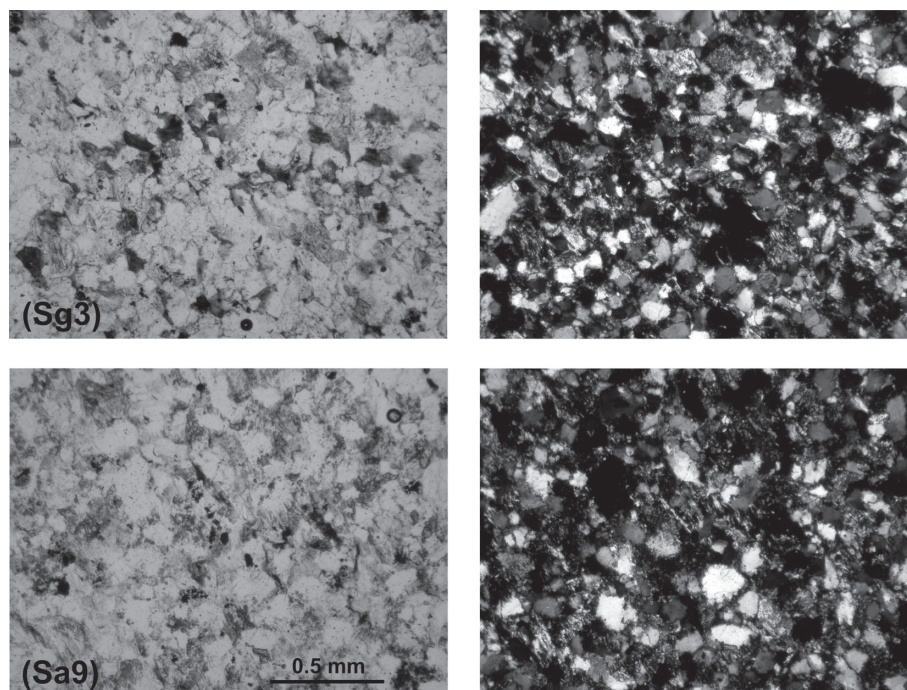


Fig. 12.2: Microfotografie di un campione prelevato da una mola rinvenuta a Stare gmajne (Sg3) e di una roccia campionata in un affioramento lungo la Sava nei pressi di Lubiana (Sa9). Si notano le comuni caratteristiche mineralogiche-petrografiche: grana minuta ( $\leq 0,2/0,3$  mm) costituita in gran parte da quarzo, feldspati e miche; immagini a sinistra con IN, quelle a destra con NX.  
Sl. 12.2: Mikrofotografije vzorca žrnelj s Starih gmajn (Sg3) in kamna iz Save v bližini Ljubljane (Sa9). Opazijo se skupne mineraloško-petrografske značilnosti: šibka zrnatost ( $\leq 0,2/0,3$  mm) sestavljena iz kremena, gline, sljude; slike na levi z IN, tiste na desni z NX.

lo sfruttamento sia di depositi primari che secondari di queste particolari litologie.<sup>25</sup>

### 12.3.3 SERPENTINITI

Tra i manufatti studiati quattro asce forate e due lame d'ascia, provenienti dalla Ljublanica, sono costituite da serpentinite. Lo studio mineralogico-petrografico dei campioni della Slovenia ha consentito di rilevare una stretta somiglianza con le asce forate in serpentinite provenienti dal Friuli-Venezia Giulia e dall'Istria. Questi reperti sono in genere costituiti da serpentino probabilmente antigoritico a grana da media a fine, magnetite in quantità variabile presente sotto forma di microgranulazioni delimitanti maglie localizzate o di aggregati irregolari e frequenti relitti di clinopirosseno.<sup>26</sup>

Sulla base della distribuzione delle asce forate in questa litologia, più numerose in Friuli e nel Ljubljansko barje rispetto alle zone meridionali del *Caput Adriae*, e seguendo un approccio comparativo adottato anche da

Bistrice (Pohorje, severovzhodna Slovenija),<sup>28</sup> izdanki serpentinitov na Gradiščanskem (vzhodna Avstrija, blizu meje z Madžarsko),<sup>29</sup> Štajerskem in v Visokih Turah (osrednja Avstrija).<sup>30</sup> Kot je prikazano v enem izmed novejših prispevkov,<sup>31</sup> kažejo bibliografski podatki in preliminarne analize na veliko podobnost med arheološkimi vzorci in nekaterimi izdanki serpentinitov v Visokih Turah, ki jih skupaj s sekundarnimi depoziti označujemo za najverjetnejše izvorno območje (sl. 12.4).

### 12.3.4 METAULTRAMAFITI

Tri kladivaste sekire so iz metamorfozne ultramafične kamnine, v literaturi označene kot metaultramafit.<sup>32</sup> Arheometrične raziskave v preteklosti so omenjeno litologijo prepoznale kot eno izmed najbolj razširjenih med kladivastimi sekirami *Caput Adriae*.<sup>33</sup> Na podlagi

<sup>28</sup> Vrabec et al. 2007.

<sup>29</sup> Evren 1972; Koller 1985.

<sup>30</sup> Melcher et al. 2002; Melcher, Meisel 2004.

<sup>31</sup> Bernardini et al. 2006-2007.

<sup>32</sup> D'Amico et al. 1996; 2001.

<sup>33</sup> D'Amico et al. 1996; 2001; C. D'Amico in E. Montagnari Kokelj, Common use of eastern Alpine lithologies in NE Italy and Slovenia during the Copper Age. V: *The linking role of the*

<sup>25</sup> D'Amico et al. 2004; D'Amico, Starnini 2006a; Pétrequin et al. 2006.

<sup>26</sup> D'Amico et al. 1997, 419; 2001; Bernardini et al. 2006-2007.

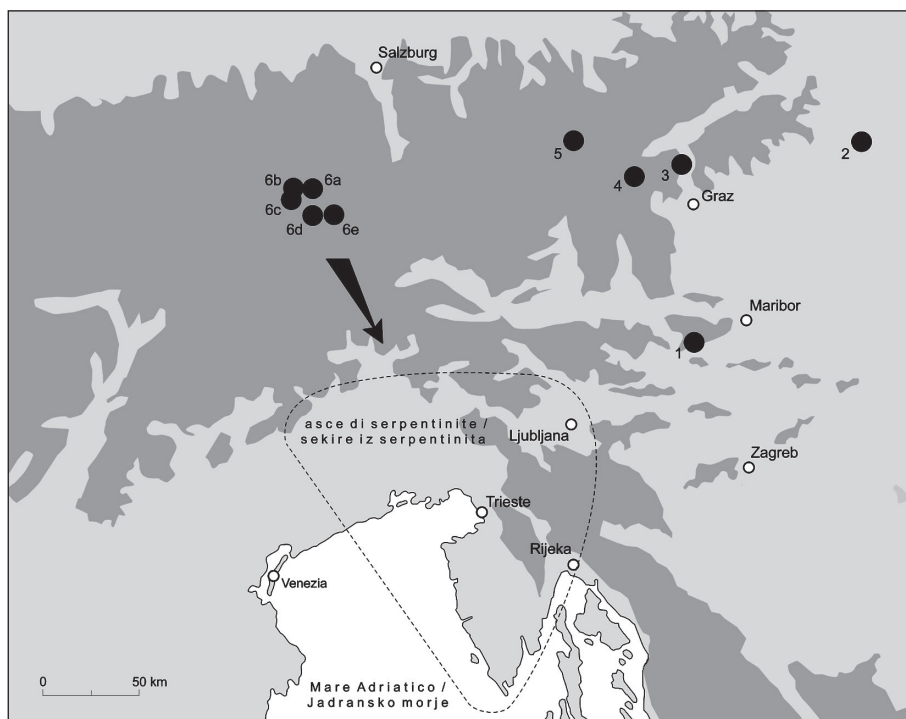


Fig. 12.3: Gli affioramenti di serpentiniti campionati nelle Alpi Orientali: 1, SBUC (Slovenska Bistrica Ultramafic Complex, Pohorje, Slovenia); 2, Bernstein, Steinbach, Badersdorf (Burgenland, Austria); 3, Pernegg (Stiria, Austria); 4, Kraubath (Stiria, Austria); 5, Hochgrössen (Stiria, Austria); 6a: Stubachtal, 6b: Felbertal, 6c: Hintersee, 6d: Kals, 6e: valle di Möll a sud di Heiligenblut (Alti Tauri, Austria). Il riquadro tratteggiato indica l'area di ritrovamento delle asce forate in serpentinite studiate fino ad oggi.

Sl. 12.3: Izdanki serpentinitov vzorčenih v Vzhodnih Alpah: 1. SBUC (ultramafični kompleks pri Slovenski Bistrici, Pohorje, Slovenija); 2. Bernstein, Steinbach, Badersdorf (Gradišćanska, Avstrija); 3. Pernegg (Štajerska, Avstrija); 4. Kraubath (Štajerska, Avstrija); 5. Hochgrössen (Štajerska, Avstrija); 6a. Stubachtal, 6b. Felbertal, 6c. Hintersee, 6d. Kals, 6e. dolina reke Möll, južno od Heiligenbluta (Visoke Ture, Avstrija). Z neskelnjeno črto obdano polje označuje območje z najdišči do sedaj preučениh kladivastih sekir iz serpentinita.

altri studiosi per le stesse problematiche,<sup>27</sup> le ricerche per l'individuazione della zona di provenienza si sono concentrate nelle Alpi orientali. Sono stati campionati i principali affioramenti di rocce serpentinosi in quest'area (Fig. 12.3): il Complesso Ultramafico di Slovenska Bistrica (Pohorje, Slovenia nord-orientale),<sup>28</sup> le serpentiniti affioranti nel Burgenland (Austria orientale, poco distante dal confine con l'Ungheria),<sup>29</sup> in Stiria e negli Alti Tauri (Austria centrale).<sup>30</sup> Come messo in evidenza in un recente contributo,<sup>31</sup> i dati bibliografici e le analisi preliminari indicano una stretta somiglianza tra i campioni archeologici e alcuni affioramenti di serpentiniti negli Alti Tauri, che vengono quindi considerati, insieme ai depositi secondari ad essi collegati, una delle più probabili zone di provenienza (Fig. 12.4).

analiz, ki so jih opravili D'Amico et al.,<sup>34</sup> je bila zelo natančno opisana njena parageneza: ostanki olivina in/ali klinopiroksena, temne rogovače, Mg-rogovalce, tremolita, aktinolit in klorita iz neoformacije.

Isti avtor predpostavlja skupni razvoj enotnega vzhodnoalpskega kompleksa tako za metaltramafite kot tudi za serpentinite. Čeprav za razliko od serpentinitov vzorčenje možnih izvornih območij za metaltramafite še ni bilo opravljeno, pa velja omeniti dejstvo, da sekire iz metaltramafitov najdemo predvsem na Tržaškem krasu in v osrednji Sloveniji, skoraj nič pa v Furlaniji, kjer so pogoste sekire iz serpentinita. Upošteva tudi tipološke posebnosti lahko torej sklepamo na različno izvorno območje, ki je nekoliko bolj vzhodno od izvorne območja serpentinitov v Visokih Turah.

<sup>27</sup> Majerowicz et al. 2000; Skoczylas et al. 2000.

<sup>28</sup> Vrabc et al. 2007.

<sup>29</sup> Evren 1972; Koller 1985.

<sup>30</sup> Melcher et al. 2002; Melcher, Meisel 2004.

<sup>31</sup> Bernardini et al. 2006-2007.

*Alps in the past cultures: an archaeometrical approach*, Congress AIAR, 13-14 February 2004, Bressanone, v tisku.

<sup>34</sup> 2001.

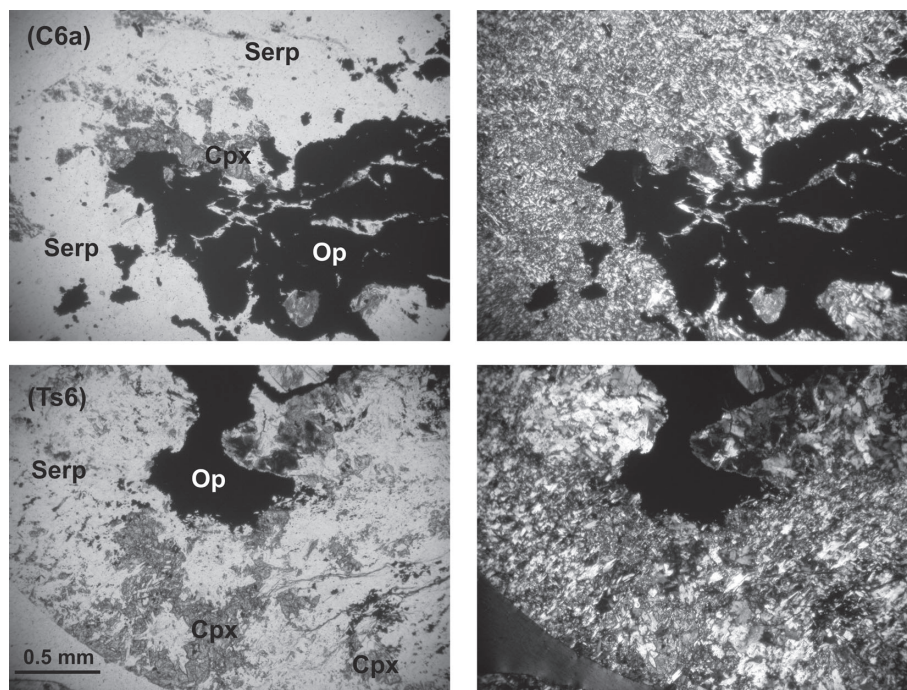


Fig. 12.4: Microfotografie del campione C6a dalla valle di Möll a sud di Heiligenblut (punto di campionamento 6e di Fig. 12.3, Austria centrale) in alto, e dell'ascia forata T6 da S. Stefano Aquileiese (Udine) in basso. Immagini a sinistra con IN, quelle a destra con NX. Entrambi i campioni mostrano una struttura non pseudomorfa di serpentino a grana fine con relitti di clinopirosseno e chiazze irregolari di minerali opachi; abbreviazioni: Serp, serpentino; Cpx, clinopirosseno; Op, minerali opachi.

Sl. 12.4: Mikrofotografije vzorca C6a (zgoraj) iz doline reke Möll, južno od Heiligenbluta (mesto vzorčenja 6e na sl. 12.3, osrednja Avstrija) in klavivasta sekira T6 (spodaj) z najdišča S. Stefano Aquileiese (Videm). Slike na levi z IN, tiste na desni z NX. Oba vzorca kažeta na pseudomorfnu serpentinitno strukturo s fino zrnatostjo in ostanki klinopirossena ter nepravilnimi sledovi neprosojnih mineralov; okrajšave: Serp, serpentinit; Cpx, klinopirossen, Op, neprosojni minerali.

### 12.3.4 METAULTRAMAFITI

Tre asce forate sono costituite da una roccia ultrafemica metamorfosata, definita nella letteratura come metaultramafite.<sup>32</sup> Precedenti indagini archeometriche avevano già riconosciuto questa litologia come una delle più diffuse tra le asce forate rinvenute nel *Caput Adriae*.<sup>33</sup> Sulla base delle analisi effettuate da D'Amico et al.,<sup>34</sup> è stata definita con precisione la sua paragenesi: relitti di olivina e/o clinopirosseno e orneblenda bruna, Mg-orneblenda, tremolite, actinolite e clorite di neoformazione.

Lo stesso autore ipotizza una provenienza comune da un unico complesso delle Alpi orientali sia per le metaultramafite che per le serpentiniti. Sebbene, a differenza di quanto fatto per le serpentiniti, non si sia ancora proceduto a un campionamento delle possibili aree di provenienza delle metaultramafite, la distribuzio-

<sup>32</sup> D'Amico et al. 1996; 2001.

<sup>33</sup> D'Amico et al. 1996; 2001; C. D'Amico e E. Montagnari Kokelj, Common use of eastern Alpine lithologies in NE Italy and Slovenia during the Copper Age. In: *The linking role of the Alps in the past cultures: an archaeometrical approach*, Congress AIAR, 13-14 February 2004, Bressanone, in corso di stampa.

<sup>34</sup> 2001.

### 12.4 DISKUSIJA

#### 12.4.1 ORODJA IZ KAMNIN LOKALNEGA IZVORA

Večina glajenih kamnitih orodij je iz surovin lokalnega izvora, med katerimi prevladujejo tufi in tufiti (48,7 %), poleg njih so orodja iz karbonatnih kamnin (9,7 %) in drugih redkeje zastopanih litoloških tipov (muljevci ali cineritni tufi 4,8 %; muljevci 2,4 %; spliti 2,4 %; keratofirji 2,4 %; sericitni filiti 2,4 %). Preliminarni podatki za orodja na odbitkih kažejo na uporabo piroklastičnih kamnin, čeprav so te fine zrnatosti in školjkastega preloma (100 %). Delež drugih surovin za orodja na odbitkih se zdi, vsaj preliminarno, povsem zanemarljiv. V primeru, da glajena orodja in orodja na odbitkih združimo, jih je iz lokalne surovine narejenih kar 76 %.

Čeprav ni mogoče izključiti izkoriščanja primarnih nahajališč npr. tufov in tufitov v severni Sloveniji,<sup>35</sup> bi lahko bili prodnati nanosi Save glede na tam opravljeno vzorčenje najpomembnejši vir pridobivanja surovine med

<sup>35</sup> Bernardini et al. 2006-2007.



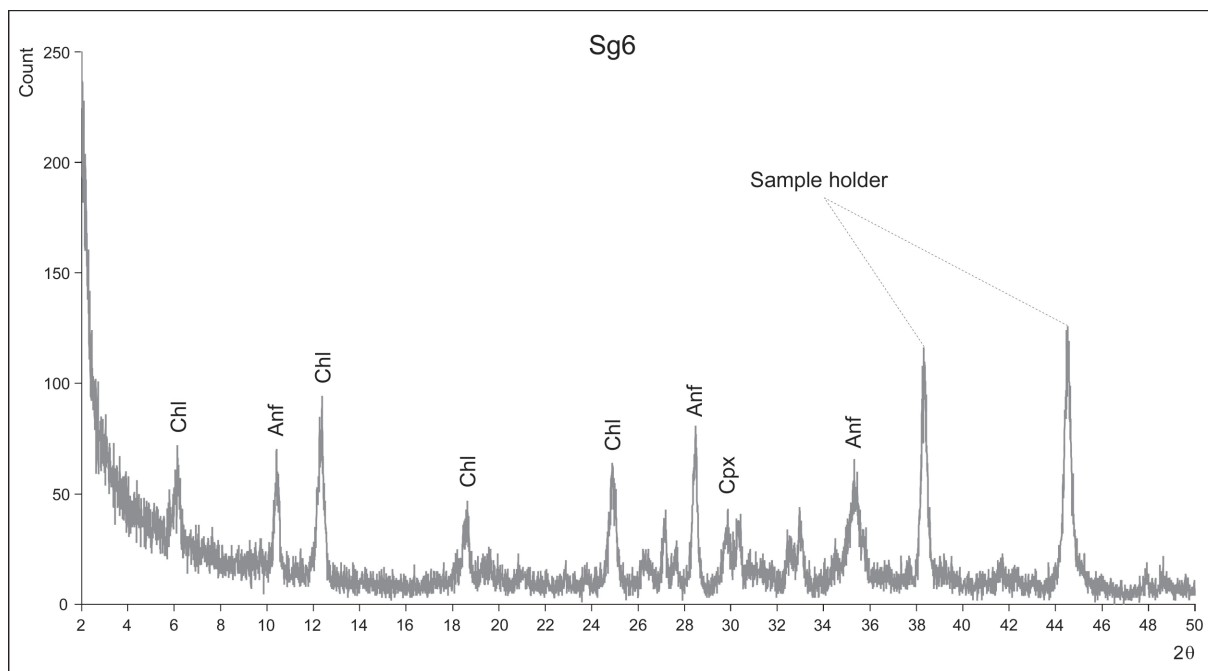


Fig. 12.5: Difrattogramma dell'ascia Sg6 in metaultramafite ad anfibolo, clorite e clinopirosseno proveniente da Stare gmajne. Sigle: Chl, clorite; Anf, anfibolo; Cpx, clinopirosseno.

Sl. 12.5: Difraktogram sekire Sg6 iz metaultramafita pri amfibolu, kloritu in klinopirosenu s Starih gmajn. Okrajšave: Chl, klorit; Anf, amfibol; Cpx, klinopirosen.

ne delle asce forate in questa litologia – concentrate nel Carso triestino e nella Slovenia centrale, quasi assenti nella pianura friulana a differenza dei manufatti in serpentinite – e la particolare tipologia inducono a pensare a un'area di provenienza diversificata e più orientale rispetto a quella riconosciuta per le asce in serpentinite nell'area degli Alti Tauri.

## 12.4 CONSIDERAZIONI

### 12.4.1 MANUFATTI DI PROVENIENZA LOCALE O VICINA

La maggioranza dei manufatti in pietra levigata sono costituiti da materie prime locali, tra cui soprattutto tufi e tufiti (48,7 %), accanto a rocce carbonatiche (9,7 %) e altre litologie scarsamente attestate (siltiti o tufi cineritici 4,8 %; siltiti 2,4 %; spiliti 2,4 %; cheratofiri 2,4 %; filladi sericitiche 2,4 %). Anche per i manufatti in pietra scheggiata i dati preliminari raccolti indicano l'utilizzo di rocce piroclastiche, sebbene si assista alla selezione di litologie a grana particolarmente fine e a frattura concoide (100 %). L'incidenza di altre materie prime scheggiabili appare, in via preliminare, del tutto minoritaria. Se si considerano insieme sia i manufatti in pietra levigata che in pietra scheggiata analizzati, la percentuale di quelli fabbricati con materie prime locali è pari a ben il 76 %.

koliščarji z Ljubljanskega barja v 4. tisočletju pr. Kr. Med vzorci, pobranimi v koritu Save blizu Ljubljane, so bile namreč odkrite kamnine, ki povsem ustrezajo surovini za glajena orodja in orodja na odbitkih.

### 12.4.2 UVOŽENA ORODJA

Posamezna glajena kamnita orodja – ploščate sekire iz HP-metaofiolita (4,8 %), kladivaste sekire iz serpentinita (14,6 %) in metaultramafita (7,3 %) – kažejo na izmenjavo med različnimi regijami na srednje ali dolge razdalje.

#### 12.4.2.1 PLOŠČATE SEKIRE IZ SEVERO-ZAHODNOITALIJANSKIH HP-METAOFIOLITOV

Raziskovanje ploščatih sekir iz severozahodnoitalijanskega HP-metaofiolita ima v Italiji in Evropi dolgo tradicijo.<sup>36</sup> Tako so v zadnjih letih z zanesljivostjo lahko identificirali in datirali nekatere primarne izdanke v visokogorju.<sup>37</sup> Obenem obstajajo dokazi, ki kažejo na izkoriščanje sekundarnih nahajališč.<sup>38</sup>

<sup>36</sup> D'Amico et al. 2004; D'Amico 2005; D'Amico, Starnini 2006b; Pétrequin et al. 2005; 2006.

<sup>37</sup> Pétrequin et al. 2005; 2006.

<sup>38</sup> D'Amico, Starnini 2006a.

Sebbene non si possa escludere lo sfruttamento di depositi primari – in Slovenia settentrionale nel caso di tufi e tufiti –,<sup>35</sup> i depositi alluvionali della Sava potrebbero aver rappresentato, in base ai campionamenti effettuati, la principale fonte di approvvigionamento delle materie prime litiche utilizzate dalle popolazioni che abitavano il Ljubljansko barje nel IV millennio a.C.. Tra i campioni raccolti lungo la Sava nei pressi di Lubiana sono state infatti riconosciute rocce del tutto simili a quelle impiegate per la maggior parte dei manufatti in pietra levigata e scheggiata.

## 12.4.2 MANUFATTI IMPORTATI

Alcuni gruppi di manufatti in pietra levigata – lame d'ascia in HP metaofiolite (4.8 %), asce forate in serpentinite (14.6 %) e metaultramafite (7.3 %) – documentano invece scambi a media e lunga distanza con aree diverse.

### 12.4.2.1 LAME D'ASCIA IN HP METAOFIOLITI PROVENIENTI DALL'ITALIA NORD-OCCIDENTALE

Gli studi sulle lame d'ascia in HP metaofiolite dell'Italia nord-occidentale in Italia e in Europa sono molto sviluppati.<sup>36</sup> Negli ultimi anni le ricerche hanno permesso di identificare con precisione e datare alcune zone di estrazione dagli affioramenti primari in alta quota.<sup>37</sup> Nello stesso tempo vi sono evidenze che testimoniano anche lo sfruttamento di depositi secondari.<sup>38</sup>

Il quadro delle presenze di manufatti importati nell'Italia nord-orientale, in Slovenia e Croazia è riassunto in Bernardini et al.<sup>39</sup> Le due piccole lame d'ascia inserite nel presente lavoro sono, in base ai dati oggi a disposizione, gli unici reperti di questo tipo nella Slovenia centrale insieme ad altri due manufatti, anch'essi di piccole dimensioni, provenienti dalle palafitte di Deschmann. Se le aree costiere del *Caput Adriae* sono inserite nello scambio di manufatti in HP metaofioliti già a partire dalla cultura di Danilo/Vlaška, sembra che la Slovenia centrale sia raggiunta da questi traffici in un momento molto più tardo. Le asce in giada scoperte nelle palafitte di Deschmann dovrebbero infatti essere riferibili al III millennio a.C.; l'ascia da Stare gmajne è inquadabile verso la fine del IV millennio a.C., mentre per il manufatto dalla Ljubljana mancano dati di contesto. Anche in altre zone d'Europa, come nel Giura francese,

<sup>35</sup> Bernardini et al. 2006–2007.

<sup>36</sup> D'Amico et al. 2004; D'Amico 2005; D'Amico, Starnini 2006b; Pétrequin et al. 2005; 2006.

<sup>37</sup> Pétrequin et al. 2005; 2006.

<sup>38</sup> D'Amico, Starnini 2006a.

<sup>39</sup> 2006–2007.

Pregled uvoženih kamnitih orodij, ki se pojavljajo na tleh severovzhodne Italije, Slovenije in Hrvaške, že najdemo pri Bernardini et al.<sup>39</sup> Dve majhni ploščati sekiri, ki ju dodajamo v tem prispevku, pa sta na podlagi doslej zbranih podatkov poleg dveh tudi majhnih orodij z Dežmanovih kolišč edinstveni najdbi omenjenega litološkega tipa v osrednji Sloveniji. Če se je priobalni pas *Caput Adriae* vključil v izmenjavo orodij iz HP-metaofiolitov že od srednjega neolitika (stopnja Danilo/Vlaška) naprej, se zdi, da je bilo ozemlje osrednje Slovenije v izmenjavo vključeno šele veliko pozneje. Sekiri iz žada z Dežmanovih kolišč bi lahko namreč datirali v 3. tisočletje pr. Kr., medtem ko se sekira s Starih gmajn zdi starejša in jo postavljamo v čas proti koncu 4. tisočletja. Odprta ostaja datacija za najdbo iz Ljubljane, ki je bila najdena zunaj zanseljivega arheološkega konteksta. Kakor koli že, tudi na drugih območjih Evrope, npr. v francoski Juri, je prišlo do izmenjave majhnih sekir iz alpskih metaofiolitov, ki so bile skoraj zagotovo nasajene z uporabo vmesnika oz. nastavka iz rogovja, razmeroma pozno v prazgodovini.<sup>40</sup>

### 12.4.2.2 KLADIVASTE SEKIRE IZ SERPENTINITA

Kladivaste sekire iz serpentinita se pojavljajo samo med najdbami iz Ljubljane. Gre za 4 orodja, med katerimi je ena sekira cela, ostale tri pa samo fragmenti. Majhna ploščata sekira iz serpentinita, ki odstopa po obliki, je verjetno ponovno uporabljena počena kladivasta sekira. Treba pa je omeniti, da se znotraj te litološke skupine pojavlja še fragment distalnega dela velike ploščate sekire.

Najdbe iz serpentinita so pogoste v Furlaniji-Juljski krajini in na Ljubljanskem barju, medtem ko se njihovo število proti jugu v Istro zmanjšuje (*sl. 12.6*); na tem območju je namreč najbolj zastopana litološka skupina diabaz.<sup>41</sup> Poleg tega razpoložljivi arheometrični podatki kažejo, da so na vzhodu in severu Hrvaške sekire iz serpentinitov manj pogoste od orodij iz magmatskih ali metamorfni kamnin.<sup>42</sup> Zdi se, da torej navedeni podatki kažejo na vzhodnoalpski izvor obravnavane kamnine. Slednje potrjujejo tudi v zadnjem času odkriti izdanki serpentinitov v Visokih Turah in z njimi povezana sekundarna nahajališča, ki jih po vsej verjetnosti lahko opredelimo kot eno izmed izvornih območij za orodja

<sup>39</sup> 2006–2007.

<sup>40</sup> Pétrequin et al. 2006.

<sup>41</sup> D'Amico et al. 2001; Alberti et al. 2007; Bernardini et al. 2006–2007; F. Bernardini, E. Montagnari Kokelj in A. Velušček, *Prehistoric cultural connections in the North-Eastern Adriatic regions, identified by means of archaeometrical analyses of stone axes*. V: S. Forenbaher in T. Kaiser (ur.), *A Connecting Sea: Maritime Interaction in Adriatic Prehistory*, BAR International Series, v tisku; Bernardini et al., v pripravi.

<sup>42</sup> Balen, Balen, Kurtanjer 2002; Šimek, Kurtanjer, Paunović 2002.



si assiste allo scambio di lame d'ascia in metaofioliti alpine, sempre di piccole dimensioni e quasi sicuramente immanicate tramite un elemento intermedio in corno di cervo, in una fase tarda della preistoria.<sup>40</sup>

#### 12.4.2.2 ASCE FORATE IN SERPENTINITE

Solo tra i materiali raccolti nella Ljubljana vi sono asce forate in serpentinite. Si tratta di quattro manufatti, tra cui uno integro e tre frammentari. Una piccola lama d'ascia in serpentinite, vista la forma particolare, potrebbe essere il riutilizzo di un'ascia forata rotta. Deve inoltre essere menzionata anche la presenza di un frammento distale di una grande lama d'ascia in questa litologia.

I reperti in serpentinite sono molto numerosi in Friuli-Venezia Giulia e nel Ljubljansko barje mentre il loro numero diminuisce procedendo verso sud nella penisola istriana (Fig. 12.6), area in cui la litologia più comune delle asce forate è il basalto doleritico.<sup>41</sup> Inoltre, i dati archeometrici a disposizione indicano che nella Croazia orientale e settentrionale le asce in serpentinite non sono tanto frequenti quanto quelle ottenute da altre rocce, magmatiche o metamorfiche.<sup>42</sup> I dati sopraccitati sembrerebbero dunque confermare una provenienza alpina orientale di questa materia prima. Recenti studi hanno consentito di riconoscere nelle serpentinite degli Alti Tauri e dei depositi secondari ad esse collegati una delle più probabili fonti di approvvigionamento di questo gruppo di manufatti.<sup>43</sup> Bisogna tuttavia sottolineare che fino ad oggi non sono stati effettuati campionamenti di confronto degli affioramenti di serpentinite nella Croazia settentrionale.

Allo stato attuale non è ancora possibile riconoscere una tipologia vera e propria che consenta di individuare forme peculiari di momenti diversi della preistoria e il loro areale di distribuzione. Solo alcune osservazioni generali, da verificare nell'ambito delle future ricerche, possono essere formulate. Tra i manufatti in pietra levigata da Sammartenchia nell'alta pianura friulana, vi sono quattordici asce forate, tutte in serpentinite, in gran parte rinvenute durante ricognizioni di superficie. Un'eccezione è rappresentata dall'ascia forata SAM306, proveniente dallo strato quattro, struttura 153 di Sammartenchia.<sup>44</sup> La maggior parte dei materiali editi

tega litološkega tipa.<sup>43</sup> Ob tem pa je treba tudi poudariti, da primerjalno vzorčenje na serpentinitih iz severne Hrvaške do danes še ni bilo opravljeno.

Trenutno stanje je takšno, da določenih tipov sekir še ni mogoče povezati z določenimi obdobji oz. območji. Podamo lahko le splošne opazke, ki pa jih bo treba v prihodnosti še preveriti. Med glajenimi orodji iz Sammartenchie v Furlaniji je bilo najdenih 14 kladivastih sekir. Vse so iz serpentinita in v večini pobrane pri površinskem pregledu najdišča. Izjemo predstavlja kladivasta sekira SAM306, ki izvira iz plasti 4, strukture 153.<sup>44</sup> Za večino objavljenih orodij je značilen krožni presek.<sup>45</sup> Gre za morfološko značilnost, ki je do danes še nismo srečali pri ostalih sekirah iz serpentinita na območju *Caput Adriae*.<sup>46</sup> Enako velja za sekiro 211 iz Sammartenchie,<sup>47</sup> ki je za razliko od predhodnih pravilnega pravokotnega preseka s topimi robovi in edini doslej najdeni tak primerek. Izvzemši nekatere najdbe so zgoraj navedena orodja fino obdelana do take mere, da so se zabrisale morfološke značilnosti surovine. Prečni, krožni ali pravokotni preseki in vsesplošno skrbnejša izdelava ločujejo kladivaste sekire iz Sammartenchie od podobnih z ostalih najdišč v Furlaniji-Juljski krajini, kar je morda dokaz različne starosti.

Povrnimo se k osrednji Sloveniji. Glajena kamnita orodja z Resnikovega prekopa na Ljubljanskem barju,<sup>48</sup> ki smo jih preučili le makroskopsko in zato niso zajeta na sl. 12.6, vsebujejo nekatere indice o začetkih izkoriščanja serpentinitov za proizvodnjo kladivastih sekir na omenjenem območju, ki ga je proces neolitizacije zajel nekoliko kasneje, kot to velja za severovzhodnojadransko obalo.<sup>49</sup> Med glajenimi orodji tako najdemo kladivaste sekire zaobljenih oblik - v enem primeru z ušesom na distalnem delu -, ki so jih verjetno pridobili iz rečnih prodnikov, ki izvirajo iz ultramafičnega kompleksa pri Slovenski Bistrici na jugovzhodnih obronkih Pohorja (severovzhodna Slovenija).<sup>50</sup>

Orodja iz Ljubljane ponujajo indice o morfotipološkem razvoju kladivastih sekir iz serpentinita v 4. tisočletju pr. Kr. Med 4 orodji tega litološkega tipa iz Ljubljane, ki verjetno izvirajo z Visokih Tur (osrednja Avstrija), sta najdbi L9 in L12 v frontalnem pogledu ozki in bikonveksni, v lateralnem skoraj pravokotni, z ušesom na proksimalnem delu, in ju ne moremo primerjati z najdbami iz severovzhodne Italije.<sup>51</sup> V nasprotju s tem sta

<sup>40</sup> Pétrequin et al. 2006.

<sup>41</sup> D'Amico et al. 2001; Alberti et al. 2007; Bernardini et al. 2006-2007; F. Bernardini, E. Montagnari Kokelj in A. Velušček, *Prehistoric cultural connections in the North-Eastern Adriatic regions, identified by means of archaeometrical analyses of stone axes*. In: S. Forenbaher e T. Kaiser (ed.), *A Connecting Sea: Maritime Interaction in Adriatic Prehistory*, BAR International Series, in corso di stampa; Bernardini et al., in preparazione.

<sup>42</sup> Balen, Balen, Kurtanjer 2002; Šimek, Kurtanjer, Paunović 2002.

<sup>43</sup> Bernardini et al. 2006-2007.

<sup>44</sup> Pessina, D'Amico 1999, 56, Fig. 29.

<sup>43</sup> Bernardini et al. 2006-2007.

<sup>44</sup> Pessina, D'Amico 1999, 56, sl. 29.

<sup>45</sup> Pessina, D'Amico 1999, sl. 26: 212; 28: 216/6.

<sup>46</sup> D'Amico et al. 1996; Peloi 1996-1997, 124-125; Bernardini et al. 2006-2007; Alberti et al. 2007.

<sup>47</sup> Pessina, D'Amico 1999, sl. 26: 212.

<sup>48</sup> Velušček 2006a.

<sup>49</sup> Guštin 2005a; Velušček 2006a.

<sup>50</sup> Janak et al. 2004, 2; 2006, 20-21; Sassi et al. 2004, 237; Alberti et al. 2007; Vrabc, de Hoog, Janak 2007.

<sup>51</sup> D'Amico et al. 1996; Peloi 1996-1997.

presenta una sezione circolare,<sup>45</sup> caratteristica morfologica che non si riscontra tra le altre asce in serpentinite del *Caput Adriae*, note fino ad oggi.<sup>46</sup> Lo stesso vale per l'ascia 211 di Sammardenchia,<sup>47</sup> che, a differenza delle precedenti, ha una sezione rettangolare molto regolare dagli angoli smussati, non riscontrabile in altri casi. Tranne alcuni reperti, i manufatti sopraccitati sono finemente lavorati a tal punto da rendere irriconoscibile la morfologia originaria del supporto da cui sono stati ricavati. Le sezioni trasversali circolari o rettangolari e più in generale l'accuratezza della lavorazione distinguono le asce forate di Sammardenchia da quelle rinvenute in altre località del Friuli-Venezia Giulia, rispecchiando forse una differenza cronologica.

Se ci rivolgiamo alla Slovenia centrale l'industria in pietra levigata di Resnikov prekop<sup>48</sup> nel Ljubljansko barje, osservata solo a livello macroscopico e quindi non considerata in Fig. 12.6, fornisce alcuni indizi sul primo sfruttamento di rocce serpentinosi per la produzione di asce forate nel territorio sopraccitato, toccato dal processo di neolitizzazione in un momento più tardo rispetto alle aree costiere dell'Adriatico nord-orientale.<sup>49</sup> Infatti tra gli strumenti in pietra levigata vi sono alcune asce forate di forma arrotondata - e in un caso con la perforazione in posizione distale - probabilmente ottenute da ciottoli fluviali, la cui materia prima potrebbe corrispondere alle serpentinita affioranti nel Complesso Ultramafico di Slovenska Bistrica ai margini sud-orientali dei rilievi di Pohorje (Slovenia nord-orientale).<sup>50</sup>

I manufatti della Ljubljanska forniscano forse alcuni indizi sullo sviluppo morfo-tipologico delle asce forate in serpentinite nel IV millennio a.C.. Tra i quattro manufatti in questa litologia scoperti nelle acque della Ljubljanska, provenienti probabilmente dall'area degli Alti Tauri (Austria centrale), i reperti L9 e L12 presentano una forma stretta e biconvessa in prospettiva frontale, subrettangolare in quella laterale con la perforazione in posizione prossimale, non confrontabile con le collezioni dell'Italia nord-orientale.<sup>51</sup> I reperti in questione sono invece molto simili ad un'ascia rinvenuta a Töplitsch in Carinzia.<sup>52</sup> Anche se i dati a disposizione sono insufficienti per fornire indicazioni sicure, questi elementi potrebbero forse indicare che nella prima metà del IV millennio a.C. il Ljubljansko barje, pur aprendosi agli influssi provenienti dall'Italia, sia legato ai territori dell'Austria centrale in modo più stretto e che le numerose asce in serpentinite

sekiri zelo podobni najdbi iz Töplitscha na Koroškem.<sup>52</sup> Sicer skromni razpoložljivi podatki tako nakazujejo, da je na Ljubljanskem barju v prvi polovici 4. tisočletja pr. Kr. vsekakor zaznati vplive iz Italije, da pa je bilo to območje takrat tesneje povezano z osrednjo Avstrijo. Na površju najdene furlanske sekire iz serpentinita naj bi bile namreč v veliki meri nekoliko mlajše.

Sekire bolj splošne trikotaste oblike, ki je pogojena z obliko predmeta, iz katerega so bile izdelane, je težko tipološko razvrstiti po skupinah. V velikem številu jih najdemo med kladivastimi sekirami Dežmanovih kolišč<sup>53</sup> in v Furlaniji-Juljski krajini. Izjemo predstavlja fragment distalnega dela sekire B56 z Dežmanovih kolišč,<sup>54</sup> ki je na frontalni strani okrašen s tremi dobro vidnimi podolžnimi žlebovi, ki se na rezilu skoraj združijo. Ploskvi med žlebovi sta izpolnjeni z ne prav skrbno vrezanima mrežastima vzorcema. Vse ploskve pa so tudi fino zglačene. Iz frontalne perspektive je razvidno, da sta lateralni ploskvi rahlo ukrivljeni. Iz lateralne perspektive pa sta frontalni ploskvi horizontalni in vzporedni, medtem ko je rezilo izbočeno. Prečni presek je pravokoten z debelino 36 mm. Za obliko najdemo odlično analogijo v fragmentarno ohranjeni in delno predelani sekiri z Opčin na Tržaškem krasu.<sup>55</sup>

#### 12.4.2.3 KLADIVASTE SEKIRE IZ METAUSTRAMAFITA

Med preučevanimi najdbami so iz metaultramafita narejene 2 kladivaste sekiri s Starih gmajn in ena z Notranjih Goric. Kladivaste sekire iz omenjene kamnine najdemo predvsem na Tržaškem krasu in Ljubljanskem barju, medtem ko so v Furlaniji in v Istri maloštevilne (sl. 12.7). Vsa ta orodja so temnosive do črne, redkeje rjave barve. Čeprav so bila podvržena glajenju, je njihova površina ostala zrnata in hrapava, kar je verjetno posledica tehnoloških značilnosti osnovne surovine. Velik del najdb medsebojno povezujejo tudi ponavljajoče se morfološke značilnosti. Cela sekira s Starih gmajn (sl. 12.9: Sg7), fragmentarno ohranjena sekira z Notranjih Goric,<sup>56</sup> sekira B61 z Dežmanovih kolišč,<sup>57</sup> skupina orodij iz jam na Krasu<sup>58</sup> in sekira iz Pule<sup>59</sup> imajo bikonkavni prečni presek. Gre za morfološko značilnost, ki jo do sedaj še nismo srečali pri drugih litoloških tipih, verjetno bi jo lahko povezali z načinom nasaditve. Vsekakor se pri

<sup>45</sup> Pessina, D'Amico 1999, Fig. 26: 212; 28: 216/6.

<sup>46</sup> D'Amico et al. 1996; Peloi 1996-1997, 124-125; Bernardini et al. 2006-2007; Alberti et al. 2007.

<sup>47</sup> Pessina, D'Amico 1999, Fig. 26: 212.

<sup>48</sup> Velušček 2006a.

<sup>49</sup> Guštin 2005a; Velušček 2006a.

<sup>50</sup> Janak et al. 2004, 2; 2006, 20-21; Sassi et al. 2004, 237; Alberti et al. 2007; Vrabc, de Hoog, Janak 2007.

<sup>51</sup> D'Amico et al. 1996; Peloi 1996-1997.

<sup>52</sup> Piccotti 1977, 291; Vahlkamp 1979, 7-8, Fig. 1; von Uslar 1991, 251.

<sup>53</sup> Piccotti 1977, 291; Vahlkamp 1979, 7-8, sl. 1; von Uslar 1991, 251.

<sup>54</sup> Peloi 1996-1997; Korošec, Korošec 1969, t. 76: 7,12; 77: 8,13,14; 78: 5,8.

<sup>55</sup> Korošec, Korošec 1969, t. 78: 4.

<sup>56</sup> Marchesetti 1903, t. 11: 5.

<sup>57</sup> Schmid 1910, sl. 9: 9; Korošec, Korošec 1969, t. 78: 6.

<sup>58</sup> Korošec, Korošec 1969, t. 78: 9.

<sup>59</sup> Iz jame v okolici Slivna (neobjavljeno), iz Čotarjeve pečine in Orehove pejce (D'Amico et al. 1996, sl. 155: 5-6).

<sup>60</sup> Marchesetti 1903, t. 11: 6; Alberti et al. 2007.

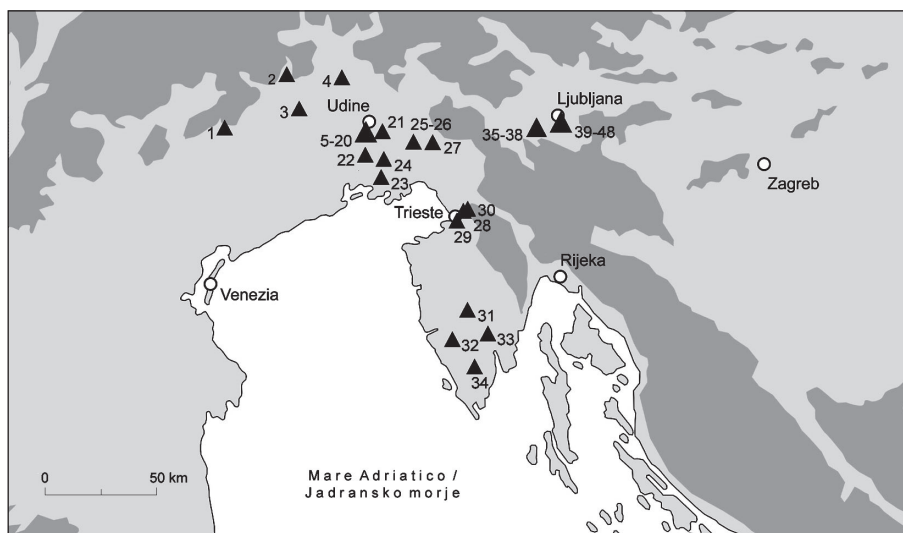


Fig. 12.6: Asce forate in serpentinite nell'area del *Caput Adriae*.

1: S. Tomè (PN, Friuli-Venezia Giulia), n. AQ9514; 2: Meduno (PN, Friuli-Venezia Giulia), n. AQ250607; 3: Gradisca di Provesano (PN, Friuli-Venezia Giulia), n. AQ221855; 4: S. Eliseo di Caporiacco (UD, Friuli-Venezia Giulia), n. AQ223078; 5-20: Sammardenchia (UD, Friuli-Venezia Giulia), nn. AQ225152, AQ223082; AQ225170, SAM6, SAM90, SAM143, SAM148, SAM211-SAM213, SAM216, SAM301, SAM306, SAM315; Pozzuolo del Friuli (UD, Friuli-Venezia Giulia) nn. AQ116005, AQ223080; 21: Pavia di Udine (UD, Friuli-Venezia Giulia), n. AQ225151; 22: Castions di Strada (UD, Friuli-Venezia Giulia), n. AQ232515; 23: S. Stefano Aquileiese (UD, Friuli-Venezia Giulia), n. AQ455715; 24: Novacco (UD, Friuli-Venezia Giulia), n. AQ331243; 25-26: Mossa (GO, Friuli-Venezia Giulia), n. 1325, senza numero; 27: Nova Gorica (Slovenia occidentale), senza numero; 28: Opicina (TS, Friuli-Venezia Giulia), senza numero; 29: Montedoro (TS, Friuli-Venezia Giulia), n. TS2280; 30: Grotta Sottomonte (TS, Friuli-Venezia Giulia), n. TS25785; 31: Sv. Ivan od Šterne (Istria, Croazia), n. P-194; 32: Sandalja (Istria, Croazia), n. P-15059; 33-34: Istria (Croazia), nn. P-12, P-14; 35-38: Ljubljana (Ljubljansko barje, Slovenia), nn. 8, 9, 11, 12; 39-48: Palafitte di Deschmann (Ljubljansko barje, Slovenia), nn. B45, B46, B48, B50, B52, B54, B56, B59, B60, B62.

**Bibliografia:** Castions di Strada, Grotta Sottomonte, Meduno, Montedoro, Pavia di Udine, Pozzuolo del Friuli n. AQ116005, Sammardenchia n. AQ225152, S. Eliseo di Caporiacco, S. Stefano Aquileiese, S. Tomè (D'Amico et al. 1996); Sammardenchia tutti i campioni siglati SAM (D'Amico et al. 1997; Pessina, D'Amico 1999) eccetto SAM315 (determinazione macroscopica); Gradisca di Provesano, Novacco, Mossa, Pozzuolo del Friuli n. AQ223080, Sammardenchia nn. AQ223082; AQ225170 (D'Amico, dati inediti); Palafitte di Deschmann (Peloi 1996-1997); Istria, Nova Gorica, Opicina, Sandalja, Sv. Ivan od Šterne (Alberti et al. 2007).

*Sl. 12.6: Kladivaste sekire iz serpentinita na območju Caput Adriae.*

1: S. Tomè (PN, Furlanija-Juljska krajina), št. AQ9514; 2: Meduno (PN, Furlanija-Juljska krajina), št. AQ250607; 3: Gradisca di Provesano (PN, Furlanija-Juljska krajina), št. AQ221855; 4: S. Eliseo di Caporiacco (UD, Furlanija-Juljska krajina), št. AQ223078; 5-20: Sammardenchia (UD, Furlanija-Juljska krajina), št. AQ225152, AQ223082; AQ225170, SAM6, SAM90, SAM143, SAM148, SAM211-SAM213, SAM216, SAM301, SAM306, SAM315; Pozzuolo del Friuli (UD, Furlanija-Juljska krajina) št. AQ116005, AQ223080; 21: Pavia di Udine (UD, Furlanija-Juljska krajina), št. AQ225151; 22: Castions di Strada (UD, Furlanija-Juljska krajina), št. AQ232515; 23: S. Stefano Aquileiese (UD, Furlanija-Juljska krajina), št. AQ455715; 24: Novacco (UD, Furlanija-Juljska krajina), št. AQ331243; 25-26: Muš (GO, Furlanija-Juljska krajina), št. 1325, brez št.; 27: Nova Gorica (zahodna Slovenija), brez št.; 28: Opčine (TS, Furlanija-Juljska krajina), brez št.; 29: Montedoro (TS, Furlanija-Juljska krajina), št. TS2280; 30: Grotta Sottomonte (TS, Furlanija-Juljska krajina), št. TS25785; 31: Sv. Ivan od Šterne (Istra, Hrvaška), št. P-194; 32: Šandalja (Istra, Hrvaška), št. P-15059; 33-34: Istra (Hrvaška), št. P-12, P-14; 35-38: Ljubljana (Ljubljansko barje, Slovenija), št. 8, 9, 11, 12; 39-48: Dežmanova kolišča (Ljubljansko barje, Slovenija), št. B45, B46, B48, B50, B52, B54, B56, B59, B60, B62.

**Literatura:** Castions di Strada, Grotta Sottomonte, Meduno, Montedoro, Pavia di Udine, Pozzuolo del Friuli št. AQ116005, Sammardenchia št. AQ225152, S. Eliseo di Caporiacco, S. Stefano Aquileiese, S. Tomè (D'Amico et al. 1996); iz Sammardenchie vsi vzorci označeni s SAM (D'Amico et al. 1997; Pessina, D'Amico 1999) razen SAM315 (makroskopska determinacija); Gradisca di Provesano, Novacco, Muš, Pozzuolo del Friuli št. AQ223080, Sammardenchia št. AQ223082; AQ225170 (D'Amico, neobjavljeno); Dežmanova kolišča (Peloi 1996-1997); Istra, Nova Gorica, Opčine, Šandalja, Sv. Ivan od Šterne (Alberti et al. 2007).

scoperte in superficie nella pianura friulana siano in gran parte riferibili a una fase più recente.

Forme più generiche vagamente sub-triangolari, fortemente condizionate dalla natura del supporto da cui sono state prodotte e quindi difficilmente raggruppabili

majhnem številu v celoti ohranjenih orodij v lateralni perspektivi rezilo pogostokrat kaže kot nesimetrično izbočeno (glej sekiri s Starih gmajn in Pule).

Po zaslugi analiziranih orodij z Ljubljanskega barja je mogoče podati kronološko sliko in preliminarno orisati

in una tipologia, sono infatti largamente attestate tra le asce forate provenienti dalle palafitte di Deschmann<sup>53</sup> e tra quelle rinvenute in Friuli-Venezia Giulia. Rappresenta un'eccezione il frammento distale dell'ascia B56, proveniente sempre dalle palafitte di Deschmann,<sup>54</sup> decorato con tre evidenti scanalature longitudinali su una superficie frontale, una centrale e due marginali, convergenti verso il tagliente. Lo spazio definito da questi solchi presenta una decorazione incisa a reticolo non particolarmente curata. Le superfici sono finemente levigate, in prospettiva frontale le superfici laterali sono leggermente curve, in quella laterale le superfici frontali sono orizzontali e parallele mentre il tagliente è arcuato, la sezione trasversale è rettangolare con un'altezza di 36 mm. Questa forma trova un riscontro puntuale in un'ascia frammentaria e in parte rilavorata da Opicina nel Carso triestino.<sup>55</sup>

#### 12.4.2.3 ASCE FORATE IN METAULTRAMAFITE

Tra i materiali studiati, due asce forate da Stare gmajne e una da Notranje Gorice sono costituite da metaultramafite. Le asce forate costituite da questa roccia sono diffuse soprattutto nel Carso triestino e nel Ljubljansko barje mentre sono rare in Friuli e nella penisola istriana (Fig. 12.7). Tutti i manufatti sono di colore grigio scuro-nero e più raramente marrone e, sebbene siano stati sottoposti a levigatura, mantengono un aspetto granuloso e scabro, probabilmente dovuto alle proprietà tecniche della materia prima. La gran parte dei reperti sono inoltre accomunati da caratteristiche morfologiche ricorrenti. L'ascia intera da Stare gmajne (Fig. 12.9: Sg7), quella frammentaria da Notranje Gorice,<sup>56</sup> un'ascia siglata B61 dalle palafitte di Deschmann,<sup>57</sup> una serie di manufatti dalle grotte del Carso (da una cavità nei pressi di Slivia - dato inedito -, dalla caverna Cotariova e da quella dei Ciclami)<sup>58</sup> e un'ascia da Pola<sup>59</sup> hanno la sezione trasversale biconcava. Questa morfologia, fino ad ora mai riscontrata in associazione con altre litologie, potrebbe essere connessa a un particolare sistema di immanicatura. Inoltre, nei pochi esemplari integri, il tagliente si presenta molto spesso arcuato inclinato in prospettiva laterale (vedi le asce da Stare gmajne e Pola).

Grazie ai manufatti analizzati venuti alla luce nel Ljubljansko barje è possibile definire la cronologia e ten-

<sup>53</sup> Peloi 1996-1997; Korošec, Korošec 1969, Tav. 76: 7,12; 77: 8,13,14; 78: 5,8.

<sup>54</sup> Korošec, Korošec 1969, Tav. 78: 4.

<sup>55</sup> Marchesetti 1903, Tav. 11: 5.

<sup>56</sup> Schmid 1910, Fig. 9: 9; Korošec, Korošec 1969, Tav. 78: 6.

<sup>57</sup> Korošec, Korošec 1969, Tav. 78: 9.

<sup>58</sup> Da una cavità nei pressi di Slivia - dato inedito -, dalla caverna Cotariova e da quella dei Ciclami (D'Amico et al. 1996, Fig. 155: 5-6).

<sup>59</sup> Marchesetti 1903, Tav. 11: 6; Alberti et al. 2007.

tipološki razvoj te skupine orodij. Že omenjena sekira s Starih gmajn (sl. 12.9: Sg7) in fragment z Notranjih Goric imata dobri analogiji v drugih orodjih z Notranjih Goric.<sup>60</sup> Ta skupina sekir, pripisana drugi polovici 4. tisočletja pr. Kr.,<sup>61</sup> je v bistvu tipološko homogena: skoraj trikotno podaljšano telo, ki je masivno in obenem elegantno, z zaobljenim talonom ter s konkavno frontalno ploskvijo. V lateralni perspektivi se kažeta skoraj pravokotna oblika in nesimetrično izbočeno rezilo. Robovi, ki povezujejo frontalni in lateralni ploskvi, so vedno zaobljeni. In končno, uho je na proksimalnem delu.

Sekire s podobnimi tipološkimi značilnostmi poznamo doslej samo z Ljubljanskega barja. Ostale kladvaste sekire iz metaultramafita in bikonkavnega preseka s Tražaškega krasa in Istre imajo namreč vedno bolj čokato in nepravilno telo, tudi talon je bolj štirioglat.<sup>62</sup> Žal je bila večina orodij pobranih na površini ali pa je brez zanesljivih stratigrafskih podatkov. Navkljub temu je mogoče na podlagi najdbe sekire omenjenega tipa na Dežmanovih koliščih (sekira B61), ki jo zelo verjetno lahko datiramo v 3. tisočletje pr. Kr.,<sup>63</sup> sklepati, da so se sekire iz metaultramafita, tipološko gledano, razvile iz podaljšane trikotne oblike z zaobljenim talonom in ušesom na proksimalnem delu (tip A) v bolj čokato orodje z nesimetričnim ali štirioglatim proksimalnim zaključkom (tip B) (sl. 12.8). Ni mogoče tudi izključiti, da so nekatera orodja manjših dimenzij nastala kot posledica ponovne uporabe sekir tipa A.

Izključno prisotnost sekir tipa A na najdišču iz druge polovice 4. tisočletja pr. Kr. na Ljubljanskem barju in razprostranjenost sekir tipa B predvsem na Tržaškem krasu, s skoraj popolno odsotnostjo v Furlaniji, kjer so sicer številne kladvaste sekire iz serpentinita, si lahko razložimo z okrepljenimi stiki med osrednjo Slovenijo in Tržaškim krasom v 4. in 3. tisočletju pr. Kr. Stiki med tema področjema so dosegli vrhunec v obdobju ljubljanske kulture, ki je dodobra prežela kulturno podobo Krasa v 3. tisočletju.<sup>64</sup> V tem oziru je primerno poudariti, da poznamo bodisi iz Orehove pejce bodisi iz Čotarjeve pečine poleg značilne keramike ljubljanske kulture<sup>65</sup> tudi sekire iz metaultramafita tipa B.

Sistematična raziskava o možnih izvornih območjih omenjene skupine najdb še ni opravljena. Njihova razprostranjenost in litološka ter tipološka uniformnost kljub temu namigujeta na to, da je izvorno območje za surovino treba iskati nekje v Vzhodnih Alpah ali celo dlje. Poleg tega razlike v razprostranjenosti sekir iz metaultramafita - v glavnem jih poznamo z Ljubljanskega barja

<sup>60</sup> Schmid 1910, sl. 9: 3.

<sup>61</sup> Za kronologijo Starih gmajn in Notranjih Goric glej Velušček 2004a in poglavje 1.3 v tem zborniku.

<sup>62</sup> Marchesetti 1903, t. 11: 6; Korošec, Korošec 1969, t. 78: 9; D'Amico et al. 1996, sl. 155: 5,6; Peloi 1996-1997, 241-245.

<sup>63</sup> Velušček 2004g.

<sup>64</sup> Montagnari Kokelj 1994.

<sup>65</sup> Gilli, Montagnari Kokelj 1992-1993; Montagnari Kokelj, Greif, Presello 2002.



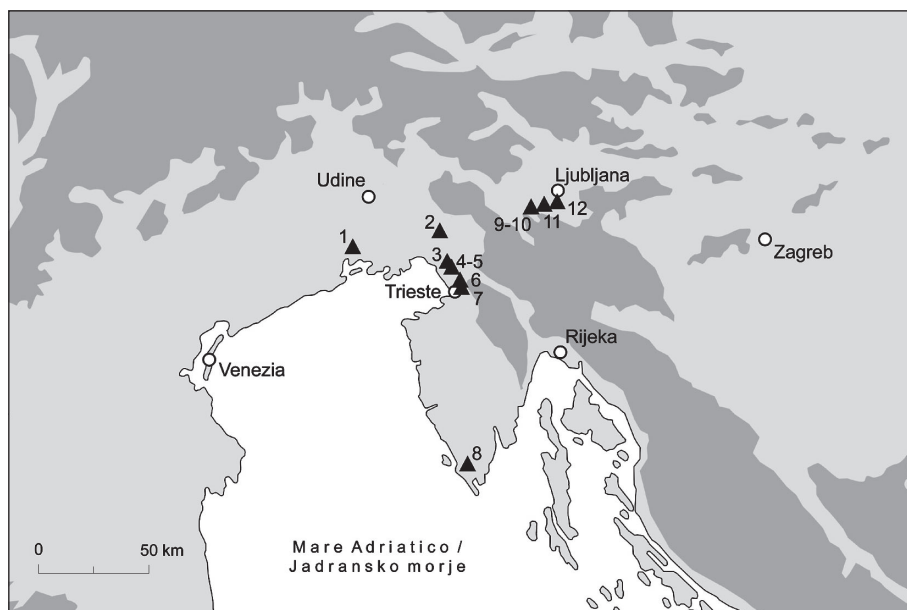


Fig. 12.7: Asce forate in metaultramafite nell'area del *Caput Adriae*.

1: Torsa di Pocenia (UD, Friuli-Venezia Giulia), n. AQ225172; 2: Valle del Vipacco (Slovenia occidentale), n. 142; 3: Grotta presso Slivia (TS, Friuli-Venezia Giulia), senza numero collezione Battaglia; 4-5: Grotta Cotariova (TS, Friuli-Venezia Giulia), nn. TS20418, TS4232; 6: Grotta dei Ciclami (TS, Friuli-Venezia Giulia), n. TS33965; 7: Grotta delle Tre Querce (TS, Friuli-Venezia Giulia), senza numero; 8: Pola (Istria, Croazia), senza numero; 9-10: Stare gmajne (Ljubljansko barje, Slovenia), nn. Sg6, Sg7; 11: Notranje Gorice (Ljubljansko barje, Slovenia), n. B53b; 12: Palafitte di Deschmann (Ljubljansko barje, Slovenia), n. B61.

**Bibliografia:** Grotta dei Ciclami, Grotta Cotariova n. TS20418, Torsa di Pocenia (D'Amico et al. 1996); Pola, Valle del Vipacco (Alberti et al. 2007); Notranje Gorice, Palafitte di Deschmann (Peloi 1996-1997); Grotta Cotariova n. TS4232 (D'Amico, dati inediti); Stare gmajne (vedi capitolo 3 in questo volume); Grotta presso Slivia, Grotta delle Tre Querce (dati inediti).

*Sl. 12.7: Kladivaste sekire iz metaultarmafita na območju Caput Adriae.*

1: Torsa di Pocenia (UD, Furlanija-Juljska krajina), št. AQ225172; 2: Vipavska dolina (zahodna Slovenija), št. 142; 3: Rusa spilja (TS, Furlanija-Juljska krajina), brez številke v zbirki Battaglia; 4-5: Čotarjeva pečina (TS, Furlanija-Juljska krajina), št. TS20418, TS4232; 6: Orehova pejca (TS, Furlanija-Juljska krajina), št. TS33965; 7: Pečina pri dubih (TS, Furlanija-Juljska krajina), brez številke; 8: Pula (Istra, Hrvaška), brez številke; 9-10: Stare gmajne (Ljubljansko barje, Slovenija), št. Sg6, Sg7; 11: Notranje Gorice (Ljubljansko barje, Slovenija), št. B53b; 12: Dežmanova kolišča (Ljubljansko barje, Slovenija), št. B61.

**Literatura:** Orehova pejca, Čotarjeva pečina št. TS20418, Torsa di Pocenia (D'Amico et al. 1996); Pula, Vipavska dolina (Alberti et al. 2007); Notranje Gorice, Dežmanova kolišča (Peloi 1996-1997); Čotarjeva pečina št. TS4232 (D'Amico, neobjavljeno); Stare gmajne (glej poglavje 3 v tem zborniku); Rusa spilja, Pečina pri dubih (neobjavljeno).

tare di delineare in via preliminare lo sviluppo tipologico di questo gruppo di manufatti. L'ascia integra da Stare gmajne (Fig. 12.9: Sg7) e il frammento mediano da Notranje Gorice trovano confronti tipologici precisi in altri manufatti scoperti in quest'ultimo sito.<sup>60</sup> Tali asce, tutte riferibili alla seconda metà del IV millennio a.C.,<sup>61</sup> sono sostanzialmente identiche dal punto di vista tipologico: hanno un corpo subtriangolare allungato, massiccio e slanciato nello stesso tempo, con un tallone arrotondato e superfici frontali concave; in prospettiva laterale presentano una forma subrettangolare con un tagliente arcuato inclinato. I margini formati dall'unione delle superfici frontali con quelle laterali sono sempre arrotondati. Infine il foro è posto in posizione prossimale.

in Tržaškega krasa (*sl. 12.7*) - in tistih iz serpentinita - pogoste so v Furlaniji in tudi na Ljubljanskem barju (*sl. 12.6*) - kažejo na dve izvorni območji: 1. območje Visokih Tur in z njim povezana sekundarna nahajališča za orodja iz serpentinita;<sup>66</sup> 2. območje za sekire iz metaultramafita, ki ga je treba še ugotoviti, pa je verjetno bolj proti vzhodu in manjše po obsegu, na kar kaže tudi morfološka homogenost med najdbami.

## 12.5 SKLEPI

V 4. tisočletju pr. Kr. se je Ljubljansko barje oskrbovalo s surovinami za izdelavo kamnitih orodij v glavnem iz lokalnih virov, kar velja za glajena kamnita orodja kot tudi za orodja na odbitkih, čeprav so za slednja na voljo samo preliminarni podatki. Kar 76 % analiziranih najdb

<sup>60</sup> Schmid 1910, Fig. 9: 3.

<sup>61</sup> Per la cronologia di Stare gmajne e Notranje Gorice vedi Velušček 2004a e capitolo 1.3 in questo volume.

<sup>66</sup> Bernardini et al. 2006-2007.



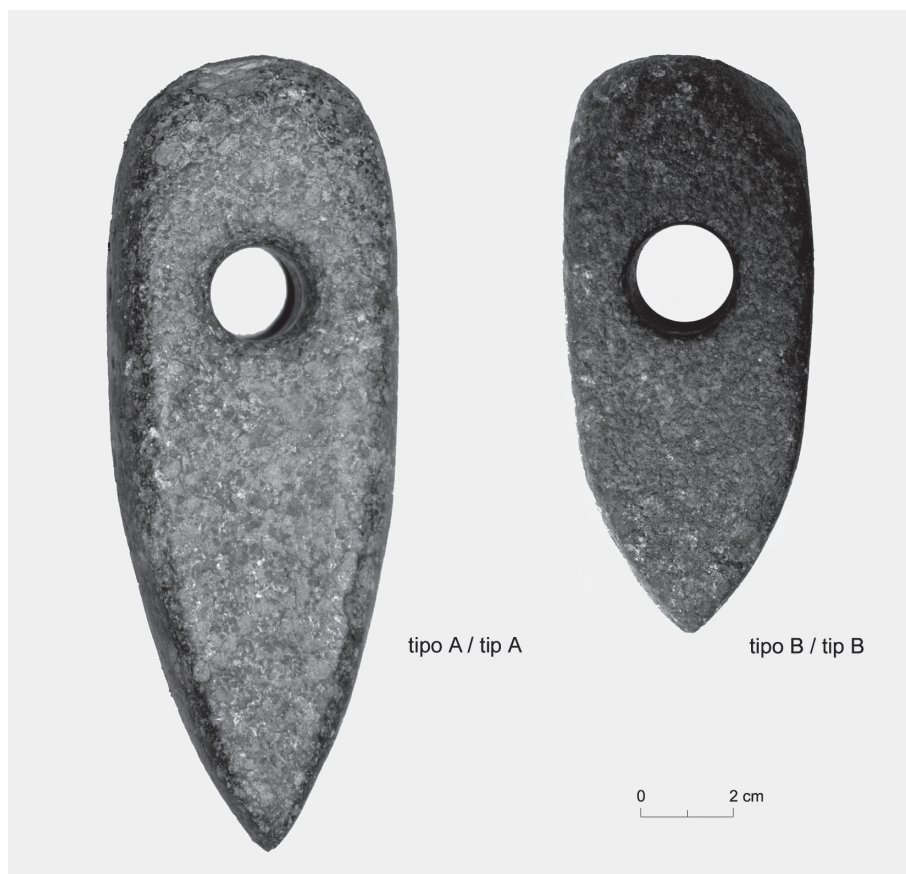


Fig. 12.8: Asce forate in metaultramafite di tipo A da Stare gmajne (a sinistra) e di tipo B da Pola (a destra).

Sl. 12.8: Kladvasti sekiri iz metaultramafita tipa A s Starih gmajn (na levi) in tipa B iz Pule (na desni).

Questa particolare tipologia non è stata fino ad oggi riconosciuta in contesti estranei al Ljubljansko barje. Infatti le altre asce forate in metaultramafite a sezione biconcava rinvenute nel Carso triestino e in Istria hanno sempre un corpo più tozzo e irregolare con un tallone maggiormente squadrato.<sup>62</sup> Purtroppo la gran parte dei manufatti proviene da superficie o è priva di precisi dati stratigrafici. Tuttavia, la presenza di un'ascia di questo tipo tra i materiali scoperti nelle palafitte di Deschmann (ascia B61), riferibile con ogni probabilità al III millennio a.C.,<sup>63</sup> induce a ipotizzare che le asce in metaultramafite si siano sviluppate dal punto di vista tipologico da forme triangolari allungate con tallone arrotondato e foro in posizione prossimale (tipo A) a manufatti più tozzi con l'estremità prossimale irregolare o squadrata (tipo B) (Fig. 12.8). Non si può tuttavia escludere la possibilità che alcuni dei manufatti caratterizzati da dimensioni ridotte e una morfologia poco slanciata siano il prodotto del riutilizzo/recupero di asce di tipo A.

<sup>62</sup> Marchesetti 1903, Tav. 11: 6; Korošec, Korošec 1969, Tav. 78: 9; D'Amico et al. 1996, Fig. 155: 5,6; Peloi 1996-1997, 241-245.

<sup>63</sup> Velušček 2004g.

je namreč narejenih iz lokalnih kamnin, ki jih najdemo tudi v prodnati nanosih Save, kar kaže na potencialno izvorno območje. Za izdelavo večine ploščatih sekir, dlet in brusov so bili izbrani tufi in tufiti s srednjo zrnatostjo. Za industrijo na odbitkih pa so uporabili izvorno podobne kamnine najfinejše zrnatosti in školjkastega preloma.

Manjše število uvoženih najdb priča o izmenjavah na srednje in dolge razdalje, kar dovoljuje uvrstiti Ljubljansko barje v mrežo stikov, ki se začne razvijati v tem obdobju in ki povezuje severovzhodno Italijo z vzhodnoalpskim območjem in Balkanom. Verjetni izvor sekir iz serpentinita (4 kladvaste sekire in 2 ploščati iz Ljublanice, kar predstavlja 14,6 % preučevanih najdb) je območje Visokih Tur, kar kaže na tesne vezi med območjem osrednje Avstrije in Ljubljanskim barjem vsaj od prve polovice 4. tisočletja pr. Kr. Slednje potrjuje tudi keramika z brazdastim vrezom.<sup>67</sup> Poleg tega so arheometrične analize nekaterih ogrličnih obročkov s Hočevarice pokazale, da so ti narejeni iz kamnin, ki izvirajo s Pohorja ali s Karavank.<sup>68</sup>

<sup>67</sup> Velušček 2004d, 258-259.

<sup>68</sup> Skaberne, Mladenović 2004.

L'esclusiva presenza di asce tipo A nei siti della seconda metà del IV millennio a.C. nel Ljubljansko barje e la diffusione di manufatti tipo B soprattutto nel Carso triestino, con un'assenza quasi totale nella pianura friulana – dove sono numerosissime le asce forate in serpentinite –, potrebbero trovare una spiegazione nel crescente incremento di contatti tra Slovenia centrale e Carso triestino tra il IV e il III millennio a.C.. I rapporti tra queste due aree raggiungono l'apice durante lo sviluppo della cultura di Lubiana la cui influenza permea fortemente gli aspetti culturali carsici nel III millennio a.C..<sup>64</sup> A tal proposito è opportuno sottolineare che sia la grotta dei Ciclami che la Cotariva hanno restituito, oltre alle asce in metaultramafite di tipo B, anche resti ceramici con precisi confronti nei siti classici della cultura di Lubiana tra cui le tipiche coppe riccamente decorate su piede multilobato.<sup>65</sup>

Per quanto riguarda la provenienza di questo gruppo di reperti, non si è ancora proceduto a uno studio sistematico delle possibili formazioni di provenienza. La loro distribuzione e l'uniformità sia litologica che tipologica inducono nondimeno a ritenere che l'area sorgente della materia prima debba essere ricercata in una zona circoscritta nelle Alpi Orientali o forse più lontano. Inoltre le marcate differenze a livello di distribuzione tra le asce in metaultramafite – presenti quasi esclusivamente nella piana di Lubiana e nel Carso triestino (Fig. 12.7) – e quelle in serpentinite – abbondanti sia in Friuli che nel Ljubljansko barje (Fig. 12.6) – indicherebbero due bacini di approvvigionamento diversificati: 1. l'area degli Alti Tauri e dei depositi secondari ad essi correlati per i manufatti in serpentinite;<sup>66</sup> 2. un'area ancora da identificare probabilmente in posizione più orientale e dai limiti più ristretti – come l'omogeneità morfologica dei reperti sembra suggerire – per le asce in metaultramafite.

## 12.5 CONCLUSIONI

Le strategie di approvvigionamento litico dei siti del Ljubljansko barje nel IV millennio a.C. si basano in gran parte sullo sfruttamento di risorse locali, sia per i manufatti in pietra levigata che per quelli in pietra scheggiata, sebbene per questi ultimi i dati a disposizione siano ancora preliminari. Infatti il 76 % dei reperti analizzati è costituito da rocce di provenienza locale o vicina, comuni anche nei depositi alluvionali della Sava, che potrebbero dunque rappresentare la principale fonte di approvvigionamento. Per la fabbricazione di gran parte delle lame d'ascia, delle asce scalpello e delle coti vengono infatti selezionati tufi e tufiti a grana media; le industrie in pietra scheggiata sono in genere realizzate

<sup>64</sup> Montagnari Kokelj 1994.

<sup>65</sup> Gilli, Montagnari Kokelj 1992–1993; Montagnari Kokelj, Greif, Presello 2002.

<sup>66</sup> Bernardini et al. 2006–2007.

V contesto tesnih povezav z območjem osrednje Avstrije je pojav ploščatih sekir iz alpskih metaofiolitov severozahodnoitalijanskega izvora (1 sekira iz Ljubljance in 1 s Starih gmajn, kar predstavlja 4,8 % od preučevanih najdb) verjetno odsev okrepljenih stikov med Padsko nižino in osrednjo Slovenijo. Gre namreč za orodja, ki jih sicer najdemo vzdolž vzhodnojadranske obale vsaj od stopnje Danilo/Vlaška naprej, a se očitno v 4. tisočletju pojavijo tudi v notranjosti, torej na ozemlju osrednje Slovenije.<sup>69</sup> Ni naključje, da predstavlja zahodno mejo najdišč horizonta keramike z brazdastim vrezom prav kraška planota in da so med živalskimi ostanki na Hočevarici tudi morske ribe.<sup>70</sup> Uvoz sekir iz alpskih metaofiolitov se nadaljuje tudi v prvi polovici 3. tisočletja pr. Kr., kar dokazujeta dve majhni ploščati sekiri z Dežmanovih kolišč.

Zbirka uvoženih najdb je obogatena tudi z neko drugo skupino sekir iz alohtonih kamnin, ki so se pojavile na polovici 4. tisočletja pr. Kr. (7,3 % od preučevanih najdb). K prvemu tipu prištevamo sekire iz metaultramafita, ki so bikonkavnega preseka, imajo podaljšano trikotno obliko, zaobljen talon in nesimetrično izbočeno rezilo (tip A) in so znane s Starih gmajn, Notranjih Goric in morda tudi drugih sočasnih naselbin Ljubljanskega barja. Z razvojem ljubljanske kulture in širjenjem njenega vpliva proti zahodu sekire iz metaultarmafita, ki so bolj čokatih oblik, s štirioglatim ali nesimetričnim talonom ter v večini primerov bikonkavnega preseka (tip B), dosežejo Tržaški kras in se pojavijo tudi v Istri, medtem ko jih v Furlaniji v glavnem ne najdemo. S slednjega območja poznamo samo eno sekiro iz metaultramafita, ki je bila najdena na obali, na najdišču Torsa di Pocenia, medtem ko so sekire iz serpentinita zelo številne. Zaradi velikega števila analiziranih sekir iz Furlanije-Juljske krajine se takšna razprostranjenost sekir iz metaultramafita ne zdi naključna. Odkritje bakrene sekire tipa Kozarac na območju Ogleja, ki ima zanesljive primerjave v kalupih za sekire z Ljubljanskega barja, lahko kaže na polarizacijo furlanskega dela obalnega pasu, kjer je bila, kot omenjeno, najdena tudi sekira iz metaultramafita, proti vzhodu.<sup>71</sup> Izvorno območje za sekire iz metaultramafita še ni odkrito, vsekakor pa ga je treba iskati verjetno nekje na območju Vzhodnih Alp ali morda še dlje, zagotovo pa se razlikuje od izvornega območja serpentinitov.

Čprav jih v tem prispevku ne obravnavamo, se zdi primerno opozoriti, da so med glajenimi kamnitimi orodji z Dežmanovih kolišč in mogoče tudi z Maharskega prekopa tudi kladivaste sekire iz dolerita, katerih verjetni izvor je treba iskati na območju *banijskega ofiolitskega kompleksa*, ki predstavlja severni rob *centralnodinarskega ofiolitskega pasu* na Hrvaškem.<sup>72</sup> Takšni dokazi so pomembni pričevalci o stikih z Balkanom.

<sup>69</sup> Bernardini et al. 2006–2007.

<sup>70</sup> Velušček 2004a.

<sup>71</sup> D'Amico et al. 1996, 231.

<sup>72</sup> Bernardini et al., v tisku.

su rocce geneticamente simili a grana finissima e frattura concoide.

Un numero più ristretto di reperti importati offre informazioni sugli scambi a media e lunga distanza, consentendo di collocare il Ljubljansko barje in una complessa rete di contatti che iniziano a svilupparsi in questo periodo collegando in maniera più stretta l'Italia nord-orientale con il mondo alpino orientale e balcanico. La probabile provenienza delle asce in serpentinite (quattro asce forate e due lame d'ascia dalla Ljubljanica pari al 14.6 % del complesso studiato) dalla zona degli Alti Tauri sottolinea lo stretto legame tra Austria centrale e il Ljubljansko barje almeno dalla prima metà del IV millennio a.C., testimoniato anche dalla presenza in entrambe le zone di ceramiche attribuite all'orizzonte HKBV.<sup>67</sup> Inoltre, altre indagini archeometriche hanno dimostrato che un gruppo di perline rinvenute nel sito di Hočevarica sarebbe costituito da una roccia proveniente da Pohorje o dalla catena delle Caravanche che marca proprio il confine tra la Slovenia nord-occidentale e l'Austria centro-meridionale.<sup>68</sup>

In questo contesto di stretti legami con l'area austriaca la comparsa di lame d'ascia in metaofioliti alpine provenienti dall'Italia nord-occidentale (un'ascia dalla Ljubljanica e una da Stare gmajne pari al 4.8 % del complesso analizzato) è probabilmente uno dei segnali del progressivo incremento dei contatti tra l'area padana nord-orientale e la Slovenia centrale. Questa classe di materiali, presente lungo le coste dell'Adriatico orientale almeno dalla cultura di Danilo/Vlaška, penetra all'interno del *Caput Adriae* proprio in questa fase.<sup>69</sup> Non è un caso che i limiti occidentali delle presenze di ceramiche attribuite all'orizzonte HKBV corrispondano all'altopiano carsico e che tra i resti di fauna rinvenuti a Hočevarica ve ne siano alcuni che documentano sicuri contatti con le aree costiere.<sup>70</sup> L'arrivo di asce in metaofioliti alpine continua probabilmente durante lo sviluppo della cultura di Lubiana nella prima metà del III millennio a.C., come è suggerito dalle due piccole lame in giada scoperte nelle palafitte di Deschmann.

Il quadro si arricchisce di un altro gruppo di asce costituite da materie prime alloctone a partire circa dalla metà del IV millennio a.C. (7.3 % dei materiali). Il primo tipo di asce in metaultramafite a sezione biconcava, dalla forma triangolare allungata con tallone arrotondato e tagliente arcuato inclinato (tipo A), fa la sua comparsa a Stare gmajne come a Notranje Gorice e probabilmente anche negli altri siti coevi del Ljubljansko barje. Con lo sviluppo della cultura di Lubiana e l'estendersi della sua influenza verso ovest, asce in metaultramafite più tozze con un tallone squadrato o irregolare, ma comunque nella gran parte dei casi caratterizzate da una sezione

Na koncu lahko rečemo, da je Ljubljansko barje od 4. tisočletja pr. Kr., ki je bilo pred tem na obrobju obmorskih severovzhodnojadranskih izmenjevalnih poti, začelo postopoma prevzemati osrednjo posredovalno vlogo po eni strani med severovzhodno Padsko nižino in Podonavjem, po drugi pa med Balkanom in Vzhodnimi Alpami. Temeljno spodbudo za ta proces, ki je med drugim pripeljal tudi do polarizacije priobalnega pasu *Caput Adriae* proti vzhodu, je verjetno iskati v naraščanju zanimanja za območja, bogata z bakrovo rudo, kjer se je začel razvoj zgodnje metalurgije.

*Iz italijanščine prevedel A. Velušček*

<sup>67</sup> Velušček 2004d, 258-259.

<sup>68</sup> Skaberne, Mladenović 2004.

<sup>69</sup> Bernardini et al. 2006-2007.

<sup>70</sup> Velušček 2004a.

biconcava (tipo B), raggiungono il Carso triestino e si spingono anche più lontano - fino in Istria - mentre il Friuli sembra in gran parte impermeabile a questo fenomeno. Qui un unico esemplare di ascia in metaultramafite è stato rinvenuto a Torsa di Pocenia nell'area costiera, mentre le attestazioni di asce forate in serpentinite sono numerosissime. Dato il buon numero di determinazioni a disposizione per il Friuli-Venezia Giulia questa particolare distribuzione delle asce in metaultramafite potrebbe non essere casuale. Il rinvenimento di un'ascia ad occhio in rame nella zona di Aquileia con sicuri confronti con l'ambito di Lubiana potrebbe indicare una polarizzazione della fascia costiera friulana, da dove proviene anche l'unica ascia in metaultramafite sopraccitata, verso est.<sup>71</sup> La fonte di approvvigionamento delle asce in metaultramafite, non ancora individuata, va probabilmente ricercata in un'area relativamente circoscritta nelle Alpi orientali o forse più lontano, con ogni probabilità diversa da quella delle serpentiniti.

Sebbene tra i materiali presentati in questo contributo non compaiano, è tuttavia opportuno ricordare la presenza tra i manufatti in pietra levigata scoperti nelle palafitte di Deschmann e forse tra quelli di Maharski prekop di asce forate in dolerite la cui probabile provenienza, in base a recenti indagini, dovrebbe corrispondere al *Banija Ophiolite Complex*, margine settentrionale della *Central Dinaric Ophiolitic Belt* in Croazia.<sup>72</sup> Tali attestazioni sono un'importante testimonianza dell'esistenza di rapporti con l'area balcanica.

In conclusione a partire dal IV millennio a.C. il Ljubljansko barje, in precedenza toccato solo marginalmente dai traffici attivi lungo le coste dell'Adriatico nord-orientale, acquista progressivamente un ruolo centrale di mediazione, da una parte, tra l'Italia padana nord-orientale e il mondo danubiano, dall'altra, tra quello balcanico e l'area alpina orientale. La motivazione alla base di questo processo, che tra l'altro conduce alla polarizzazione delle aree costiere del *Caput Adriae* verso est, va forse ricercata in una crescente attrazione per quei territori, ricchi di depositi di rame, in cui inizia a svilupparsi la prima metallurgia.

<sup>71</sup> D'Amico et al. 1996, 231.

<sup>72</sup> Bernardini et al., in stampa.

## 12.6 CATALOGO DEI REPERTI / KATALOG NAJDB

### 12.6.1 MANUFATTI IN PIETRA LEVIGATA

#### 12.6.1.1 STARE GMAJNE

**Sg3** (inedita) - mola in fillade sericitica (XRD; OM).

Si tratta di una lastra di roccia che presenta una superficie particolarmente levigata con ogni probabilità a causa del suo utilizzo come mola.

Lung. 170 mm; larg. 145 mm; sp. 12 mm.

**Sg5** (canale 12/29, x = 113,4; Fig. 12.9: Sg5) - lama d'ascia in giada o eclogite (stereomicroscopia; XRD su manufatto).

Presenta un corpo appiattito di forma triangolare con tagliente arcuato, lati distinti e sezione trasversale subrettangolare. Tutte le superfici sono ben levigate e non si riconoscono strie da levigatura; rimangono tracce di picchiettatura poco evidenti in corrispondenza delle superfici laterali e del tallone. Il tagliente, osservato allo stereomicroscopio, presenta microfratture dai margini arrotondati.

Lung. 52 mm; larg. 35 mm; sp. 13 mm.

**Sg6** (trincea 1; Fig. 12.9: Sg6) - frammento distale di ascia forata in metaultramafite (XRD).

Si tratta di un piccolo manufatto di forma subtriangolare con tagliente arcuato, probabilmente ottenuto dal riutilizzo di un'ascia rotta di dimensioni maggiori. Le superfici sono coperte da tracce di picchiettatura e la perforazione è bidirezionale.

Lung. (60) mm; larg. 39 mm; sp. 49 mm.

**Sg7** (canale 12/24, x = 94; Fig. 12.9: Sg7) - ascia forata in metaultramafite (XRD).

Ha grandi dimensioni e presenta un corpo massiccio di forma triangolare allungata con tallone arrotondato e sezione trasversale biconcava. In prospettiva laterale ha una forma subrettangolare con tagliente arcuato inclinato. Il foro, ottenuto tramite una perforazione bidirezionale, è spostato verso il tallone. Tutte le superfici sono levigate sebbene mantengano un aspetto scabro dovuto probabilmente alle caratteristiche della materia prima.

Lung. 165 mm; larg. 62 mm; sp. 52 mm.

**Sg8** (trincea 3; Fig. 12.9: Sg8) - frammento di cote in calcare impuro con quarzo (XRD).

Presenta un corpo appiattito con un foro bidirezionale in corrispondenza dell'estremità conservata.

Lung. (42) mm; larg. 25 mm; sp. 9 mm.

**Sg9** (trincea 3; Fig. 12.9: Sg9) - crogiolo in siltite quarzo-feldspatica (XRD).

Presenta un corpo ovale con una depressione allungata longitudinale con una superficie fortemente alterata probabilmente per il suo utilizzo in attività metallurgiche.

Lung. 153 mm; larg. 111 mm; sp. 55 mm.

**Sg10** (canale 2/93, x = 52,5; Fig. 12.9: Sg10) - cote in siltite o tufo cineritico quarzo-feldspatico con clorite (XRD).

Ha una forma allungata con sezione trasversale sub-circolare. Un'estremità si restringe e si assottiglia ed è attraversata da un piccolo foro bipiramidale. Su questa parte del manufatto sono evidenti strie di levigatura con direzione prevalentemente inclinata.

Lung. 76 mm; larg. 22 mm; sp. 20 mm.

#### 12.6.1.2 NOTRANJE GORICE

**NG1** (Korošec, Korošec 1969, Tav. 78: 6) - frammento mediano di ascia forata in metaultramafite (XRD).



Tale reperto è stato pubblicato tra quelli provenienti dalle palafitte di Deschmann (Korošec, Korošec 1969, Tav. 78: 6) ma è possibile riferirlo con sicurezza a Notranje Gorice grazie al riconoscimento dello stesso tra i materiali pubblicati in Schmid 1910, Fig. 9: 8. Si tratta della parte mediana di un'ascia del tutto simile al reperto Sg7 da Stare gmajne. Si conserva la porzione che dal margine del foro si restringe verso la posizione in cui originariamente si trovava il tagliente. Ha la sezione trasversale biconcava e le superfici sono levigate sebbene mantengano un aspetto scabro. Le superfici fratturate mostrano tracce evidenti di picchiettatura probabilmente legate a un riutilizzo del manufatto come pestello o percussore.

Lung. (90) mm; larg. 55 mm; sp. 47 mm.

### 12.6.1.3 BLATNA BREZOVICA

**BB3** (Fig. 12.9: BB3) - cote in siltite o tufo cineritico quarzofeldspatico (XRD).

Ha una forma allungata con una sezione trasversale irregolare. In corrispondenza di un'estremità il manufatto si restringe e si assottiglia ed è attraversato da un piccolo foro bipiramidale. Le superfici conservano tracce di usura ma sono ancora visibili radi segni di picchiettatura. Su una delle facce, sull'estremità opposta rispetto al foro, sono visibili piccole chiazze con lucentezza metallica.

Lung. 70 mm; larg. 23 mm; sp. 17 mm.

### 12.6.1.4 SPODNJE MOSTIŠČE

**SM1** (inedita) - ascia scalpello in tufo o tufite quarzofeldspatica (XRD).

Presenta una forma sub-rettangolare stretta e allungata. Il corpo è massiccio con una sezione trasversale ovale. Il tagliente è arcuato-inclinato e presenta tracce di usura sotto forma di scheggiature. Solo l'area prossima al tagliente è finemente levigata mentre sul resto delle superfici sono ancora riconoscibili tracce di picchiettatura.

Lung. 140 mm; larg. 45 mm; sp. 31 mm.

### 12.6.1.5 LJUBLJANICA

**L1** (Fig. 12.10: L1) - ascia forata in roccia carbonatica (stereomicroscopio; test con acido).

In prospettiva frontale presenta una forma biconvessa, un tallone piatto, un tagliente biconvesso e una perforazione mediana; in prospettiva laterale ha una forma subrettangolare con il tagliente curvo e il tallone squadrato con angoli arrotondati. La sezione trasversale è subrettangolare. Le superfici sono levigate ma si conservano tracce di picchiettatura.

Lung. 98 mm; larg. 41 mm; sp. 32 mm.

**L2** (Fig. 12.10: L2) - lama d'ascia in tufo o tufite (stereomicroscopia).

Presenta un corpo massiccio di forma subrettangolare con tallone squadrato leggermente rastremato, tagliente arcuato inclinato con minute fratture da usura (?) e sezione subrettangolare. Tutte le superfici sono ben levigate.

Lung. 131 mm; larg. 58 mm; sp. 31 mm.

**L3** (Fig. 12.10: L3) - lama d'ascia in tufo fine (XRD; OM).

Presenta un corpo subtrapezoidale con tallone rettilineo, margini appena distinti, tagliente arcuato inclinato e sezione subrettangolare. Le superfici sono levigate ma alcune aree depresse

dall'andamento irregolare e dalla superficie scabra non sono state del tutto appianate.

Lung. 106 mm; larg. 49 mm; sp. 25 mm.

**L4** (Fig. 12.10: L4) - lama d'ascia in tufo o tufite (stereomicroscopia). Presenta un corpo massiccio di forma subrettangolare con tallone appena arrotondato, fianchi convessi, tagliente arcuato con minute fratture da usura (?). Il tagliente è ben levigato mentre le altre superfici conservano chiare tracce di picchiettatura.

Lung. 134 mm; larg. 57 mm; sp. 30 mm.

**L5** (Fig. 12.10: L5) - frammento distale di ascia forata in tufo fine (XRD, OM).

Non è possibile ricostruire la sua forma originaria. In prospettiva frontale presenta superfici laterali curve e un tagliente simmetrico biconvesso, curvo in prospettiva laterale. La sezione trasversale è subrettangolare. Tutte le superfici sono levigate finemente e strie di levigatura non sono riconoscibili a livello macroscopico.

Lung. (78) mm; larg. 39 mm; sp. 38 mm.

**L6** (Fig. 12.10: L6) - frammento prossimale di lama d'ascia in tufo cineritico (XRD, OM).

La forma del corpo era probabilmente subrettangolare. I margini sono convessi, il tallone è leggermente arrotondato, la sezione trasversale è ovale. Le superfici sono levigate ma soprattutto in corrispondenza dei margini e del tallone sono ancora visibili tracce di picchiettatura.

Lung. (60) mm; larg. 50 mm; sp. 28 mm.

**L7** (Fig. 12.10: L7) - lama d'ascia in giada (stereomicroscopia; XRD su manufatto).

Presenta un corpo triangolare appiattito con tagliente arcuato inclinato, fianchi distinti e sezione subrettangolare. Le superfici sono finemente levigate (sono visibili strie da levigatura longitudinali) tranne i fianchi che sono coperti da picchiettatura. Il tagliente è ben affilato e apparentemente privo di tracce d'uso tranne in un punto in cui è intaccato da una frattura larga 11 mm.

Lung. 81 mm; larg. 41 mm; sp. 17 mm.

**L8** (Fig. 12.11: L8) - ascia forata frammentaria in serpentinite (XRD, OM).

In prospettiva frontale presenta un corpo subtriangolare con un tallone di forma irregolare, superfici laterali curve e un tagliente piatto simmetrico; la sezione trasversale era probabilmente subrettangolare. Le superfici conservate mostrano una levigatura medio-fine con evidenti strie con direzione mista tranne in corrispondenza del tagliente dove sono trasversali; tracce di picchiettatura sono del tutto assenti. Non è possibile riconoscere tracce tecnologiche in corrispondenza del tallone a causa degli effetti del suo utilizzo.

Lung. 72 mm; larg. 44 mm; sp. (24) mm.

**L9** (Fig. 12.11: L9) - ascia forata in serpentinite (XRD su manufatto).

Presenta una stretta forma biconvessa in prospettiva frontale, subrettangolare in quella laterale. Il tagliente è curvo; il foro è collocato nella parte prossimale dell'ascia. Tutte le superfici sono finemente levigate e conservano strie con direzione mista.

Lung. 125 mm; larg. 22 mm; sp. 56 mm.

**L11** (Fig. 12.11: L11) - frammento prossimale di ascia forata in serpentinite (XRD, OM).

Il frammento è troppo piccolo per ricostruire la forma originaria. Era probabilmente simile a quella delle asce L9 e L12. Le superfici conservate sono ben levigate.

Lung. (60) mm; larg. 34 mm; sp. (27) mm.

**L12** (Fig. 12.11: L12) - frammento distale di ascia forata in serpentinite (XRD, OM).

Ha una stretta forma biconvessa in prospettiva frontale mentre in quella laterale è subrettangolare. Il tagliente era probabilmente curvo; il foro è collocato nella parte prossimale dell'ascia.



Tutte le superfici sono finemente levigate e conservano strie con direzione mista.

Lung. (78) mm; larg. 27 mm; sp. 55 mm.

**L13** (Fig. 12.11: L13) – frammento di cote in argillite tufacea (XRD, OM).

In corrispondenza di un'estremità presenta un foro ottenuto mediante una perforazione bidirezionale. Il corpo ha una sezione trasversale rettangolare, margini distinti e si restringe gradualmente verso l'estremità forata. Le superfici frontali sono notevolmente levigate mentre i fianchi sono più scabri.

Lung. (60) mm; larg. 37 mm; sp. 21 mm.

**L14** (Fig. 12.11: L14) – ascia forata non finita o peso (?) in roccia carbonatica (stereomicroscopio; test con acido).

Ha un corpo di forma triangolare con un piccolo foro collocato in corrispondenza dell'estremità più stretta; la sezione trasversale è subrettangolare. Tutte le superfici sono coperte con tracce di picchiettatura fini e dense e non sono levigate. L'estremità più larga ha un profilo arrotondato.

Lung. 141 mm; larg. 35 mm; sp. 69 mm.

**L15** (Fig. 12.12: L15) – manufatto in roccia carbonatica, forse una lama d'ascia (test con acido).

Presenta un corpo di forma irregolare con tallone rettilineo e tagliente arcuato inclinato. Le superfici hanno probabilmente subito processi di dissoluzione.

Lung. 73 mm; larg. 42 mm; sp. 22 mm.

**L44** (Fig. 12.12: L44) – manufatto in tufo cineritico, forse una lama d'ascia non finita (XRD, OM).

Presenta un corpo subtrapezoidale appiattito con margini distinti, sezione subrettangolare appiattita, estremità distale arcuata inclinata e tallone arcuato.

Lung. 103 mm; larg. 40 mm; sp. 12 mm.

**L45** (Fig. 12.12: L45) – ascia scalpello in tufo o tufite (stereomicroscopia).

Presenta un corpo massiccio subrettangolare con tallone squadrato, tagliente nettamente rastremato con andamento breve e rettilineo con fratture da usura e sezione ovale. Il tagliente è ben levigato mentre il corpo dell'ascia è coperto da un'accurata picchiettatura. Interessante notare che anche il tallone è levigato forse per un motivo connesso all'immanicatura o all'utilizzo del manufatto.

Lung. 139 mm; larg. 58 mm; sp. 35 mm.

**L46** (Fig. 12.12: L46) – lama d'ascia in tufo o tufite (stereomicroscopia).

Presenta un corpo di forma rettangolare abbastanza massiccio con tallone squadrato e tagliente arcuato inclinato con fratture da usura e sezione subrettangolare. I margini sono ben distinti. Tutte le superfici sono ben levigate e in particolare il tagliente.

Lung. 112 mm; larg. 50 mm; sp. 28 mm.

**L47** (Fig. 12.12: L47) – frammento distale di lama d'ascia in serpentinite (XRD, OM).

La forma del corpo era probabilmente subrettangolare, il tagliente è leggermente arcuato, la sezione è pianoconvessa. Le superfici sono ben levigate soprattutto in prossimità del tagliente mentre verso la parte mediana compaiono tracce di picchiettatura soprattutto su una faccia del manufatto.

Lung. (56) mm; larg. 55 mm; sp. 22 mm.

**L48** (Fig. 12.12: L48) – frammento prossimale di lama d'ascia in arenaria tufacea (XRD, OM).

Presenta un corpo massiccio che aveva probabilmente una forma subtrapezoidale con sezione ovale. Il tallone si presenta squadrato con angoli smussati. Le superfici sono levigate ma sono ancora presenti tracce di picchiettatura.

Lung. (100) mm; larg. 59 mm; sp. 37 mm.

**L49** (Fig. 12.13: L49) – frammento prossimale di lama d'ascia in tufo litico cristallino grossolano (XRD, OM).

Il corpo è massiccio con margini distinti e sezione subrettangolare; è probabile che la forma fosse subrettangolare. Le superfici sono abbastanza alterate rendendo difficile la lettura delle tracce tecnologiche. Tuttavia, alcune piccole aree meglio conservate sono ben levigate.

Lung. (85) mm; larg. 62 mm; sp. 31 mm.

**L50** (Fig. 12.13: L50) – frammento prossimale di una lama d'ascia in arenaria tufacea (XRD, OM).

Il corpo si presenta abbastanza massiccio con margini distinti, tallone rettilineo e sezione subrettangolare. La forma doveva essere subrettangolare o subtrapezoidale. Le superfici sono molto alterate.

Lung. (74) mm; larg. 61 mm; sp. 25 mm.

**L51** (Fig. 12.13: L51) – lama d'ascia in tufo o tufite (stereomicroscopia).

Presenta un corpo massiccio di forma rettangolare con tallone rettilineo con angoli smussati, fianchi convessi, tagliente leggermente arcuato e sezione ovale. Le superfici sono ben levigate.

Lung. 101 mm; larg. 44 mm; sp. 29 mm.

**L52** (Fig. 12.13: L52) – frammento prossimale di lama d'ascia in tufo cristallino grossolano (XRD, OM).

Presenta un corpo che doveva avere una forma subrettangolare, con sezione ovale, margini convessi e tallone leggermente arcuato. La larghezza del manufatto aumenta dal tallone verso la parte distale. Le superfici sono levigate, in particolar modo in corrispondenza del tallone.

Lung. (71) mm; larg. 42 mm; sp. 22 mm.

**L53** (Fig. 12.13: L53) – frammento distale di lama d'ascia in argillite tufacea (stereomicroscopia; XRD, OM).

La forma del corpo era probabilmente subrettangolare con margini distinti; il tagliente è arcuato inclinato con fratture da usura; la sezione trasversale è ovale. Le superfici sono finemente levigate sebbene siano appena percettibili tracce di picchiettatura.

Lung. (65) mm; larg. 58 mm; sp. 26 mm.

**L54** (Fig. 12.13: L54) – ascia scalpello in tufo grossolano (XRD, OM).

Presenta un corpo massiccio di forma subtrapezoidale che si restringe a partire dal tallone verso il tagliente. Quest'ultimo si presenta lungo appena 25 mm e ha un andamento leggermente arcuato; il tallone è subrettilineo; la sezione del corpo è pianoconvessa. Le superfici sono ben levigate tranne in un'area della superficie frontale piatta.

Lung. 128 mm; larg. 52 mm; sp. 29 mm.

**L55** (Fig. 12.14: L55) – martello (?) ricavato da una lama d'ascia frammentaria in tufo grossolano (XRD, OM).

Presenta un corpo rettangolare con tallone leggermente arcuato, estremità distale subrettilinea, margini distinti e sezione subrettangolare. Il tallone è la parte più levigata; tracce di picchiettatura interessano soprattutto la parte mediana e distale del manufatto. Le superfici sono forse alterate, almeno in alcuni punti, rendendo problematica una descrizione puntuale delle tracce dei processi tecnologici.

Lung. 99 mm; larg. 53 mm; sp. 29 mm.

**L56** (Fig. 12.14: L56) – lama d'ascia in arenaria tufacea (XRD, OM).

Presenta un corpo massiccio di forma subrettangolare con tallone squadrato, tagliente subrettilineo con fratture da usura, margini leggermente arrotondati e sezione subrettangolare. Le superfici sono levigate ma non al punto da eliminare completamente le irregolarità della roccia.

Lung. 130 mm; larg. 59 mm; sp. 30 mm.

**L57** (Fig. 12.14: L57) – lama d'ascia in spilite (XRD, OM).

Presenta un corpo abbastanza massiccio di forma subtrapezoidale con tallone arrotondato, tagliente semicircolare con fratture da utilizzo, fianchi distinti e sezione subrettangolare. La

larghezza dell'ascia aumenta dal tallone verso il tagliente. Tutte le superfici sono ben levigate.

Lung. 112 mm; larg. 53 mm; sp. 26 mm.

**L59** (*Fig. 12.14: L59*) – lama d'ascia in cheratofiro (XRD, OM).

Presenta un corpo subrettangolare con tallone rettilineo, tagliente semicircolare, margini convessi e sezione ovale schiacciata. Le superfici non sono levigate ma coperte da una picchiettatura uniforme.

Lung. 111 mm; larg. 47 mm; sp. 26 mm.

**L60** (*Fig. 12.14: L60*) – oggetto triangolare, forse un peso, in arenaria tufacea (XRD, OM). Presenta una forma triangolare con i lati leggermente concavi, con al centro, sicuramente in un caso, una tacca larga circa 10 mm. Le superfici sono coperte da tracce di picchiettatura.

Lung. 67 mm; sp. 21 mm.

**L61** (*Fig. 12.14: L61*) – lama d'ascia in serpentinite (XRD, OM).

Presenta un corpo trapezoidale appiattito con tagliente arcuato intaccato da fratture da utilizzo, fianchi distinti e sezione rettangolare. Le superfici sono ben levigate (sono ben visibili strie da levigatura con direzione mista).

Lung. 51 mm; larg. 44 mm; sp. 13 mm.

## 12.6.2 MANUFATTI IN PIETRA SCHEGGIATA

### 12.6.2.1 STARE GMAJNE

**Sg1, Sg2 e Sg4** (inedite) – schegge in tufo cineritico (OM).

Si tratta di semplici schegge derivanti dalla produzione di strumenti in pietra scheggiata.

### 12.6.2.2 BLATNA BREZOVICA

**BB1 e BB2** (inedite) – schegge in tufo cineritico (OM).

Si tratta di semplici schegge derivanti dalla produzione di strumenti in pietra scheggiata.

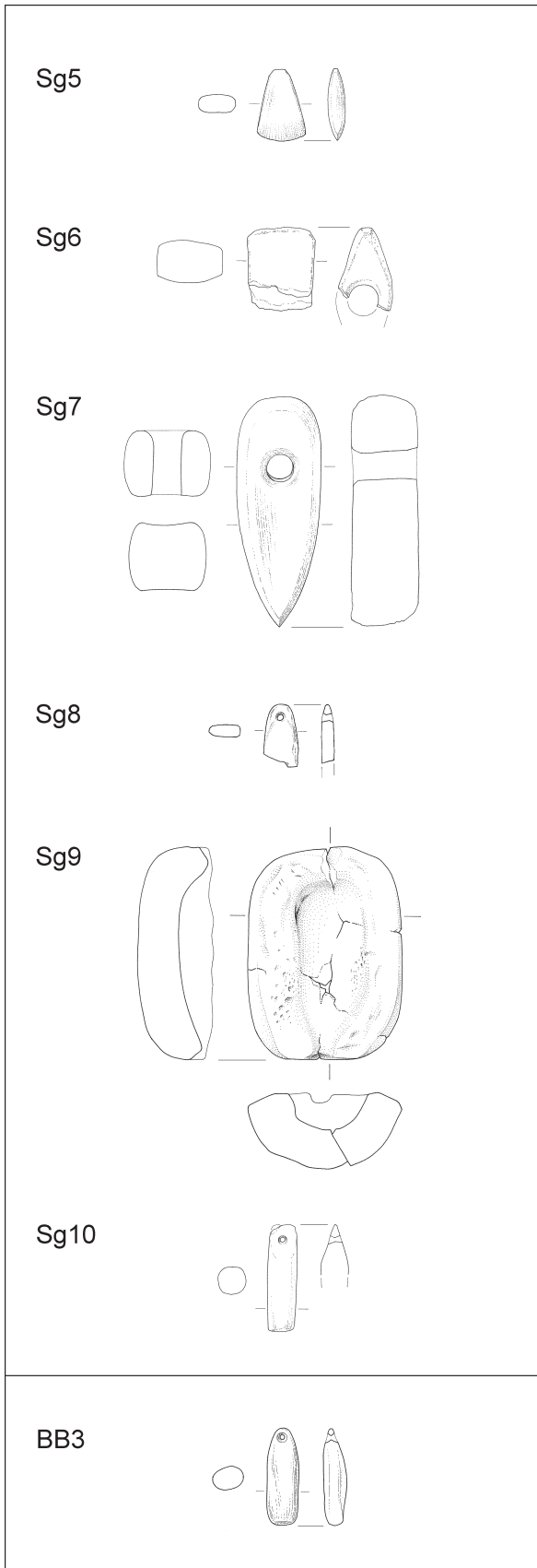


Fig. 12.9: Manufatti in pietra levigata da Stare gmajne (Sg) e Blatna Brezovica (BB). Scala = 1 : 5.

Sl. 12.9: Glajena kamnita orodja s Starih gmajn (Sg) in Blatne Brezovice (BB). M = 1 : 5.

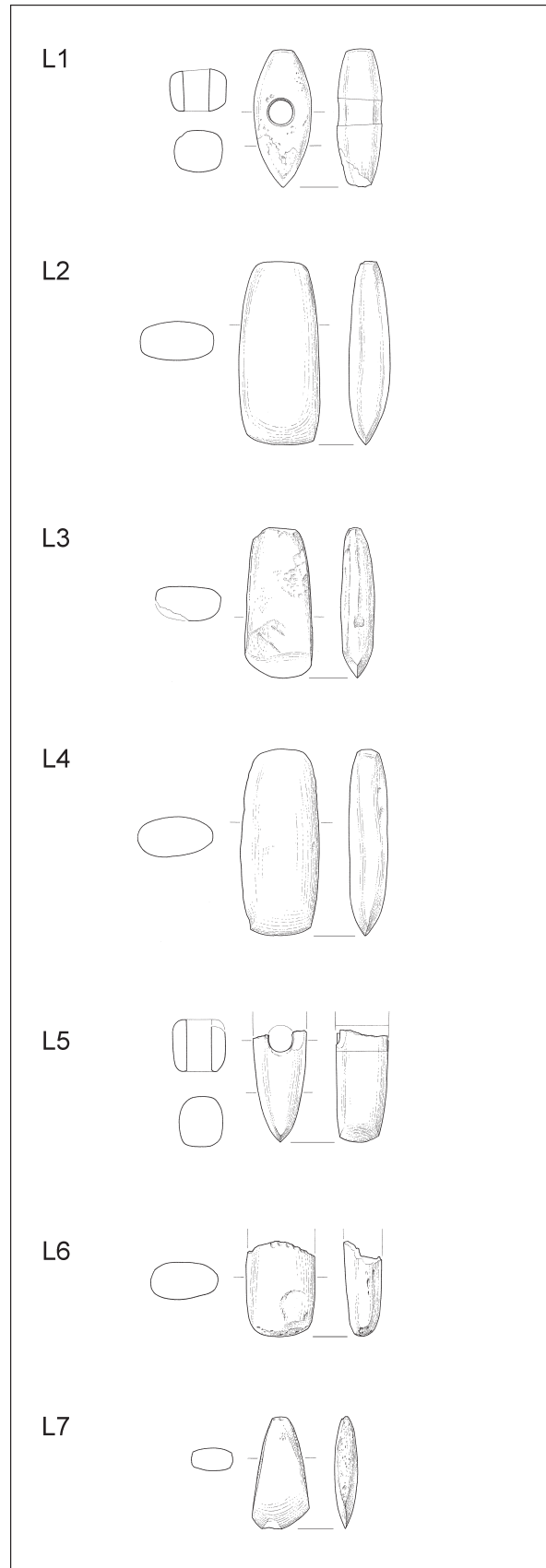


Fig. 12.10: Manufatti in pietra levigata dalla Ljubljana (L). Scala = 1 : 5.

Sl. 12.10: Glajena kamnita orodja iz Ljubljane (L). M = 1 : 5.

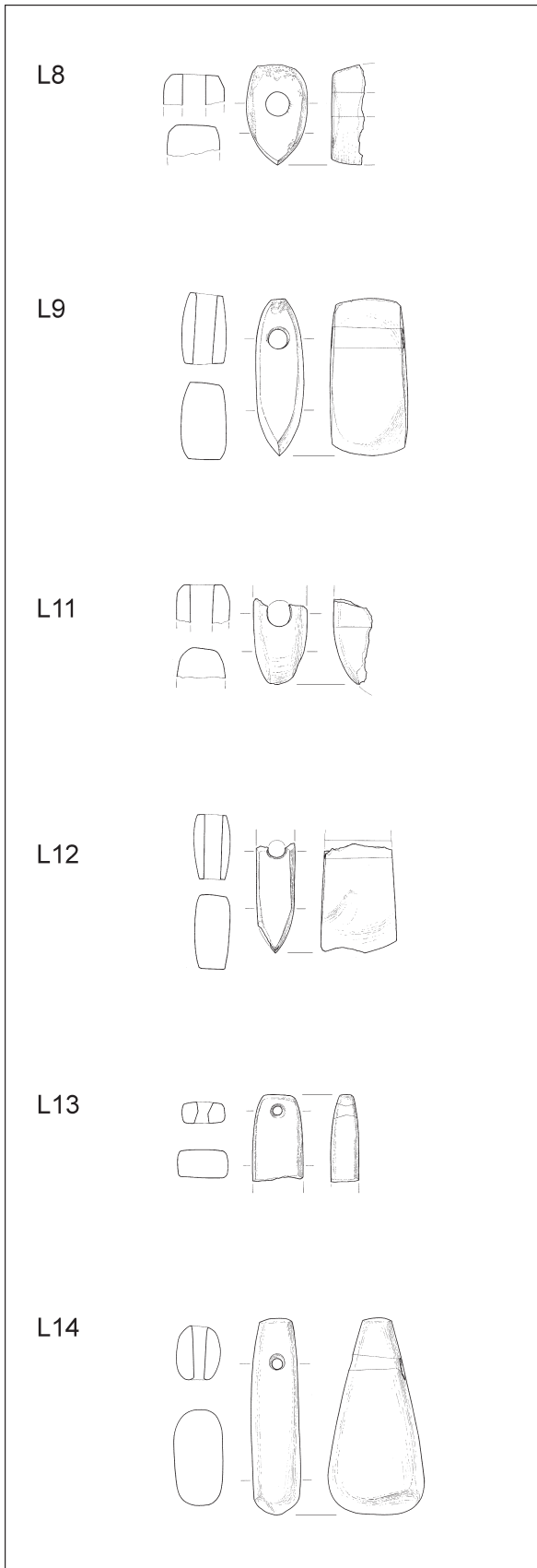


Fig. 12.11: Manufatti in pietra levigata dalla Ljubljana (L).  
Scala = 1 : 5.

Sl. 12.11: Glajena kamnita orodja iz Ljubljane (L). M = 1 : 5.

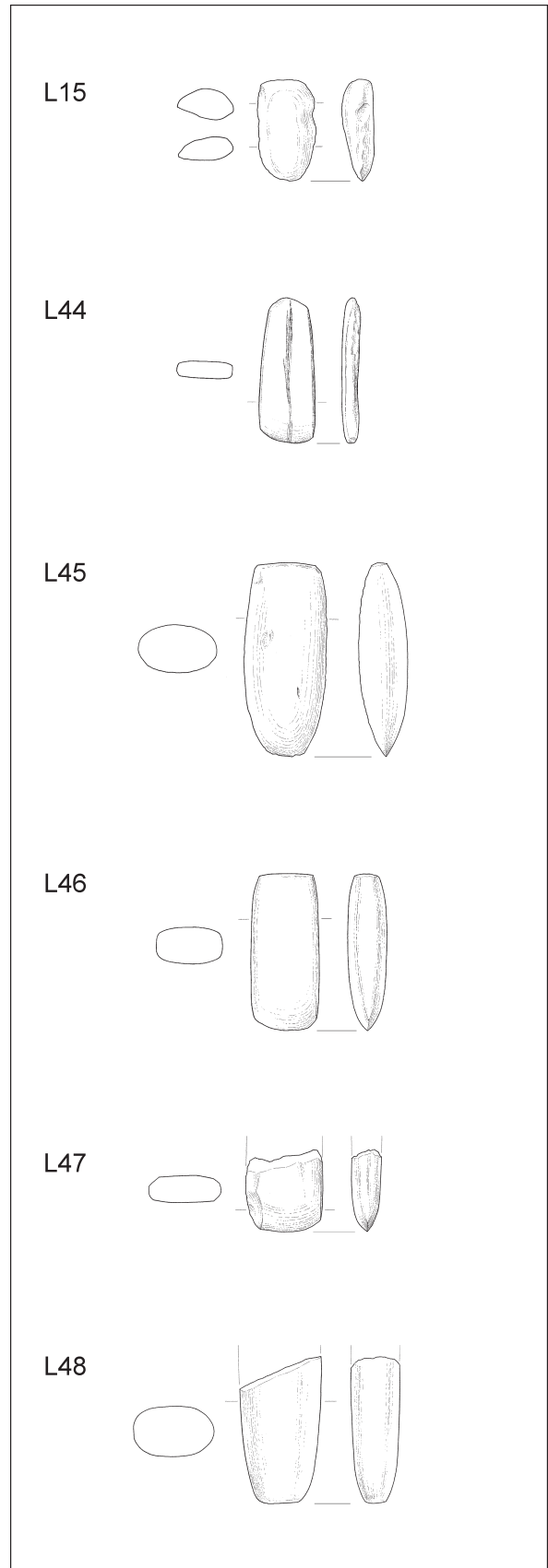


Fig. 12.12: Manufatti in pietra levigata dalla Ljubljana (L).  
Scala = 1 : 5.

Sl. 12.12: Glajena kamnita orodja iz Ljubljane (L). M = 1 : 5.

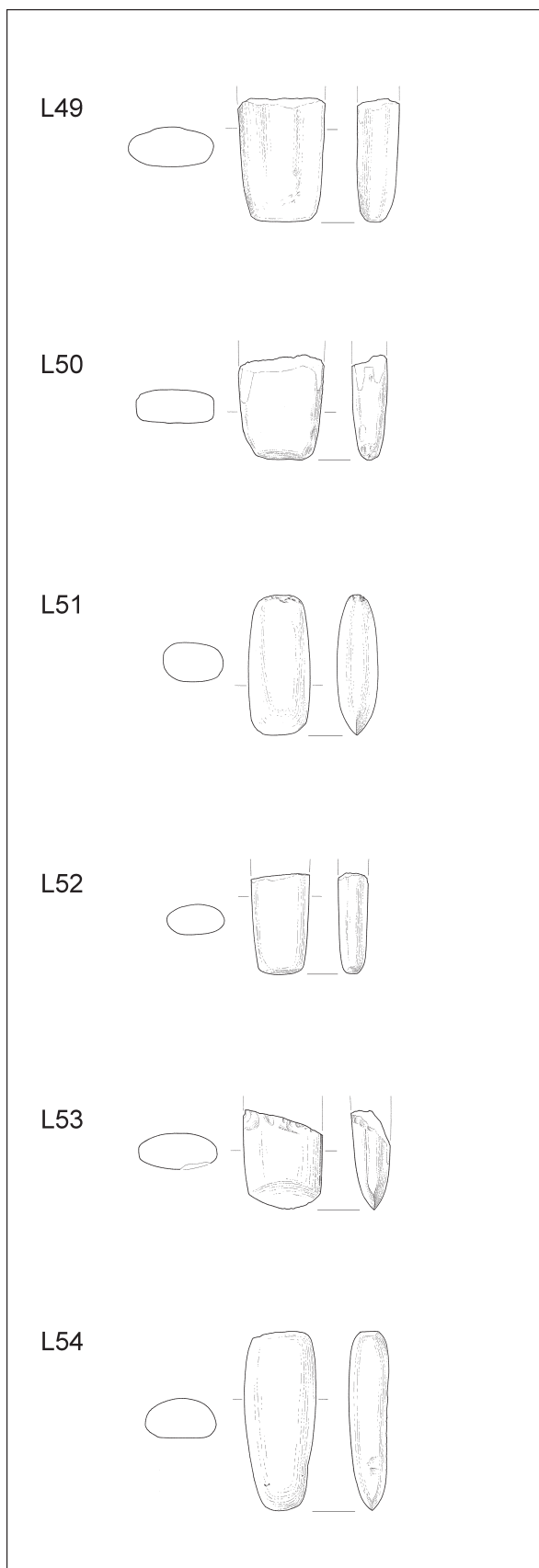


Fig. 12.13: Manufatti in pietra levigata dalla Ljubljana (L).  
Scala = 1 : 5.  
Sl. 12.13: Glajena kamnita orodja iz Ljubljane (L). M = 1 : 5.

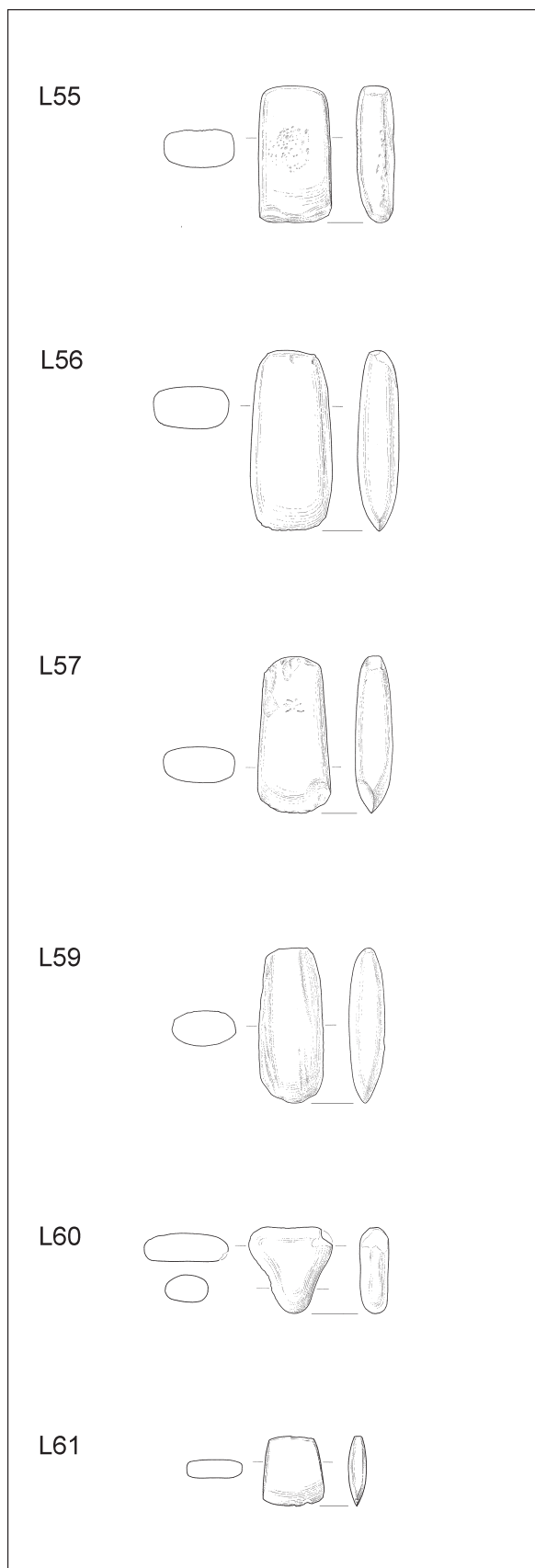


Fig. 12.14: Manufatti in pietra levigata dalla Ljubljana (L).  
Scala = 1 : 5.  
Sl. 12.14: Glajena kamnita orodja iz Ljubljane (L). M = 1 : 5.





# 13. PETROLOŠKA SESTAVA IN IZVOR KAMNITIH NAJDB Z NAJDIŠČ STARE GMAJNE IN BLATNA BREZOVICA

Janez TURK

## Izvleček

Določili smo petrološko sestavo žrmlj in drugega kamnitega inventarja z arheoloških najdišč Stare gmajne in Blatna Brezovica. Žrmlje pripadajo po sestavi v veliki večini kremenovemu peščenjaku in kremenovemu konglomeratu. Nahajališča takšnih kamnin so v hribovjih v neposredni bližini Ljubljanskega barja. Izvorno območje kamnitega materiala so karbonsko-permske in srednjepermske klastične kamnine, ki gradijo hribovje v pasu med Ljubljano in Horjulom, torej severozahodno ob Ljubljanskem barju.

**Ključne besede:** žrmlje, kamnita orodja, kremenov peščenjak, kremenov konglomerat, Ljubljansko barje, Slovenija, eneolitik.

## 13.1 UVOD

Med kamnitimi najdbami na arheoloških najdiščih, tako antičnih kot tudi prazgodovinskih, so pogosto žrmlje. Žrmlje oz. ročni mlini z dvema kamnoma za mletje žita so izpričano v uporabi vsaj od časa mlajše kamene dobe do danes. Po iznajdbi vodnih mlinov so jih uporabljali predvsem tam, kjer se zaradi klimatskih in geoloških razmer ter oblikovanosti tal vodno mlinarstvo niti ni moglo razviti.<sup>1</sup>

Kot surovina za žrmlje se od nekdaj uporablja kamen. Ker dve kamninski kolesi drgneta drugo ob drugo, je zaželeno, da ima kamnina, ki se uporablja za žrmlje, visoko trdoto. Takšna kamnina se ne kruši, obraba je počasnejša oz. življenjska doba materiala daljša. V nasprotnem primeru bi se kamnita "kolesa" hitro izrabila zaradi trenja. Tega so se ljudje zavedali že zelo zgodaj, saj so kot surovino za žrmlje uporabljali največ kamnine, katerih sestavni del je predvsem kremen. Petrografska sestava žrmlj z arheoloških najdišč na območju Slovenije

<sup>1</sup> SEM internet: [http://www.burger.si/MuzejiInGalerije/SlovenskiEtnografskiMuzej/SEM2000/TekstSEM\\_1.html](http://www.burger.si/MuzejiInGalerije/SlovenskiEtnografskiMuzej/SEM2000/TekstSEM_1.html)

# 13. PETROLOGIC COMPOSITION AND ORIGIN OF STONE FINDS FROM THE SITES STARE GMAJNE AND BLATNA BREZOVICA

Janez TURK

## Abstract

Petrologic composition of querns and other stone assemblage from archaeological sites Stare gmajne and Blatna Brezovica was assessed. Querns are mostly of quartz sandstone and quartz conglomerate. Such rocks can be found on hills nearby the Ljubljansko barje. Sources of this kind of rock are Carboniferous-Permian and Middle Permian clastic rocks, which form hills in a band stretching from Ljubljana to Horjul, i.e. northwestern outskirts of the Ljubljansko barje.

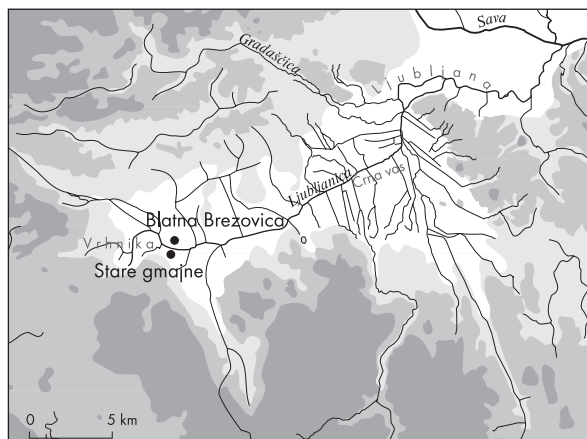
**Keywords:** querns, stone tools, quartz sandstone, quartz conglomerate, the Ljubljansko barje, Slovenia, Eneolithic.

## 13.1 INTRODUCTION

Querns are usually relatively frequent stone finds on archaeological sites, which date to ancient or even prehistoric period. Querns with two coarse stones for grinding grain have evidently been used at least since the time of the Neolithic to present-day. Querns were, after the invention of watermill, used mostly in places where milling could not be practised due to climatic and geological conditions or morphology of area.<sup>1</sup>

Querns are made from stone since ever. Because the two quernstones rub against each other, it is required, that the rock used for making quern is hard. Such rock does not chip, wears out slowly and, consequently, lifespan of material is longer. If any other rock would be used, the stone "wheels" would quickly get worn out due to friction. People were aware of this from the beginning, as they used quartz rocks mainly for querns. Petrographic composition of the querns from Slovenian archaeological sites confirms, that they were made mainly of quartz

<sup>1</sup> SEM internet: [http://www.burger.si/MuzejiInGalerije/SlovenskiEtnografskiMuzej/SEM2000/TekstSEM\\_1.html](http://www.burger.si/MuzejiInGalerije/SlovenskiEtnografskiMuzej/SEM2000/TekstSEM_1.html)



Sl. 13.1: Ljubljansko barje s koliščema Stare gmajne in Blatna Brezovica.

Fig. 13.1: The Ljubljansko barje with Stare gmajne and Blatna Brezovica pile-dwellings.

dokazuje, da so te predvsem iz kremenovih konglomeratov in peščenjakov ter magmatskih kamnin.<sup>2</sup> Takšna surovina se je ohranila v uporabi vse do 20. stoletja. Večina arheoloških najdb pripada le fragmentom žrmelj. Ko se je kamnina izrabila, so jo očitno zavrgli.

## 13.2 METODA

Kamniti fragmenti žrmelj, celih žrmelj je malo, in drugih kamnitih najdb, ki so bili odkriti na arheoloških najdiščih Stare gmajne in Blatna Brezovica na Ljubljanskem barju (sl. 13.1), so bili pregledani le makroskopsko. Zanimale so nas glavne značilnosti kamnin, to je tip kamnine in bližnje nahajališče. Nahajališča nismo preverili na terenu oz. nismo dejansko iskali kamnin, ki bi bile ekvivalentne analiziranim, ampak smo uporabili podatke z osnovne geološke karte Slovenije in predvsem "Tolmač" k tej karti. Na podlagi znanih geoloških podatkov smo sklepali na nahajališče kamnin, ki ustrezajo analiziranim kamninam.

## 13.3 REZULTATI

Vsega skupaj je bilo pregledanih 58 kamnov z najdišč Stare gmajne (sl. 13.2) in Blatna Brezovica (sl. 13.3), ki obe pripadata koliščarski kulturi. Arheološki najdišči sta datirani v drugo polovico 4. tisočletja pr. Kr.,<sup>3</sup> takšne starosti naj bi bili tudi ostanki žrmelj in drugih kamnitih najdb.

45 kamnov skoraj zagotovo predstavlja žrmlje oz. fragmente žrmelj. 35 artefaktov izvira z najdišča Stare gmajne, 10 pa z Blatne Brezovice. Analiza je pokazala,

conglomerates and sandstones, and of magmatic rocks.<sup>2</sup> Such raw material was in use until the 20<sup>th</sup> century. The majority of archaeological finds are only fragments of querns. When the rock was worn out, it was apparently thrown away.

## 13.2 METHODOLOGY

Stone fragments of querns and of other stone finds from the archaeological sites Stare gmajne and Blatna Brezovica at the Ljubljansko barje (Fig. 13.1), were only macroscopically examined. Complete pieces of querns are hardly preserved. We were interested in the main features of rocks, i.e. the type of rock and nearby deposit. We did not confirm sources of rocks on the field, i.e. we did not actually search for rocks that would be an equivalent to the ones analysed. Instead, we used data from the Basic Geological Map of Slovenia and, above all, explanation to this map. Based on already known geological data, we determined the sources rocks that match the rocks analysed.

## 13.3 RESULTS

58 stones from the sites Stare gmajne (Fig. 13.2) and Blatna Brezovica (Fig. 13.3), were examined. Both sites belong to the pile-dwelling culture and are dated to the second half of the 4<sup>th</sup> millennium BC.<sup>3</sup> Fragments of querns and stone finds should date to the same period.

45 stones are almost definitely querns or fragments of querns. 35 artefacts originate from Stare gmajne and 10 from Blatna Brezovica. The analysis demonstrated that querns/fragments of querns are of five lithologic types of rocks:

1. fine- and middle-grained quartz conglomerate with sandy mica cement
2. middle- and coarse-grained quartz sandstone with components of mica (or without it)
3. calcarenite (oolitic limestone)
4. tuff
5. quartz-porphry (rhyolite?).

Vast majority of analysed querns are quartz conglomerates and sandstones. Only two examples are of calcarenite, while tuff and quartz-porphry (or rhyolite?) are present by only one piece each.

<sup>2</sup> Horvat, Župančič 1987.

<sup>3</sup> Poglavje 7 v tem zborniku.

<sup>2</sup> Horvat, Župančič 1987.

<sup>3</sup> See Chapter 7 in this monograph.

da žrmlje oz. njihovi fragmenti pripadajo naslednjim petim litološkimi tipom kamnin:

1. drobnno- in srednjezrnatemu kremenovemu konglomeratu s peščenosljudnatim vezivom
2. srednje- in debelozrnatemu kremenovemu peščenjaku s primesjo sljude (lahko tudi brez nje)
3. kalkarenitu (oolitnemu apnenecu)
4. tufu
5. kremenovemu porfirju (riolitu?).

Velika večina analiziranih žrmlj pripada kremenovim konglomeratom in peščenjakom. Kalkarenitne sestave sta le dva primerka, medtem ko tufu in kremenovemu porfirju (oz. riolitu?) pripadata le po en primerek.

### 13.3.1 STARE GMAJNE

#### 13.3.1.1 ŽRMLJE

Žrmlje z najdišča Stare gmajne po svoji sestavi pripadajo kremenovemu peščenjaku (19 kosov) in kremenovemu konglomeratu (12 kosov). Peščenjaki so večinoma debelozrnati (velikost zrn blizu 2 mm), poleg kremenovih zrn so prisotna tudi posamezna zrna sljude. V nekaterih primerkih sljuda nastopa izrazito podrejeno, spet drugi kremenovi peščenjaki so s sljudo bogatejši. Vsi peščenjaki so sive barve, izjema je rdeči grödenski peščenjak, v katerem ni zaslediti sljudnate primesi.

Tudi kremenovi konglomerati so sive barve. Konglomerati so večidel drobnozrnati, saj velikost prodnikov večinoma ne presega 1 cm ali pa je celo manjša od 0,5 cm. Prodniki so zaobljeni do pologlati. Prodniki v konglomeratu so relativno redki, večino kamnine gradi peščena osnova. Peščeno vezivo je kremenovo-sljudnate sestave, prevladuje kremen. Le eden primerk konglomerata je že na videz drugačen od ostalih. Osnovo gradi rdeče kremenovo peščeno vezivo brez primesi sljude, medtem ko so zaobljeni kremenovi prodniki prav tako rdečkaste in maloštevilni bele barve. Prodniki so relativno veliki v primerjavi s sivimi konglomerati, njihova velikost se giblje okoli 1 cm. Tudi ta primerk prištevamo h grödenski seriji.

Dva kamna pripadata oolitnemu apnenecu oz. kalkarenitu (peščenjak, sestavljen iz kalcitnih oolitnih zrn). Oba kalkarenita sta debelozrnata, močno preperela in rdečkaste barve.

Kos tufa je temnozeleno barve in debelozrnat (zrna velikosti 1–2 mm). Kamen, verjetno gre za t. i. terilni kamen,<sup>4</sup> je skoraj popolnoma okrogel in kot takšen predstavlja zelo dobro ohranjen del žrmlj.

Podobne oblike je tudi najdba iz kremenovega porfirja oz. riolita. Kremenov porfir in riolit prištevamo k magmatskim predorninam granitske sestave. Točna sestava kamna je zaradi preperelosti makroskopsko

<sup>4</sup> Glej poglavje 3 v tem zborniku: t. 3.18: 11.

### 13.3.1 STARE GMAJNE

#### 13.3.1.1 QUERNS

Querns from the site Stare gmajne are of quartz sandstone (19 pieces) and of quartz conglomerate (12 pieces). Sandstones are mostly coarse-grained (size of grains nearly 2 mm), also individual grains of mica are present beside quartz grains. Amount of mica is poor in some examples, while the others quartz sandstones contain more of it. All sandstones are grey, with the only exception being the red Gröden sandstone, which does not contain any mica.

Quartz conglomerates are also grey. Conglomerates are mostly fine-grained, as the size of pebbles does generally not surpass 1 cm or is even smaller than 0.5 cm. Pebbles are rounded to semi-angular. Pebbles contain relatively small amount of conglomerate; the majority of rock has a sandy matrix. Sandy cement is of quartz-mica composition with quartz prevailing. Only one conglomerate example is visibly different from the rest. Matrix is of a red quartz sandy cement without components of mica, while round quartz pebbles are red and sometimes white. Pebbles are relatively large in comparison to grey conglomerates; their size is c. 1 cm. Also this example is of the Gröden series.

Two stones are of oolitic limestone or calcarenite (sandstone consisting of calcite oolitic grains). Both calcarenites are coarse-grained, strongly disintegrated and of a reddish colour.

Piece of tuff is dark green and coarse-grained (grains 1–2 mm in size). Stone, probably the top part of the quern,<sup>4</sup> is almost completely round and as such presents excellently preserved part of quern.

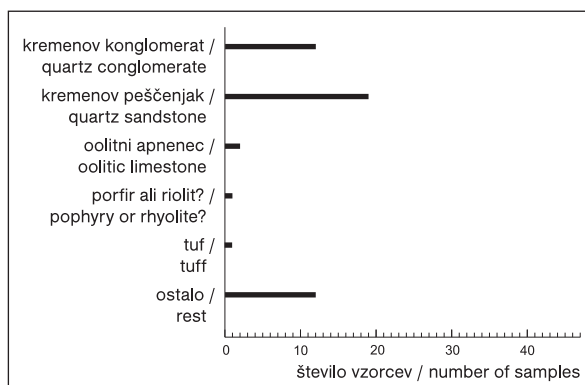
The find made of quartz-porphry or rhyolite has a similar shape. Quartz-porphry and rhyolite are granite magmatic igneous rocks. Exact composition of stone is hard to determine macroscopically as it was considerably disintegrated. For detailed description of this stone, we should make thin sections and determine its composition under the microscope.

#### 13.3.1.2 DESCRIPTION OF OTHER STONE FINDS THAT ARE NOT PARTS OF QUERNS

Assemblage of others rocks contains two chert pebbles of oblong shape that were used as tools, probably mallet. Considering the texture of both pebbles, we assume that it is silicified limestone.

The others 7 pieces are probably ordinary stones of no useful value, i.e. were not directly used as tools. Same is true for three dolomite blocks, all affected by condensation on the surface. Block of limestone is

<sup>4</sup> See Chapter 3 in this monograph: *Pl. 3.18: 11.*



Sl. 13.2: Stare gmajne; število vseh analiziranih najdb po litoloških tipih.

Fig. 13.2: Stare gmajne; all analysed finds according to lithologic types.

težko določljiva. Za natančno določitev tega kamna bi bilo treba narediti zbrusek in sestavo določiti pod mikroskopom.

#### 13.3.1.2 OPIS OSTALIH KAMNITIH NAJDB, KI NISO DELI ŽRMELJ

Inventar ostalih kamnin vsebuje dva roženčeva prodnika podolgovate oblike, ki sta bila uporabljena kot orodje, verjetno tolkač. Glede na teksturo obeh prodnikov sklepamo, da gre za silificiran apnenec.

Preostalih 7 primerkov predstavlja po vsej verjetnosti navadne kamne, ki niso imeli kakšne uporabne vrednosti oz. niso neposredno služili kot orodje. Takšni so trije dolomitni bloki, njihove površine so reliefno kondenzirane. Podoben jim je blok apnenca. Ti kamni so bili glede na morfološke značilnosti prinešeni iz kakšne jame oz. spodmola na južnem obrobju Ljubljanskega barja. Enako velja za kamen sige. Najdena sta bila še dva kamna močno preperelih karbonatov (apnenec in dolomit), temno zelen kamen tufa ter dve pedogeni tvorbi (konkreciji), ki sta v sedimentu lahko nastali v poznejšem času.

#### 13.3.2 BLATNA BREZOVICA

Žrmlje z najdišča Blatna Brezovica imajo skoraj enovito sestavo. Devet od desetih kamnov pripada kremenovemu konglomeratu. Kremenov peščenjak je le eden in še ta je debelozrnat. Po sestavi in sivi barvi je peščenjak enak konglomeratom. Peščena osnova je v vseh primerih razen v enem kremenovo-sljudnata. Prodniki so pogloblati do zaobljeni in večinoma manjši od 0,5 cm. Konglomerati so torej enaki kot tisti z najdišča Stare gmajne.

similar to them. These stones were, considering their morphological features, brought from a cave, or of a rock shelter on the southern margin of the Ljubljansko barje. This also applies to a piece of flowstone. Furthermore, two pieces of severely disintegrated carbonates (limestone and dolomite), dark green piece of tuff and two pedogenic forms (concretions), which could develop in sediment in a later period, were found.

#### 13.3.2 BLATNA BREZOVICA

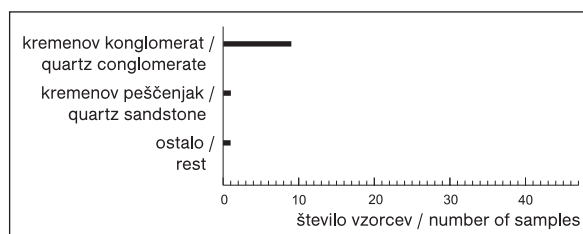
All the querns from Blatna Brezovica are of almost uniform composition. Nine out of ten stones are quartz conglomerates. Only one is coarse-grained quartz sandstone. Sandstone is the same as conglomerates with its composition and grey colour. Sandy matrix is in all examples quartz-micaceous, except in one. Pebbles are semi-angular to rounded and mostly smaller as 0.5 cm. Namely, conglomerates are identical to the ones from Stare gmajne.

Only one conglomerate is different. It has sandy matrix and pebbles are red. Composition is of a pure quartz conglomerate with matrix composed of quartz sand. Especially the colour of the rock indicates that it is of the Gröden series.

#### 13.4 ASSUMED ORIGIN OF ROCKS

Raw material, used for querns, almost certainly originates from the immediate surroundings of the Ljubljansko barje. Hilly area, that encloses the Barje on the northwest side, is composed of claystone, micaceous quartz sandstone and fine-grained conglomerate. Conglomerate has quartz-sand cement with some foliated aggregates of muscovite. These rocks are of a Permo-Carboniferous age. The area stretches between Ljubljana, Dobrova and Horjul, i.e. the wider area of Šujica valley.<sup>5</sup> These rocks are also commonly present eastwards from

<sup>5</sup> Grad, Ferjančič 1976.



Sl. 13.3: Blatna Brezovica; število vseh analiziranih najdb po litoloških tipih.

Fig. 13.3: Blatna Brezovica; all analysed finds according to lithologic types.



Po sestavi in barvi odstopa le en konglomerat. Peščena osnova in prodniki so obarvani rdeče. Po sestavi gre za čist kremenov konglomerat s kremenovim peskom v osnovi. Predvsem barva kamnine nakazuje na pripadnost h grödenski seriji.

### 13.4 PREDVIDEN IZVOR KAMNIN

Surovina, iz katere so uporabljali kamninski material za žrmlje, po vsej verjetnosti izvira iz neposredne okolice Ljubljanskega barja. Hribovit svet, ki obrobja Barje na severozahodu, je iz glinovca, sljudnatega kremenovega peščenjaka in drobnozrnatega konglomerata (s kremenovepeščenim vezivom, v katerem se pojavljajo lističi muskovita). Starost teh kamnin je karbonsko-permska. Območje se razteza med Ljubljano, Dobrovo in Horjulom oz. obsega širši okoliš doline reke Šujice.<sup>5</sup> Te kamnine se v večjem obsegu pojavljajo tudi vzhodno od Ljubljane v Posavskem hribovju, vendar so ta nahajališča že bolj oddaljena od obeh obravnavanih arheoloških najdišč.

Klastični sedimenti so značilni tudi za srednje-permske sklade. Barju najbližji izdanki se nahajajo v hribovju severno od Brezovice ter v tektonskih luskah v širši okolici Horjula. Srednje-permske kamnine predstavlja pretežno rdečkast kremenov peščenjak s prehodi v alevrolit in konglomerat. Konglomerat je navadno drobnozrnat in postopno prehaja v peščenjak. Velikost prodnikov je do 5 cm. Stopnja zaobljenosti zrn je nizka, posebno še v drobnozrnatih klastitih. Te kamnine pripadajo grödenski seriji.<sup>6</sup>

Oolitni apnenci rdečkaste barve so značilni za spodnjetriasne kamnine v zaledju Iške in Sarskega. Iška je oolitni apnec s prodrom prinesla tudi na območje Ljubljanskega barja.<sup>7</sup>

Nahajališča kremenovih porfirjev so povezana z ladinjskim vulkanizmom. Teh kamin v neposredni bližini Ljubljanskega barja ni najti, najbližja nahajališča so v širši okolici Blegoš in na Gorenjskem v okolici Preddvora, med Jelovico in Kranjem.<sup>8</sup>

Najbližja nahajališča tufa so med Drenovim gričem in Lesnim brdom ter na območju med Poljansko in Horjulsko dolino.<sup>9</sup> Druga bližnja nahajališča so v prodnih vršajih na južnem obrobju Ljubljanskega barja. Tufske prodnike so sem nanesti potoki, predvsem Iška, s hribovij, ki obkrožajo južno obrobje Ljubljanskega barja.<sup>10</sup>

<sup>5</sup> Grad, Ferjančič 1976.

<sup>6</sup> Grad, Ferjančič 1976.

<sup>7</sup> Pavšič 1989.

<sup>8</sup> Grad, Ferjančič 1976.

<sup>9</sup> Grad, Ferjančič 1976.

<sup>10</sup> Horvat 2006; Pavšič 1989.

Ljubljana, in the Posavje hills; however, these deposits are further away from the examined archaeological sites.

Clastic sediments are characteristic also for Middle Permian beds. The closest outcrops to the Ljubljansko barje can be found in hills north from Brezovica and in the nappe structure in the wider surroundings of Horjul. Middle Permian rocks are mainly of reddish quartz sandstone with transitions to aleurolite and conglomerate. Conglomerate is usually fine-grained and gradually transfers to sandstone. Pebbles are up to 5 cm large. Grains are not rounded, this is particular for fine-grained clastic rocks. These rocks belong to the Gröden series.<sup>6</sup>

Reddish oolitic limestones are characteristic for Lower Triassic rocks in hinterland of the Iška and Sarsko. The Iška carried gravel with oolitic limestone also to the area of the of Ljubljansko barje.<sup>7</sup>

Deposits of quartz-porphry are connected with the Ladinian volcanism. We cannot find these rocks in the vicinity of the Ljubljansko barje; the closest deposits are in the wider surroundings of Blegoš and in Gorenjska near Preddvor and between Jelovica and Kranj.<sup>8</sup>

The closest deposits of tuff are between Drenov Grič and Lesno Brdo and in the area between Poljane nad Škofjo Loko and the Horjul valley.<sup>9</sup> Other nearby deposits are present in gravel fans on the southern fringe of the Ljubljansko barje. Streams, mainly the Iška, discharged tuff pebbles to the Barje from hills that encircle southern outskirts of the Ljubljansko barje.<sup>10</sup>

### 13.5 CONCLUSION

Based on petrologic composition, we searched for origin of rocks mainly in the immediate environs of examined archaeological sites, or in hilly hinterland of the Ljubljansko barje (*Fig. 13.4*). Inhabitants of the pile-dwellings were almost certainly gathering material themselves, or they searched for it at deposits nearby. Some of the specimens could also come from distant places with trading.<sup>11</sup> However, they were trading mainly with rock, deposits of which were not available in wider surroundings of the settlements. At the same time, the quality of such rock had to be better as of rocks in local deposits. However, we did not find any exotic specimens in the rocks analysed and we can, based on finds examined, not presume trading with exotic material; instead, mainly local stone was used.

<sup>6</sup> Grad, Ferjančič 1976.

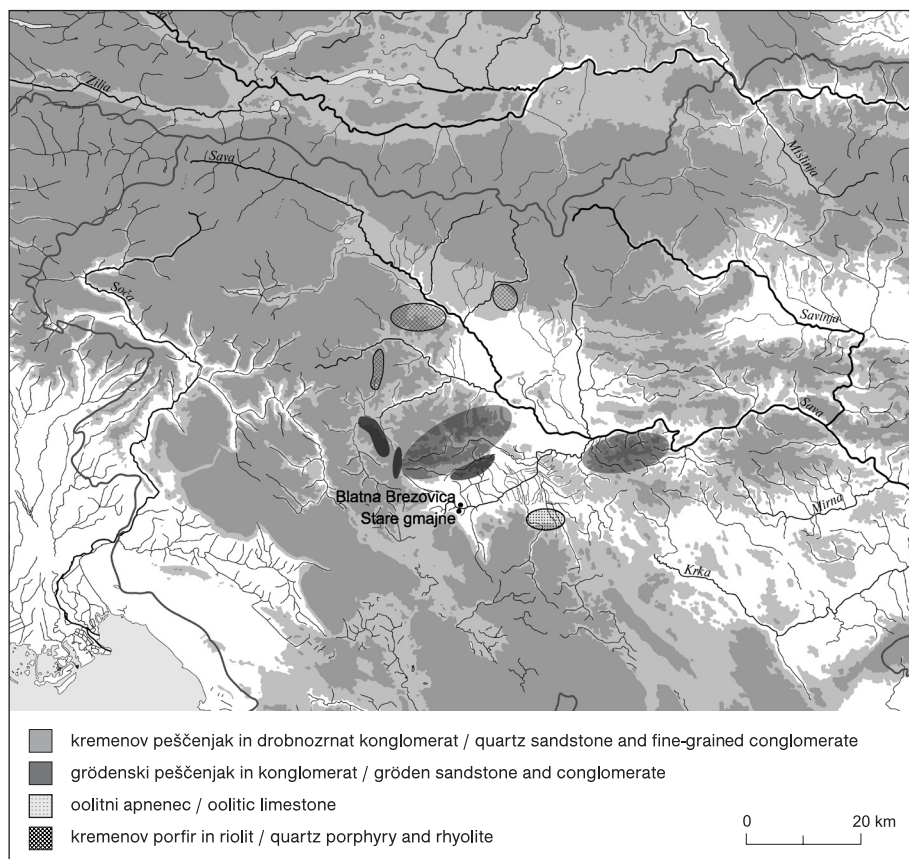
<sup>7</sup> Pavšič 1989.

<sup>8</sup> Grad, Ferjančič 1976.

<sup>9</sup> Grad, Ferjančič 1976.

<sup>10</sup> Horvat 2006; Pavšič 1989.

<sup>11</sup> See e.g. Chapter 12 in this monograph.



Sl. 13.4: Zemljevid osrednje Slovenije z označenimi območji potencialnih izvornih nahajališč obravnavanih kamnitih najdb s Starih gmajn in Blatne Brezovice.

Fig. 13.4: Map of central Slovenia with marked area of potential deposits of examined stone finds from Stare gmajne and Blatna Brezovica.

### 13.5 SKLEP

Izvor kamnin smo glede na njihovo petrološko sestavo iskali predvsem v neposredni okolici obravnavanih arheoloških najdišč oz. v hribovitem zaledju Ljubljanskega barja (sl. 13.4). Skoraj zagotovo je, da so si tedanji prebivalci kolišč surovino nabirali sami oz. jo iskali na nahajališčih, kolikor so bila ta prisotna v bližnji oz. ne preveč oddaljeni okolici. Določeni primerki so bili lahko pripeljani tudi iz oddaljenih krajev po trgovskih poteh.<sup>11</sup> Vendar so trgovali predvsem s kamnino, katere nahajališč ni bilo v širši okolici naselbin. Hkrati je morala biti kakovost takšne kamnine boljša od tiste na lokalnih nahajališčih. Vendar pa kakšnih eksotičnih primerkov med analiziranimi predmeti nismo našli, torej na podlagi obravnavanih najdb ne moremo sklepati na trgovino z eksotičnim materialom, ampak predvsem na uporabo lokalnega kamna.

<sup>11</sup> Glej npr. poglavje 12 v tem zborniku.

# 14. ARTEFAKTI IZ KOSTI, ROGOVIJ IN ZOB Z BAKRENODOBNIH KOLIŠČ STARE GMAJNE IN BLATNA BREZOVICA

Borut TOŠKAN

## Izvleček

Med terenskim raziskovanjem bakrenodobnih koliščarskih naselbin na Starih gmajnah in Blatni Brezovici je bilo poleg drugega najdenih tudi 66 artefaktov iz živalskih kosti, zob in rogovij. Koliščarji so kot surovino za njihovo izdelavo preferenčno uporabljali ostanke lovnih vrst: dlančnice oz. stopalnice in komolčnice med postkranialnimi skeletnimi elementi ter rogovja jelenov. Porazdelitev orodij v prostoru je pokazala, da lokalne koncentracije najdb niso neposredno odvisne od števila vseh živalskih ostankov na danem delu najdišča, ampak v njih odsevajo tudi od velikosti favnisitčnega vzorca neodvisni dejavniki.

**Ključne besede:** koščena orodja, orodja iz rogovij, Ljubljansko barje, eneolitik.

## 14.1 UVOD

Najdbe metalurških pripomočkov s koliščarskih naselbin Hočevarica,<sup>1</sup> Maharski prekop<sup>2</sup> in Stare gmajne<sup>3</sup> nedvoumno dokazujejo, da so se koliščarji na Ljubljanskem barju v 4. tisočletju pr. Kr. že ukvarjali z metalurško dejavnostjo. Po hipotezi A. Veluščka naj bi se prvi iskanci bakra na obravnavanem območju pojavili še celo prej, tj. vsaj sredi 5. tisočletja pr. Kr., za kar pa še ni materialnih dokazov.<sup>4</sup> Ne glede na dejanski začetek metalurške dejavnosti na Ljubljanskem barju pa je kovina (baker) kot surovina v kvantitativnem smislu sprva igrala le obrobno vlogo: najdbe bakrenih predmetov iz obdobja od sredine 5. pa do konca 3. tisočletja pr. Kr. so namreč relativno maloštevilne.<sup>5</sup> Namesto iz bakra so koliščarji orodja in okrasne predmete še vedno izdelovali

<sup>1</sup> Velušček 2004b, 51 s.

<sup>2</sup> Velušček, Greif 1998; Šmit, Nečemer 1998.

<sup>3</sup> Poglavji 3 in 11 v tem zborniku.

<sup>4</sup> Velušček 2006b, 44 s.

<sup>5</sup> Glej npr. Korošec, Korošec 1969, 21, t. 105: 1–14; Greif 1997, 52 ss; Velušček, Greif 1998, 31 ss.

# 14. BONE, ANTLER AND TEETH ARTEFACTS FROM THE COPPER AGE PILE-DWELLINGS STARE GMAJNE AND BLATNA BREZOVICA

Borut TOŠKAN

## Abstract

Fieldwork at the Copper Age pile-dwelling settlements Stare gmajne and Blatna Brezovica yielded, among other things, 66 artefacts made of animal bones, teeth and antlers. Pile-dwellers mainly used remains of wild animals as raw material: metacarpals/metatarsals and ulnae among postcranial skeletal elements, and red deer antlers. The spatial distribution of tools demonstrated that local concentrations of finds are not directly dependent on the quantity of all animal remains on the particular part of the excavation site.

**Keywords:** bone tools, antler tools, the Ljubljansko barje, Eneolithic.

## 14.1 INTRODUCTION

Finds of metallurgic accessories from the pile-dwelling settlements Hočevarica,<sup>1</sup> Maharski prekop<sup>2</sup> and Stare gmajne,<sup>3</sup> undoubtedly confirm that the dwellers were already engaged in metallurgic activity at the Ljubljansko barje in the 4<sup>th</sup> millennium BC. A. Velušček assumes that the first seekers of copper were, in the studied area, present earlier, i.e. at least from the middle of the 5<sup>th</sup> millennium BC; there is no material evidence to confirm this yet.<sup>4</sup> However, regardless of the temporal framework for the beginnings of metallurgic activities at the Ljubljansko barje, metal (copper) as raw material in quantitative sense, only played a secondary role at first: there are relatively few copper finds from the middle of the 5<sup>th</sup> to the end of the 3<sup>rd</sup> millennium BC.<sup>5</sup> Instead,

<sup>1</sup> Velušček 2004b, 51 f.

<sup>2</sup> Velušček, Greif 1998; Šmit, Nečemer 1998.

<sup>3</sup> See Chapters 3 and 11 in this monograph.

<sup>4</sup> Velušček 2006b, 44 f.

<sup>5</sup> See e.g. Korošec, Korošec 1969, 21, Pl. 105: 1–14; Greif 1997, 52 ff; Velušček, Greif 1998, 31 ff.

Tab. 14.1: Število najdenih predmetov iz kosti, rogovij in zob na najdiščih Stare gmajne (terenske raziskave iz let 2002, 2004, 2006 in 2007) in Blatna Brezovica (sondiranje iz leta 2003).  
Tab. 14.1: Number of bone, antler and teeth objects from the sites Stare gmajne (fieldwork carried out in 2002, 2004, 2006 and 2007) and Blatna Brezovica (sample trenching carried out in 2003).

Surovina / Material	Stare gmajne	Blatna Brezovica
Kost / Bone	41	5
Rogovje / Antler	14	-
Zob / Tooth	6	-

pretežno iz kamna (kremena), lesa in živalskih ostankov. Artefakti iz kosti in rogovij so v okviru bakrenodobnih najdišč z Ljubljanskega barja<sup>6</sup> še posebej številčni,<sup>7</sup> saj so pogoji za konservacijo organskega materiala v tamkajšnjem z vodo prepojenem, anaerobnem, rahlo bazičnem sedimentnem okolju izredno ugodne.<sup>8</sup> Tako je bilo med terenskim raziskovanjem na najdiščih Stare gmajne<sup>9</sup> (leta 2002, 2004, 2006 in 2007) in Blatna Brezovica<sup>10</sup> (leto 2003) izkopanih 66 takšnih predmetov (tab. 14.1), ki so podrobneje predstavljeni v tem poglavju.

Artefakti s Starih gmajn izvirajo iz devetih drenažnih jarkov v skupni dolžini približno 1200 m in dveh sond dimenzij 3 × 5 m (sl. 14.1); gradivo z Blatne Brezovice je iz sonde površine 2 m<sup>2</sup>. Medtem ko so bile najdbe med raziskovanjem drenažnih jarkov pobirane sproti (ročno) in sama kulturna plast naknadno ni bila še dodatno presejana, pa je bil izkopan sediment iz treh sond v celoti spran skozi sita (premer luknjic 3 mm in 1 mm).<sup>11</sup> Razumljivo je, da navedene razlike v načinu vzorčenja odsevajo tudi v naboru samih najdb. Povprečna velikost artefaktov iz vsake od treh sond je namreč značilno manjša od povprečne velikosti artefaktov iz drenažnih jarkov (tab. 14.2), kjer so bile mnoge drobne najdbe med terenskim raziskovanjem pač nehote sprejete in posledično zavržene.<sup>12</sup>

Med 66 razpoložljivimi izdelki in polizdelki prevladujejo tisti iz kosti (tab. 14.1), od katerih jih je bilo mogoče zoološko identificirati približno polovico, tj. 22. Čeprav bi bilo zavajajoče trditi, da je osteološka klasifika-

<sup>6</sup> Podobno velja tudi za koliščarske naselbine v drugih deželah Srednje Evrope (npr. Schlichtherle, Wahlster 1986, 76 s, 80 ss; Bartosiewicz, Choyke 1997; Provenzano 2001; Schibler 2001).

<sup>7</sup> Korošec 1963, 23; Korošec, Korošec 1969, 18 s; Bregant 1975, 32 s; Harej 1976, t. 7: 7,10–22; 1981–82, t. 19: 7–9; 29: 4; Potočnik 1988–1989; Velušček 2004b, 45 ss.

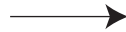
<sup>8</sup> Toškan 2005, 94 s.

<sup>9</sup> Najdišče je datirano v obdobje okoli sredine 2. polovice 4. tisočletja pr. Kr. (poglavje 7 v tem zborniku).

<sup>10</sup> Naselbina je zelo verjetno nekoliko mlajša od mlajše naselbinske faze na Starih gmajnah in prav tako sodi v 2. polovico 4. tisočletja pr. Kr. (glej poglavji 1.3 in 7 v tem zborniku).

<sup>11</sup> Za podrobnejše podatke o metodologiji terenskega raziskovanja glej poglavje 3.1 v tem zborniku.

<sup>12</sup> Prim. Toškan, Dirjec 2004, 158 ss.



Sl. 14.1: Drenažni jarki na najdišču Stare gmajne pri Verdu. Številke jarkov z arheološkimi najdbami so napisane poudarjeno. Označena je lega posameznih izdelkov iz rogovja (▲) in ostalih (●) orodij iz živalskih ostankov.

Fig. 14.1: Irrigation ditches at Stare gmajne near Verd. Numbers of ditches containing archaeological finds are emphasised. Positions of individual antler (▲) and other (●) tools made of animal remains are marked.

dwellers mostly used stone (quartz), wood and animal remains to manufacture tools and decorative items. Bone and antler artefacts are particularly numerous<sup>6</sup> at the Copper Age sites of the Ljubljansko barje,<sup>7</sup> because of extremely suitable conditions for conservation of organic material in water-soaked, anaerobic, slightly basic sediment environment.<sup>8</sup> We excavated 66 such objects (Tab. 14.1) during the fieldwork at Stare gmajne<sup>9</sup> (in 2002, 2004, 2006 and 2007) and Blatna Brezovica<sup>10</sup> (in 2003); they are introduced in more detail in this chapter.

Artefacts from Stare gmajne originate from nine irrigation ditches in total length of c. 1200 m and two trenches of 3 × 5 m (Fig. 14.1); artefacts from Blatna Brezovica were found in a trench of 2 m<sup>2</sup>. While the finds discovered during the examination of irrigation ditches were picked up by hand and the cultural layer was not additionally sifted afterwards, the entire sediment from the three trenches was sifted (3 mm and 1 mm sieve).<sup>11</sup> It is understandable that differences in sampling listed above, reflect also in the assemblage of finds. Namely, average size of artefacts from each of the three trenches is statistically significantly smaller from the average size of artefacts found in drainage ditches (Tab. 14.2), where many small finds were unintentionally overlooked and consecutively thrown away during the fieldwork.<sup>12</sup>

Bone tools prevail among 66 available tools and part-finished tools (Fig. 14.1); circa half of them, i.e. 22, were zoologically (taxonomically) identified. Although it would be deceptive to claim that osteological classification is totally objective, typological categorisation is even less standardised and often a lot less consistently used as the zoological or anatomical nomenclature. Conven-

<sup>6</sup> Korošec 1963, 23; Korošec, Korošec 1969, 18 f; Bregant 1975, 112 f; Harej 1976, Pl. 7: 7,10–22; 1981–1982, Pls. 19: 7–9; 29: 4; Potočnik 1988–1989; Velušček 2004b, 45 ff.

<sup>7</sup> This can also be seen in the case of other central European pile-dwellings (e.g. Schlichtherle, Wahlster 1986, 76 f, 80 ff; Bartosiewicz, Choyke 1997; Provenzano 2001; Schibler 2001).

<sup>8</sup> Toškan 2005, 97.

<sup>9</sup> The site dates to the 2nd half of the 4th millennium BC (see Chapter 7 in this monograph).

<sup>10</sup> The settlement is probably somewhat later as the late settlement phase of the Stare gmajne and also dates to the 2nd half of the 4th millennium BC (see Chapters 1.3 and 7 in this monograph).

<sup>11</sup> See Chapter 3.1 in this monograph for details on the methodology of field research.

<sup>12</sup> Cf. Toškan, Dirjec 2004, 157 ff.





Tab. 14.2: Opisna statistika za velikost artefaktov iz kosti, rogovij in zob s Starih gmajn in Blatne Brezovice. Podani so mediana (Me), velikost vzorca (N) in razpon vrednosti (Min.–Max.).

Tab. 14.2: Descriptive statistics of sizes of bone, antler and teeth artefacts from Stare gmajne and Blatna Brezovica. Median (Me), size of sample (N), range (Min.–Max.).

Velikost Size	Stare gmajne			Blatna Brezovica
	Jarki / Ditches	Sonda 2 / Trench 2	Sonda 3 / Trench 3	Sonda / Trench
	Me (N) Min.–Max.	Me (N) Min.–Max.	Me (N) Min.–Max.	Me (N) Min.–Max.
0–10 cm	5,9 (9) 3,7–10,0	3,9 (18) 1,3–9,7	4,6 (5) 1,3–9,5	6,1 (5) 2,6–8,1
> 10 cm	12,9 (16) 10,4–32,4	15,3 (5) 11,2–19,7	14,7 (7) 10,9–51,5	–
Σ	11,9 (25) 3,7–32,4	8,1 (23) 1,3–19,7	12,25 (12) 1,3–51,5	6,1 (5) 2,6–8,1



Sl. 14.2: Artefakt iz komolčnice domačega goveda s Starih gmajn (mikrolokacija: sonda 2, kv. 14, 5. reženj). Foto: M. Zaplatil.

Fig. 14.2: Artefact; of ulna; cattle; Stare gmajne (micro-location: trench 2, quadrant 14, deepening 5). Photo: M. Zaplatil.



Sl. 14.3: Artefakt iz odlomka diafize komolčnice jelena s Starih gmajn (mikrolokacija: jarek 1, odsek 126). Foto: M. Zaplatil.

Fig. 14.3: Artefact; of fragment of ulnae diaphysis; red deer; Stare gmajne (micro-location: ditch 1, section/sector 126). Photo: M. Zaplatil.

cija v celoti objektivna, pa so tipološka razvrščanja praviloma še bistveno manj standardizirana in pogosto precej manj konsistentno uporabljena, kot velja to za zoološko ali anatomsko nomenklaturu. Konvencionalne formalne analogije, temelječe na nekritičnem upoštevanju zunanje podobnosti med oblikami, so namreč problematične, češar ne gre zanemariti. Poleg tega so poimenovanja kot so “šilo”, “bodalo” ipd. pogosto uporabljajo brez predhodne nedvoumne opredelitve, uvajanje novih poimenovanj pa zmedo le še povečuje. Zaradi navedenega so artefakti v tem prispevku razvrščeni predvsem po anatomsko-zooloških kriterijih, medtem ko je ugotavljanje namena uporabe posameznega orodja postavljeno v ozadje.<sup>13</sup>

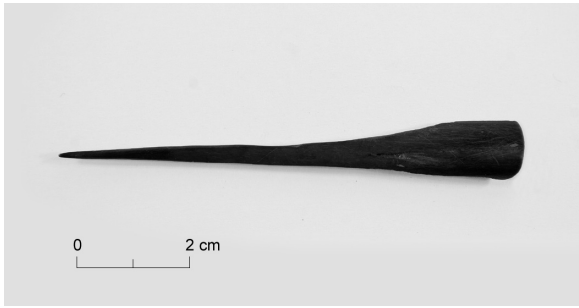


Sl. 14.4: Artefakt iz komolčnice ovce s Starih gmajn (mikrolokacija: jarek 1, odsek 129). Foto: M. Zaplatil.

Fig. 14.4: Artefact; of ulna; sheep; Stare gmajne (micro-location: ditch 1, section 129). Photo: M. Zaplatil.

tional formal analogies based on uncritical consideration of resemblance between shapes, present a problem that cannot be neglected. Moreover, terms, such as “awl”, “dagger” etc. are often used without preliminary unambiguous definition, while the introduction of new types

<sup>13</sup> Pri funkcionalni klasifikaciji orodij sem sicer sledil smernici, ki sta jih v predstavitvi artefaktov s koliščarskih naselbin pri Igu objavila P. in J. Korošec (1969).



*Sl. 14.5:* Artefakt iz odlomka diafize dolge cevaste kosti nedoločene živali s Starih gmajn (mikrolokacija: njiva vzhodno od jarka 4). Foto: M. Zaplatil.

*Fig. 14.5:* Artefact; of fragment of diaphysis of a tubular longbone; unidentified animal; Stare gmajne (micro-location: field eastwards from ditch 4). Photo: M. Zaplatil.



*Sl. 14.7:* Artefakt iz odlomka obsklepnega dela diafize dolge cevaste kosti nedoločene živali s Starih gmajn (mikrolokacija: sonda 2, kv. 2, 5. reženj). Foto: M. Zaplatil.

*Fig. 14.7:* Artefact; of fragment of periarticular part of diaphysis of tubular longbone; unidentified animal; Stare gmajne (micro-location: trench 2, quadrant 2, deepening 5). Photo: M. Zaplatil.



*Sl. 14.6:* Artefakt iz odlomka obsklepnega dela diafize dolge cevaste kosti nedoločene živali s Starih gmajn (mikrolokacija: sonda 2, kv. 3, 5. reženj). Foto: M. Zaplatil.

*Fig. 14.6:* Artefact; of fragment of periarticular part of diaphysis of tubular longbone; unidentified animal; Stare gmajne (micro-location: trench 2, quadrant 3, section 5). Photo: M. Zaplatil.



*Sl. 14.8:* Artefakt iz odlomka proksimalne epifize in diafize stopalnice srne s Starih gmajn (mikrolokacija: sonda 3, 1. reženj (humus)). Foto: M. Zaplatil.

*Fig. 14.8:* Artefact; of fragment of proximal epiphysis and diaphysis of metatarsal; roe deer; Stare gmajne (micro-location: trench 3, deepening 1 (humus)). Photo: M. Zaplatil.

### 14.1.1 STARE GMAJNE

Med artefakti iz živalskih ostankov s Starih gmajn prevladujejo koščeni izdelki. Precej jih je izdelanih iz komolčnic (*sl. 14.2-14.4*), čemur je očitno botrovala morfologija omenjenega skeletnega elementa z naravno priostrenim distalnim koncem. Še bistveno številčnejši pa so odlomki iz obsklepnih delov dolgih cevastih kosti, ki so na distalnem koncu preoblikovani v bolj ali manj ostro konico. Ta je večkrat zglajena – tudi zaradi uporabe – do sijaja. Proksimalni del koščenega odlomka (= bazalni del izdelka) je včasih lepo zaobljen (*sl. 14.5*), spet drugič povsem neobdelan (*sl. 14.6, 14.7*). Pogosto kot držaj služi kar sama sklepna glavica/skledica (*sl. 14.8-14.12*). Takšna orodja (šila oz. bodala *sensu* Korošec, Korošec 1969) prevladujejo tudi v okviru večine drugih eneolitjskih najdišč na Ljubljanskem barju<sup>14</sup> in širše.<sup>15</sup>

<sup>14</sup> Korošec 1963, 23; Korošec, Korošec 1969, 18; Bregant 1975, 32; Velušček 2004b, 46.

<sup>15</sup> Schibler 1980, 46; Bartosiewicz, Choyke 1997; Russell 2001, 271.

only still increases the chaos. For the reasons outlined above, artefacts in this paper were categorised mostly based on anatomical/taxonomical criteria, while discussion on the usage of individual tool is secondary.<sup>13</sup>

### 14.1.1 STARE GMAJNE

Bone artefacts are the most common among objects made of animal remains at Stare gmajne. Many were made on ulnae (*Figs. 14.2-14.4*), for the obvious reason of morphology of anatomical part mentioned, with naturally pointed distal end. Fragments of periarticular parts of tubular longbones, with pointed distal ends, are even more frequent. These are often polished (also from use). Proximal parts of bone fragments (= basal end of artefacts) are rounded at some examples (*Fig. 14.5*), while completely unworked in others (*Figs. 14.6, 14.7*). Bone

<sup>13</sup> Functional classification of tools was done according to the study of artefacts from the Ig pile-dwellings, published by P. in J. Korošec (1969).



*Sl. 14.9:* Artefakt iz odlomka proksimalne epifize in diafize dlančnice jelena s Starih gmajn (mikrolokacija: jarek 13, odseka 23–24). Foto: M. Zaplatil.

*Fig. 14.9:* Artefact; of fragment of proximal epiphysis and diaphysis of metacarpal; red deer; Stare gmajne (micro-location: ditch 13, sections 23-24). Photo: M. Zaplatil.



*Sl. 14.11:* Artefakt iz odlomka proksimalne epifize in diafize stopalnice jelena s Starih gmajn (mikrolokacija: jarek 1, odsek 131). Foto: M. Zaplatil.

*Fig. 14.11:* Artefact; of fragment of proximal epiphysis and diaphysis of metatarsal; red deer; Stare gmajne (micro-location: ditch 1, section 131). Photo: M. Zaplatil.



*Sl. 14.10:* Artefakt iz proksimalne epifize in diafize piščali divjega prašiča s Starih gmajn (mikrolokacija: jarek 13, odsek 35). Foto: M. Zaplatil.

*Fig. 14.10:* Artefact; of proximal epiphysis and diaphysis of fibula; wild boar; Stare gmajne (micro-location: ditch 13, section 35). Photo: M. Zaplatil.



*Sl. 14.12:* Artefakt iz odlomka proksimalne epifize in diafize stopalnice jelena s Starih gmajn (mikrolokacija: sonda 2, kv. 8, 5. reženj). Foto: M. Zaplatil.

*Fig. 14.12:* Artefact; of fragment of proximal epiphysis and diaphysis of metatarsal; red deer; Stare gmajne (micro-location: trench 2, quadrant 8, deepening 5). Photo: M. Zaplatil.

Odlomke dolgih cevastih kosti, iz katerih so izdelovali šila/bodala, so dobili s klanjem izbrane kosti v longitudinalni smeri. Pri tem so večinoma uporabljali metodo klanja po vnaprej izdelanih vrezih<sup>16</sup>: v kost, največkrat je šlo za metapodij, so vdolbli dva dovolj globoka, vzporedno potekajoča žlebova, vzdolž katerih je bila nato kost razklana na dva podolgovata odlomka primerljive velikosti. Pri kosteh večjih živali, npr. jelenu, so v dolge kosti včasih vdolbli kar štiri vzporedno potekajoče žlebove, tj. ne le na anteriorni in posteriorni strani, ampak tudi lateralno in medialno,<sup>17</sup> tako da so po razklanju kosti pridobili štiri dimenzijsko podobne in za nadaljnjo obdelavo primerne odlomke.<sup>18</sup> Takšen pristop je bil seveda nekoliko bolj tvegan, zato pa je bil proces izdelovanja polizdelkov toliko hitrejši.

Ob koščenih orodjih so na Starih gmajnah razmeroma dobro zastopana tudi orodja iz rogovij. Med razpoložljivimi najdbami prevladujejo sekire in dleta (*sensu* Korošec, Korošec 1969), najdeni pa so bili tudi

epiphyses were often used as handles (*Figs. 14.8–14.11*). Such tools (awls or daggers after Korošec, Korošec 1969) also prevail in the majority of other Eneolithic sites at the Ljubljansko barje<sup>14</sup> and wider.<sup>15</sup>

Fragments, from which awls/daggers were manufactured, were made of longitudinally split tubular longbones. They were mostly butchered according to prior made cuts<sup>16</sup>: two deep parallel grooves were cut into bone, most often metapodia, bone was then broken alongside them, to make two oblong fragments of comparable size. Bones of larger animals, e.g. red deer, sometimes had four parallel grooves cut into them, i.e. not only on anterior and posterior sides but also on lateral and medial sides,<sup>17</sup> so that four similar fragments were gained at cutting.<sup>18</sup> Such approach was a bit riskier,

<sup>14</sup> Korošec 1963, 23; Korošec, Korošec 1969, 38; Bregant 1975, 32; Velušček 2004b, 46.

<sup>15</sup> Schibler 1980, 46; Bartosiewicz, Choyke 1997; Russell 2001, 271.

<sup>16</sup> Cf. Christidou 2001, 43

<sup>17</sup> See Bartosiewicz 1999, Fig. 4.

<sup>18</sup> Cf. Christidou 2001, 43 and *Fig. 14.12*.

<sup>16</sup> Prim. Christidou 2001, 43.

<sup>17</sup> Glej Bartosiewicz 1999, sl. 4.

<sup>18</sup> Prim. Christidou 2001, 43 in *sl. 14.12*.



Sl. 14.13: Artefakt iz paročka rogovja jelena s Starih gmajn (mikrolokacija: sonda 3, kv. 6, 7. reženj). Foto: M. Zaplatil.  
Fig. 14.13: Artefact; of tine; red deer; Stare gmajne (micro-location: trench 3, quadrant 6, section 7). Photo: M. Zaplatil.



Sl. 14.15: Artefakt iz paročka rogovja jelena s Starih gmajn s sledmi glodanja malih sesalcev (mikrolokacija: jarek 12, odsek 27). Foto: M. Zaplatil.  
Fig. 14.15: Artefact; of tine with traces of gnawing of small mammals; red deer; Stare gmajne (micro-location: ditch 12, section 27). Photo: M. Zaplatil.



Sl. 14.14: Artefakt iz paročka rogovja jelena s Starih gmajn (mikrolokacija: jarek 1, odsek 131). Foto: M. Zaplatil.  
Fig. 14.14: Artefact; of tine; red deer; Stare gmajne (micro-location: ditch 1, section 131). Photo: M. Zaplatil.

v orodje preoblikovani paročki (sl. 14.13–14.15). Kot surovina so koliščarji uporabljali tako rogovja uplenjenih jelenov (sl. 14.16–14.18) kakor tudi naravno odpadle primerke (sl. 14.19, 14.20). Sodeč po razpoložljivih najdbah so prednostno obdelovali velika rogovja odraslih, nad pet let starih živali.<sup>19</sup> Najdeni primerki sicer v svojih dimenzijah<sup>20</sup> zaostajajo za modernimi trofejnimi primerki iz Srednje Evrope,<sup>21</sup> ne odstopajo pa od tistih iz nekaj več kot 1 km oddaljenega mezolitskega tabora Zalag pri Verdu.<sup>22</sup>

Sodeč po polizdelku iz jarka 4, odsek 40 (sl. 14.16), se je proces izdelave sekir oz. dlet iz rogovja začel z odstranitvijo distalnega (terminalnega) dela z rezom na meji med bazalnim in srednjim delom stebela. Sledila je

but the process of making part-finished objects was much quicker.

Apart from bone tools, also tools made on antler are comparatively well represented at Stare gmajne. Axes and chisels prevail (after Korošec, Korošec 1969), but also tines, transformed into tools were found (Figs. 14.13–14.15). The dwellers were using antlers from animals that have been hunted (Figs. 14.16–14.18) as well as shed specimens (Figs. 14.19, 14.20). Based on the available finds, they preferentially used large antlers of adults over five years old.<sup>19</sup> Specimens are smaller<sup>20</sup> as modern trophy specimens from central Europe,<sup>21</sup> but have similar dimensions as the ones from the Mesolithic camp Zalag near Verd, which lays c. 1 km from Stare gmajne.<sup>22</sup>

Part-finished object from ditch 4, section 40 (Fig. 14.16), indicates that the removal of distal (terminal) part of antler that was cut off at junction between the basal and middle beam, represented the first step in manufacturing antler axes/chisels. Removal of tines followed (brow tine, bez tine). These were sometimes sawn off, but most often cut, or faceted, which left characteristic oblique marks in a shape of a “V” or a “trapeze” (Fig. 14.21).<sup>23</sup> Manufacturing was continued with perforation for hafting a tool;<sup>24</sup> the perforation was made from both sides of the beam. They finished with making the working end (e.g. blade for axes), which was made from either distal end of the basal beam

<sup>19</sup> Prim. Clason 1983, 117.

<sup>20</sup> Obseg rože: 209 mm in 214 mm. Ostale dimenzije: glej poglavje 14.5 v tem prispevku.

<sup>21</sup> Obseg rože (povprečne vrednosti): 263,8 mm (nekdanja Jugoslavija: N = 180), 256,3 mm (Madžarska: N = 38) in 243,5 mm (Avstrija: N = 50). Vir: Clason 1983, 118.

<sup>22</sup> Obseg rože: Me = 220 mm; razpon: 185–245 mm; N = 11. Vir: Toškan, Dirjec 2006, 186.

<sup>19</sup> Cf. Clason 1983, 117.

<sup>20</sup> Diameter of the burr: 209 and 214 mm. Other dimensions: see Chapter 14.5 in this monograph.

<sup>21</sup> Diameter of the burr (average): 263.8 mm (former Yugoslavia: N = 180), 256.3 mm (Hungary: N = 38) and 243.5 mm (Austria: N = 50). From: Clason 1983, 118.

<sup>22</sup> Diameter of the burr: Me = 220 mm; span: 185–245 mm; N = 11. From: Toškan, Dirjec 2006, 186.

<sup>23</sup> Cf. Bulten, Clason 2001, 298 and Fig. 14.21.

<sup>24</sup> Perforations on axes/chisels from Stare gmajne had 17–28 mm in diameter. Perforations made on tines are smaller, i.e. 12–15 mm.





*Sl. 14.16:* Polizidelek iz baze stebila rogovja jelena s Starih gmajn (mikrolokacija: jarek 4, odsek 40). Foto: M. Zaplatil.  
*Fig. 14.16:* Part-finished object made of basal beam part of antler; red deer; Stare gmajne (micro-location: ditch 4, section 40). Photo: M. Zaplatil.



*Sl. 14.19:* Artefakt iz baze stebila odpadlega rogovja jelena s Starih gmajn (mikrolokacija: jarek 3, odsek 60). Foto: M. Zaplatil.  
*Fig. 14.19:* Artefakt; of basal beam part of shed antler; red deer; Stare gmajne (micro-location: ditch 3, section 60). Photo: M. Zaplatil.



*Sl. 14.17:* Artefakt iz baze stebila rogovja jelena s Starih gmajn (mikrolokacija: jarek 1, odsek 22). Foto: M. Zaplatil.  
*Fig. 14.17:* Artefakt; of basal beam part of antler; red deer; Stare gmajne (micro-location: ditch 1, section 22). Photo: M. Zaplatil.



*Sl. 14.20:* Artefakt iz baze stebila odpadlega rogovja jelena s Starih gmajn (mikrolokacija: sonda 3, kv. 2, kulturna plast). Foto: M. Zaplatil.  
*Fig. 14.20:* Artefakt; of basal beam part of shed antler; red deer; Stare gmajne (micro-location: trench 3, quadrant 2, cultural layer). Photo: M. Zaplatil.



*Sl. 14.18:* Artefakt iz baze stebila rogovja jelena s Starih gmajn (mikrolokacija: sonda 2, kv. 1, 6. reženj). Foto: M. Zaplatil.  
*Fig. 14.18:* Artefakt; of basal beam part of antler; red deer; Stare gmajne (micro-location: trench 2, quadrant 1, deepening 6). Photo: M. Zaplatil.



*Sl. 14.21:* Značilni poševni sledovi v obliki črke V, ki so nastali med rezanjem oz. fasetiranjem rogovja. Foto: M. Zaplatil.  
*Fig. 14.21:* Characteristic oblique traces in shape of a "V", made at cutting/faceting of antlers. Photo: M. Zaplatil.

odstranitev odvečnih parožkov (nadočnikov, sivčkov). Ti so bili včasih odžagani, največkrat pa odstranjeni z rezanjem oz. fasetiranjem, kar je na kompakti pustilo značilne poševne sledove v obliki črke "V" ali "trapeza"

part (Figs. 14.19, 14.20) or its proximal part together with part of frontal bone (Figs. 14.17, 14.18).

Teeth-made artefacts are not as numerous as the bone- and antler-made at Stare gmajne. Apart from the





*Sl. 14.22:* Artefakt iz zgornjega podočnika psa s Starih gmajn (mikrolokacija: jarek 13, odsek 30). Foto: M. Zaplatil.

*Fig. 14.22:* Artefact; of upper canine; dog; Stare gmajne (micro-location: ditch 13, section 30). Photo: M. Zaplatil.



*Sl. 14.23:* Artefakt iz odlomka diafize dolge kosti specifično nedoločene ptice s Starih gmajn (mikrolokacija: sonda 3, kv. 5, 6. reženj). Foto: M. Zaplatil.

*Fig. 14.23:* Artefact; of fragment of diaphysis of a longbone; unidentified bird; Stare gmajne (micro-location: trench 3, quadrant 5, deepening 6). Photo: M. Zaplatil.

(*sl. 14.21*).<sup>23</sup> Proces izdelave se je nadaljeval z izvrtanjem odprtine za nasajanje orodja,<sup>24</sup> pri čemer so kompakto predrli z ene in z druge strani stebela. Na koncu so izdelali še delovno površino, npr. rezilo pri sekirah, v katero so preoblikovali bodisi distalni konec bazalnega dela stebela (*sl. 14.19, 14.20*) bodisi njegov proksimalni del z nastavkom čelnice vred (*sl. 14.17, 14.18*).

Izdelki iz zob so na Starih gmajnah bistveno manj številčni od tistih iz kosti in rogovij. Z izjemo obeska iz pasjega podočnika (*sl. 14.22*), ob ogrlični cevki iz specifično nedeterminirane ptičje koščice (*sl. 14.23*) sicer edinega okrasnega predmeta med tukaj predstavljenim gradivom, so vsi preostali štirje artefakti iz zob izdelani iz spodnjih podočnikov divjega prašiča (*sl. 14.24-14.27*). Vsi imajo v špico preoblikovan distalni del, na katerem so vidni med izdelavo oz. uporabo nastali vrezi. Ti so



*Sl. 14.24:* Artefakt iz odlomka spodnjega podočnika divjega prašiča s Starih gmajn (mikrolokacija: sonda 2, kv. 6, 4. reženj). Foto: M. Zaplatil.

*Fig. 14.24:* Artefact; of fragment of lower canine; wild boar; Stare gmajne (micro-location: trench 2, quadrant 6, deepening 4). Photo: M. Zaplatil.



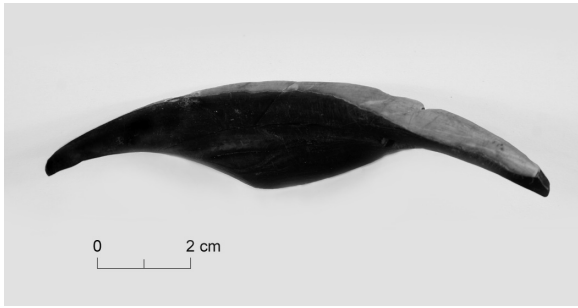
*Sl. 14.25:* Artefakt iz odlomka spodnjega podočnika divjega prašiča s Starih gmajn (mikrolokacija: jarek 1, odsek 129). Foto: M. Zaplatil.

*Fig. 14.25:* Artefact; of fragment of lower canine; wild boar; Stare gmajne (micro-location: ditch 1, section 129). Photo: M. Zaplatil.

pendant made of dog canine (*Fig. 14.22*), which together with the small necklace tube from an unidentified bird bone (*Fig. 14.23*) represents the only decorative item in assemblage studied here, all the remaining four artefacts made of teeth were made of wild boar lower canines (*Figs. 14.24-14.27*). Distal parts of all of them are pointed with visible cut-marks, made at making or during use. There are even more cut-marks seen on basal part, which is of a spoonlike shape. At two specimens (*Figs. 14.25, 14.27*) the spoonlike shaped basal end is pointed. It is interesting, that all four teeth-tools described above were found inside a single irrigation ditch (i.e. ditch 1) in distance < 20 m. No analogous objects have been found at the other Copper Age pile-dwellings of the Ljubljansko barje.

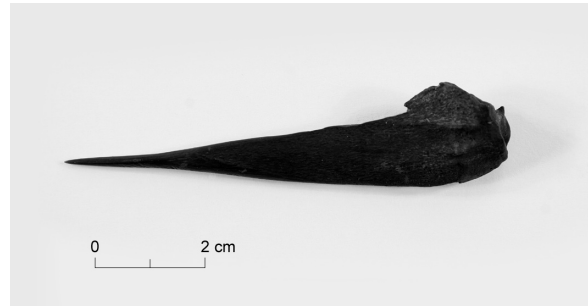
<sup>23</sup> Prim. Bulten, Clason 2001, 298 in *sl. 14.21*.

<sup>24</sup> Odprtine na sekirah/dletih s Starih gmajn so imele premer med 17 in 28 mm. Premeri odprtín na paroškkih so manjši, 12-15 mm.



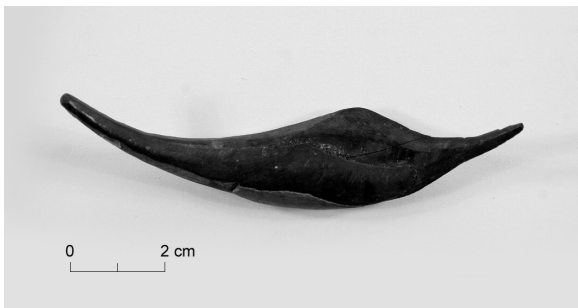
*Sl. 14.26:* Artefakt iz odlomka spodnjega podočnika divjega prašiča s Starih gmajn (mikrolokacija: jarek 1, odsek 131). Foto: M. Zaplatil.

*Fig. 14.26:* Artefact; of fragment of lower canine; wild boar; Stare gmajne (micro-location: ditch 1, section 131). Photo: M. Zaplatil.



*Sl. 14.28:* Artefakt iz odlomka distalne epifize in diafize koželjnice drobnice z Blatne Brezovice. Foto: M. Zaplatil.

*Fig. 14.28:* Artefact; of fragment of distal epiphysis and diaphysis of radius; ovicaprid; Blatna Brezovica. Photo: M. Zaplatil.



*Sl. 14.27:* Artefakt iz odlomka spodnjega podočnika divjega prašiča s Starih gmajn (mikrolokacija: jarek 1, odsek 131). Foto: M. Zaplatil.

*Fig. 14.27:* Artefact; of fragment of lower canine; wild boar; Stare gmajne (micro-location: ditch 1, section 131). Photo: M. Zaplatil.



*Sl. 14.29:* Artefakt iz odlomka diafize dolge cevaste kosti nedoločene živali z Blatne Brezovice. Foto: M. Zaplatil.

*Fig. 14.29:* Artefact; of fragment of diaphysis of tubular longbone; unidentified animal; Blatna Brezovica. Photo: M. Zaplatil.

še številčnejši na bazalnem delu, ki je preoblikovan žličasto. Pri dveh primerkih se žličasto oblikovan bazalni del končuje s špico (*sl. 14.25, 14.27*). Zanimivo je, da so bila vsa štiri opisana orodja najdena v istem drenažnem jarku (tj. jarku 1) na razdalji < 20 m. Podobni predmeti z ostalih bakrenodobnih kolišč z Ljubljanskega barja niso znani.

### 14.1.2 BLATNA BREZOVICA

Med terenskim raziskovanjem na Blatni Brezovici leta 2003<sup>25</sup> je bilo najdenih le pet obdelanih živalskih ostankov, kar sicer v luči majhne površine sondažnega polja niti ni presenetljivo. Podobno kot v primeru Starih gmajn tudi med gradivom z Blatne Brezovice prevladujejo šila (npr. *sl. 14.28, 14.29*), medtem ko je en izdelek verjetno služil kot gladilo (*sensu* Korošec, Korošec 1969; *sl. 14.30*). Podobnost repertoarjev koščene orodja z obeh najdišč potrjuje tudi nekaj deset obdelanih živalskih ostankov, ki jih je na Blatni Brezovici leta 1953

<sup>25</sup> Poglavje 5 v tem zborniku.

### 14.1.2 BLATNA BREZOVICA

Only five worked animal remains were found during fieldwork at Blatna Brezovica in 2003,<sup>25</sup> which is not astonishing, regarding small dimensions of trial trench. Similarly as at Stare gmajne, awls also prevail in Blatna Brezovica (e.g. *Figs. 14.28, 14.29*), while one object was probably a polisher (ater Korošec, Korošec 1969; *Fig. 14.30*). Resemblance of repertoires of bone tools from both sites can further be confirmed by ten worked animal remains, discovered at Blatna Brezovica by S. Jesse in 1953. Namely, bone awls and daggers prevail here as well.<sup>26</sup> It is interesting, that no antler-made tools were found during 1953 or 2003 trial trenching. The use of antler as raw material in tool making is, despite this, not questionable, as visible traces of working can be seen on some antler fragments, e.g. cut-marks or traces of smoothening.<sup>27</sup>

<sup>25</sup> See Chapter 5 in this monograph.

<sup>26</sup> Korošec 1963, 63.

<sup>27</sup> Korošec 1963, 63.

izkopal S. Jesse. Tudi med navedenim gradivom namreč prevladujejo koščena šila in bodala.<sup>26</sup> Zanimivo je, da na izdelke iz rogovij niso naleteli ne med sondiranji leta 1953 in tudi ne leta 2003. Uporaba rogovij kot surovine za izdelavo orodij pa kljub temu ni vprašljiva, saj so na nekaterih najdenih fragmentih navedenega skeletnega elementa vidne posamezne sledi obdelave, npr. vrezi oz. sledi uglajevanja.<sup>27</sup>

## 14.2 IZBIRA SUROVINE

Orodja iz živalskih ostankov je v osnovi mogoče razumeti kot stranski izdelek prehranjevanja, ki ga je človek naknadno preoblikoval v funkcionalni izdelek. V tem smislu predstavljajo neke vrste izjemo le orodja iz rogovij ter obdelani podočniki medveda, volka in drugih (velikih) zveri. Rogovje je namreč bakrenodobni človek pridobival tudi s pobiranjem naravno odpadlih primerkov, sam lov na zveri pa najverjetneje ni bil osmišljen s pridobivanjem njihovega mesa (čeprav so uplenjene medvede in volkove v končni fazi najverjetneje tudi zaužili). Iz zgoraj navedenega torej izhaja, da je človek surovino za izdelavo koščanih izdelkov in (vsaj dela) artefaktov iz rogovij pridobival iz uplenjenih lovnih in zaklanih domačih živali. Povedano drugače: izbiral je lahko med kostmi prav vseh v takratnem okolju živečih živali, če mu jih je le uspelo upleniti oz. jih je znal vzrediti.<sup>28</sup> Vendar pa v tem poglavju predstavljene najdbe nazorno kažejo, da njegov izbor ni bil naključen. Tako npr. delež jelena med koščanimi orodji s Starih gmajn bistveno presega delež iste vrste med celotnim favnističnim gradivom z omenjenega najdišča, kar kaže na očitno preferenco izdelovalcev koščanih orodij do jelenjih kosti (*tab. 14.3*).<sup>29</sup> Pa ne samo jelenjih! Bakrenodobni koliščarji so pri izbiri surovine za izdelavo koščanih orodij prednostno posegali tudi po kosteh/zobeh drugih lovnih živali (srne, divjega prašiča), medtem ko je število obdelanih ostankov domačih živali (sploh drobnice) relativno skromno.

Preferenca do kosti lovnih živali, ki je v primeru Starih gmajn celo statistično značilna (*tab. 14.4*), je bila ugotovljena tudi v primeru številnih drugih eneolitskih naselbin v regiji.<sup>30</sup> Izbira surovine, tj. taksona, za izdelavo koščanega orodja je namreč temeljila na upoštevanju strukturne trdnosti kosti posamezne živali. In ker so kosti lovnih vrst praviloma bistveno trdnejše od primerljivih skeletnih

<sup>26</sup> Korošec 1963, 23.

<sup>27</sup> Korošec 1963, 23.

<sup>28</sup> Izjemoma so koliščarji z Ljubljanskega barja razpolagali tudi z ostanki živali, ki v osrednji Sloveniji niso bile prisotne in so jih najverjetneje pridobili s trgovanjem (glej npr. Pavšič, Dirjec 2004).

<sup>29</sup> Podobne primerjave v primeru Blatne Brezovice niso smiselne, saj je velikost razpoložljivega vzorca tam pač preskromna (*tab. 14.1*).

<sup>30</sup> Npr. Bazzanella 1994, tab. 2; Bartosiewicz, Choyke 1997; Russell 2001, tab. 2.



*Sl. 14.30:* Artefakt iz obsklepnega dela epifize dlančnice/stopalnice jelena z Blatne Brezovice. Foto: M. Zaplatil.

*Fig. 14.30:* Artefact; of periarticular part of epiphysis of metacarpal/metatarsal; red deer; Blatna Brezovica. Photo: M. Zaplatil.

## 14.2 CHOICE OF RAW MATERIALS

Bone/antler/teeth-made tools could be explained as a side produce of people's diet, which was transformed into a functional product. The only exceptions here are antler-made tools and worked canines of bear, wolf and other (large) carnivores. Namely, the Copper Age man obtained antlers also by collecting shed specimens, while (large) carnivores were most probably not hunt primarily for their meat (although the caught bears and wolves were most probably consumed). We can conclude from above that people obtained raw material for bone- and (at least to some extent) antler-made artefacts from hunted wild and slaughtered domestic animals. In other words: they could choose between bones of all animals living in then environment, if they succeeded to catch or knew how to keep them.<sup>28</sup> However, the finds, introduced in this chapter, clearly show that their selection was not random. For example, the share of red deer bone tools from Stare gmajne significantly surpasses the share of the bones of the same species within the entire faunal material from the mentioned site, which shows that red deer bones were preferentially selected to manufacture bone-tools (*Tab. 14.3*).<sup>29</sup> However, not only red deer! The Copper Age pile-dwellers preferentially used bones/teeth of other wild animals (roe deer, wild boar) to make bone tools as well, while the number of worked remains of domesticates (mostly ovicaprids) is relatively small.

Preference to bones of wild animals, which is even statistically significant at Stare gmajne (*Tab. 14.4*), was also established for a number of other Eneolithic settlements in the region.<sup>30</sup> Choice of raw materials, i.e.

<sup>28</sup> Dwellers from the Ljubljansko barje sometimes used remains of animals, which were not present in central Slovenia; they were most probably obtained with trading (see e.g. Pavšič, Dirjec 2004).

<sup>29</sup> Similar comparisons to Blatna Brezovica are meaningless, as the sample is too poor (*Tab. 14.1*).

<sup>30</sup> E.g. Bazzanella 1994, Tab. 2; Bartosiewicz, Choyke 1997; Russell 2001, Tab. 2.

Tab. 14.3: Število neobdelanih ostankov posameznih taksonov velikih sesalcev v gradivu s Starih gmajn v primerjavi z zastopanostjo istih taksonov v vzorcu orodij z istega najdišča. Tretjina (21) artefaktov je izdelanih iz kosti taksonomsko nedoločenih sesalcev oz. ptic in zato v tabelo niso vključeni. Podatki o deležu zastopanosti posameznih taksonov so povzeti po Toškan, Dirjec (v pripravi).  
Tab. 14.3: Number of unworked remains of individual taxa of large mammals in assemblage from Stare gmajne in comparison to the share of the same taxa in the sample of tools from the same site. One third (i.e. 21) of the artefacts was made of taxonomically unidentified mammal/bird bones and are therefore not included here. Data on the share of individual taxa after Toškan, Dirjec (in prep.).

Takson / Taxon	Kosti in zobje / Bones and teeth		Orodja / Tools
	NISP	% NISP	N
<i>Cervus elaphus</i>	236	35,1	12 (≈ 50 %)
<i>Capreolus capreolus</i>	68	10,1	4
<i>Sus sp.</i>	104	15,5	6*
<i>Bos taurus</i>	55	8,2	2
Caprinae	155	23,0	1
<i>Canis familiaris</i>	29	4,3	1
Ostalo / Other	26	3,9	-
SKUPAJ / TOTAL	673	100	26
<i>Cervus elaphus</i> : rogovje / antlers	17		14
SKUPAJ / TOTAL	690		40

\* Gre za ostanke divjega prašiča (*Sus scrofa*); prevladujejo spodnji podočniki (N = 4). / Remains of wild boar (*Sus scrofa*); lower canines prevail (N = 4).

- zadnjega stolpca ne morem postaviti v sredino, ker je vsebina prve celice predolga

Tab. 14.4: Statistično testiranje razlik v deležu domačih oz. lovnih vrst sesalcev med neobdelanimi ostanki iz jarkov s Starih gmajn in obdelanimi ostanki iz istih jarkov; uporabljen je bil  $\chi^2$  test ( $\chi^2 = 7,62$ ; d.f. = 1; p = 0,006). Ker zanesljivo razlikovanje med zobmi/kostmi domačega in divjega prašiča pogosto ni bilo mogoče, ostanki rodu *Sus* pri izračunu niso bili upoštevani. Obrazložitev simbolov:  $f_1$  - ugotovljena frekvenca;  $f_2$  - pričakovana frekvenca. Podatki o deležu zastopanosti posameznih taksonov velikih sesalcev na najdišču Stare gmajne so povzeti po Toškan, Dirjec (v pripravi).

Tab. 14.4: Statistical testing of differences in percent of domestic or hunted (wild) mammal species between unworked remains from ditches at Stare gmajne and worked remains from the same ditches;  $\chi^2$  test ( $\chi^2 = 7.62$ ; d.f. = 1; p = 0.006) was used. As definite distinguishing between teeth/bones of pig and wild boar was often not possible, remains of genus *Sus* were not considered in calculation. Explanation of symbols:  $f_1$  - observed frequency;  $f_2$  - expected frequency. Data on share of individual taxa of large mammals on the site Stare gmajne after Toškan, Dirjec (in prep.).

		Neobdelani ostanki Unworked remains	Obdelani ostanki Worked remains	SKUPAJ TOTAL
Domače živali Domestic animals	$f_1$	239	2	241
	$f_2$	(233)	(8)	
Lovne živali Wild animals	$f_1$	348	18	366
	$f_2$	(354)	(12)	
SKUPAJ / TOTAL		587	20	607

elementov pri domestikatih,<sup>31</sup> ugotovljena preferenca do kosti jelena in srne nasproti npr. goveda in domačega prašiča sploh ni presenetljiva. Zaradi istega vzroka je zanemarljiv tudi delež obdelanih juvenilnih kosti: med gradivom s Starih gmajn sta tako od skupno 12 orodij,<sup>32</sup>

taxa, for making bone tools was based on structural strength of the bone itself. Bones of wild animals are generally more resilient as comparable anatomical parts of domesticates,<sup>31</sup> and therefore, preference towards red or roe deer bones in contrast to those of cattle and pig, is not astonishing. Due to the same reason, percent of worked bones of young animals is negligible: assemblage from Stare gmajne contains 12 tools<sup>32</sup> with preserved

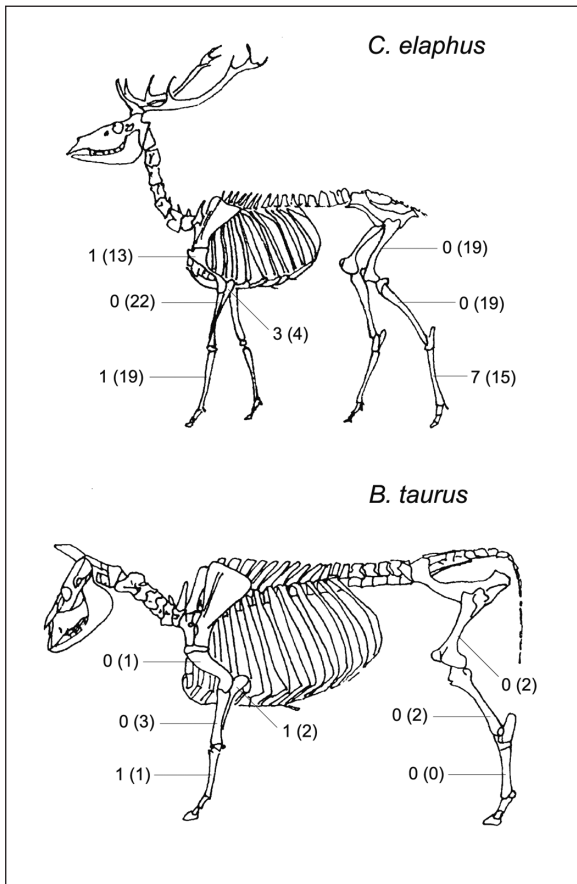
<sup>31</sup> Lyman 1999, 234 ss; Russell 2001, 272.

<sup>32</sup> Orodja iz odlomkov dlančnic/stopalnic z ohranjeno proksimalno epifizo pri tem izračunu nisem upošteval, saj je pri metapodijih osifikacija proksimalnega konca dokončana že pred skotitvijo (Silver 1972, 285 s).

<sup>31</sup> Lyman 1999, 234 ff.; Russell 2001, 272.

<sup>32</sup> Tools made of metacarpals/metatarsals with preserved proximal epiphysis were excluded from this analysis, as proximal





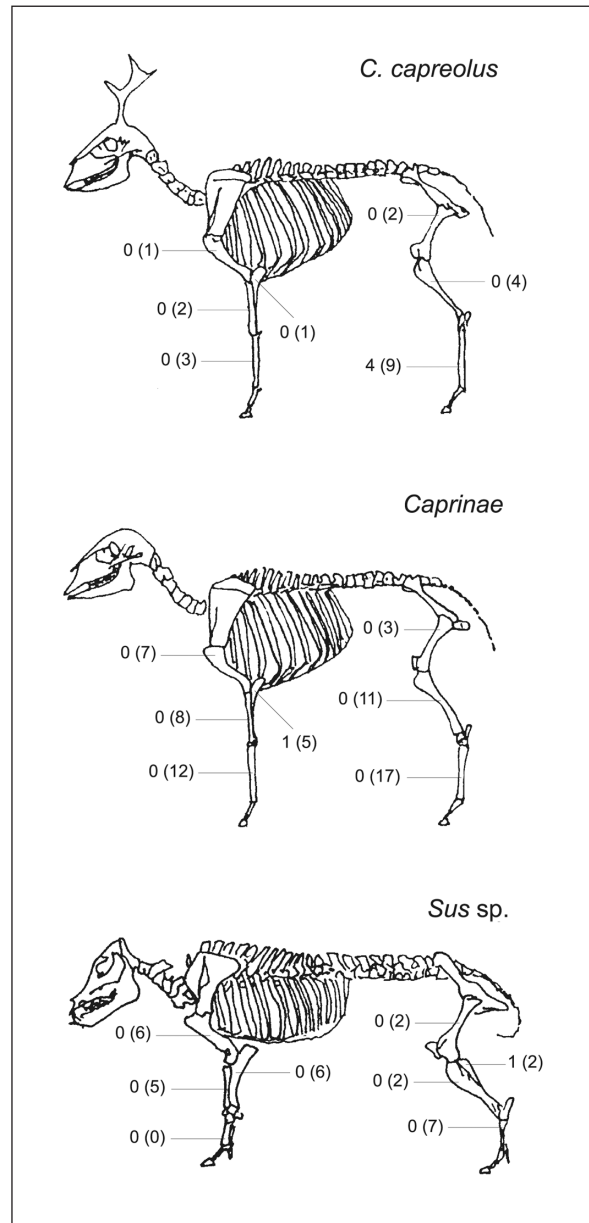
Sl. 14.31: Število obdelanih in neobdelanih (v oklepaju) kosti goveda in jelena z najdišča Stare gmajne.

Fig. 14.31: Number of worked and unworked (shown in brackets) cattle and red deer bones from Stare gmajne.



Sl. 14.32: Število obdelanih in neobdelanih (v oklepaju) kosti srne, drobnice in prašiča z najdišča Stare gmajne.

Fig. 14.32: Number of worked and unworked (shown in brackets) roe deer, ovicaprid and pig/wild boar bones from Stare gmajne.



ki imajo ohranjeno epifizo oz. obklepni del diafize, taki s še nezraščenenima epi- in diafizo le dve.<sup>33</sup>

Poleg strukturne trdnosti je na izbor surovine za izdelavo koščenega orodja vplivala tudi velikost kosti. Tako so bakrenodobni ljudje bodala praviloma izdelovali iz kosti velikih rastlinojedov (jelena, goveda), medtem ko med manjšimi šili prevladujejo ostanki srne in tudi drobnice. Prav tako je bila izdelovalcu pomembna oblika kosti. Kot je razvidno s slik 14.31 in 14.32, so namreč koliščarji s Starih gmajn<sup>34</sup> orodja izdelovali predvsem iz dlančnic/stopalnic in komolčnic. Slednje so bile zanimive zavoljo naravno priostrelega distalnega konca, tako da je bilo

epiphysis or periarticular part of diaphysis; only two of them have not been fused.<sup>33</sup>

Apart from structural strength, also size had an influence on the selection of raw materials for making bone tools. The Copper Age people were making daggers from bones of large herbivores (deer, cattle), while smaller awls were mostly made of remains of roe deer and ovicaprids. Shape of bone was also important. Dwellers from Stare gmajne<sup>34</sup> were mostly using metacarpals/metatarsals and ulnae, as seen on Figs. 14.31 and 14.32. The latter were interesting due to naturally pointed distal ends, which

epiphyses of metapodia fuse before birth (Silver 1972, 285 f).

<sup>33</sup> Cf. Bartosiewicz, Choyke 1997, 245.

<sup>34</sup> Similar can be seen in most of the other Eneolithic sites in the region. Apart from ulnae and metacarpals/metatarsals also ribs and scapulae were often used to manufacture tools.

<sup>33</sup> Prim. Bartosiewicz, Choyke 1997, 245.

<sup>34</sup> Podobno velja tudi za večino drugih eneolitskih najdišč v regiji. Poleg komolčnic in dlančnic/stopalnic so pri izdelovanju orodij razmeroma pogosto uporabljali tudi rebra in lopatice.



za izdelavo šila oz. bodala potrebno relativno malo dela. Tako tudi ne preseneča, da je bilo v orodja preoblikovanih kar polovica vseh na Starih gmajnah najdenih komolčnic jelena, srne, goveda in drobnice. Množična uporaba metapodijev cervidov – obdelanih je kar tretjina vseh najdenih primerkov – pa gre na rovaš njihove strukturne trdnosti<sup>35</sup> in razmeroma enostavnega klanja na uporabne odlomke.<sup>36</sup> Prav zavoljo slednjega je število v orodje preoblikovanih odlomkov stopalnic opazno večje od števila obdelanih odlomkov dlančnic (*sl. 14.31*); zaradi nekoliko bolj cilindrično oblikovane diafize je namreč stopalnico mogoče razklati na večje število uporabnih odlomkov kot dorzo-palmarno sploščeno dlančnico.<sup>37</sup>

Metapodiji in komolčnice niso bile edine kosti, ki so jih koliščarji z Ljubljanskega barja uporabljali kot surovino za izdelavo koščenenih orodij. Kot je mogoče razbrati s *slik 14.31* in *14.32*, so namreč v ta namen uporabljali tudi nekatere druge dolge kosti (npr. nadlahtnice, piščali), le da redkeje in manj sistematično. Sklepamo lahko, da so iz teh kosti izdelovali priložnostna orodja (orodja tipa 2 *sensu* Choyke 1982–1983, 17), medtem ko so bili metapodiji in komolčnice predmet načrtne, kompleksne obdelave s ciljem izdelati točno določene tipe orodij (orodja tipa 1 *sensu* Choyke 1982–1983, 17).<sup>38</sup> Enako nedvomno velja tudi za jelenja rogovja. Tudi iz slednjih so namreč izdelovali razmeroma ozek, specializiran nabor orodij, pa čeprav gre pri rogovjih za sicer zelo (najbolj?) pogosto uporabljano surovino. Njena priljubljenost je bila v bakreni dobi celo tako zelo velika, da je bil lov na jelene občasno bolj motiviran s pridobivanjem rogovij kot pa mesa in maščob.<sup>39</sup> Nekateri avtorji omenjajo celo prelov, do katerega naj bi (lokalno) prihajalo v določenih fazah bakrene dobe prav zavoljo velikih potreb po omenjeni surovini. V takih obdobjih je bil človek nato prisiljen povečati delež uplenjenih mlajših jelenov, katerih rogovje je za izdelavo orodij manj primerno, zato se je v teh obdobjih začasno povečala izdelava orodij iz kosti.<sup>40</sup> Sicer pa je človek rogovje vseskozi pridobival ne le z lovom, ampak tudi s pobiranjem v naravi naravno odpadlih primerkov. Ti so bili celo trdnjši in torej za obdelavo primernejši od tistih, ki so bili pridobljeni z uplenitvijo živali, če je do uplenitve prišlo pred koncem vsakoletnega ruka.<sup>41</sup> Ker so bili (pol)izdelki iz rogovij s Starih gmajn narejeni tako iz odpadlih primerkov kot tudi iz ostankov uplenjenih živali, lahko torej v luči zgoraj navedenega sklepamo, da se je človek v vasi zadrževal vsaj v obdobju zimskih in pomladnih mesecev.

Ob ogrlični cevki iz ptičje koščice predstavlja edini okrasni predmet s Starih gmajn in Blatne Brezovice podočnik psa s prevrtano korenino. Podobni obeski iz podočnikov velikih zveri so znani tudi z nekaterih

enabled much easier production of an awl or a dagger. It is thus not surprising that half of all red and roe deer, cattle and ovicaprid ulnae found at Stare gmajne, were transformed to tools. The reason for mass use of Cervidae metapodia – one third of all specimens found were worked – is their structural strength<sup>35</sup> and comparatively simple splitting to useful fragments.<sup>36</sup> Due to the latter, the number of fragments of metatarsals transformed to tools is noticeably larger as the number of worked metacarpals (*Fig. 14.31*); namely, because of slightly more cylindrically formed diaphysis, it is possible to split a metatarsal to greater number (i.e. four) of useful fragments in contrast to dorsal/palmar flattened metacarpal.<sup>37</sup>

Metapodia and ulnae were not the only bones that pile-dwellers from the Ljubljansko barje used as raw materials for making tools. They also used some of the other longbones (e.g. humerus, fibula), as seen on *Figs. 14.31* and *14.32*, but they were used more rarely/less systematically. We can assume that they were making “occasional tools” from these bones (tool type 2 after Choyke 1982–1983, 17), while the metapodia and ulnae were bones that were manufactured with planned, complex treatment with a goal to make a precisely chosen type of tool (tool type 1 after Choyke 1982–1983, 17).<sup>38</sup> Same applies to deer antlers. Namely, pile-dwellers from Ljubljansko barje were making comparatively small, specialized set of tools out of them, even though antler was (the most?) often used raw material. Antler was such a desirable material during the Copper Age that deer hunt was occasionally more motivated with gaining antlers as opposed to meat and fat.<sup>39</sup> Some scholars even assume the animals were over hunt at times, which would occur (locally) in certain phases of the Copper Age due to large demand for antler. In such periods, the amount of hunted young red deer increased. However, antlers of young deer are less appropriate for tool making and that is why the number of bone-made tools temporarily increased in these periods.<sup>40</sup> Apart from those obtained by hunting, people were also collecting shed antlers. These were more solid and therefore more suitable for processing as the ones gained through hunting whenever the animal was caught before the annual trot was finished.<sup>41</sup> Antler (part-finished) products found at Stare gmajne were made of shed as well as butchered antlers. Based on the discussion above, we can thus assume that people lived in the pile-dwelling at least during winter and spring months.

Apart from a small necklace tube made of bird bone, the only decorative item from Stare gmajne and Blatna Brezovica was dog canine with drilled root. Analogous

<sup>35</sup> Russell 2001, 272.

<sup>36</sup> Prim. Christidou 2001.

<sup>37</sup> Bartosiewicz, Choyke 1997, 247.

<sup>38</sup> Glej tudi Christidou 2001, 41.

<sup>39</sup> Choyke 1982–1983, 35.

<sup>40</sup> Schibler 2001, 83.

<sup>41</sup> Choyke 1982–1983, 34.

<sup>35</sup> Russell 2001, 272.

<sup>36</sup> Cf. Christidou 2001.

<sup>37</sup> Bartosiewicz, Choyke 1997, 247.

<sup>38</sup> See also Christidou 2001, 41.

<sup>39</sup> Choyke 1982–1983, 35.

<sup>40</sup> Schibler 2001, 83.

<sup>41</sup> Choyke 1982–1983, 34.

drugih koliščarskih naselbin z Ljubljanskega barja.<sup>42</sup> Poleg obeskov iz pasjih podočnikov so izdelovali te tudi iz podočnikov divjega prašiča, volka in medveda. Zaradi navedenega nekateri avtorji v takšnih predmetih prepoznavajo simbole lovnih sposobnosti nositelja ali celo njegov socialni status.<sup>43</sup> Če je to res tako, potem bi lahko bil obesek iz podočnika psa, ki je udomačena žival, neke vrste nadomestek obeska iz domnevno bolj cenjenih podočnikov lovnih vrst (npr. medveda, volka). Znano je namreč, da eneolitskemu človeku izdelovanje imitacij težko pridobljivih predmetov ni bilo tuje.<sup>44</sup>

### 14.3 PORAZDELITEV NAJDB V PROSTORU

Na območju najdišča Stare gmajne je bilo v letih 2002 in 2003 pregledanih 15 drenažnih jarkov, vendar so bili ostanki kolov bakrenodobnih kolib odkriti le v osmih izmed njih (*sl. 14.1*). Arheološko pozitivne jarke je mogoče razdeliti v dve skupini,<sup>45</sup> med katerima je vrzel v dolžini približno 120 metrov. Razpoložljivi podatki kažejo, da sta oba dela kolišča v grobem bolj ali manj sočasna,<sup>46</sup> da pa obstajajo med njima prepoznavne razlike v spektru tam izvajanih aktivnosti. Tako je bilo npr. v jarku 13 in ob njem ležeči sondi 3 odkritih več z metalurško dejavnostjo povezanih najdb, medtem ko te iz jarkov 1–6 in ob njih ležečih sond 1 in 2 niso znane.<sup>47</sup> Heterogeno porazdelitev v prostoru izkazujejo tudi favnistične najdbe. Tako število določenih ostankov velikih sesalcev na posameznem drenažni jarek niha med 31 in 296 (Me = 50), odstopanja med posameznimi jarki pa so precejšnja tudi po številu vseh (tj. določenih in nedoločenih) najdenih sesalskih kosti in zob (Me = 143; razpon: 89–762).<sup>48</sup>

Kaj pa porazdelitev artefaktov iz kosti in rogovij? Projekcija položaja posameznega orodja *in situ* na načrt pregledanih drenažnih jarkov pokaže, da jih večina izvira iz jarka 1 ter jarkov 12 in 13 (*sl. 14.1*). Pri tem jarek 1 izstopa tudi po največjem številu vseh v njem najdenih favnističnih ostankov (NISP = 296), medtem ko v primeru ostalih drenažnih jarkov o podobni soodvisnosti med številom najdenih orodij in številom vseh najdenih sesalskih kosti in zob ni mogoče govoriti (*sl. 14.33*). Korelacija med omenjenima količinama namreč sploh ni statistično

pendants, made of canines of large carnivores, have also been found at the other pile-dwelling settlements at the Ljubljansko barje.<sup>42</sup> Apart from dog canines, pendants were also made of wild boar, wolf and bear canines. This is the reason for some scholars to recognise symbols of hunting abilities of their wearers in such objects, or even their social status.<sup>43</sup> If this is the case, pendant from a canine dog, which is domesticated animal, could be a substitute of some kind, perhaps of allegedly more appreciated canines belonging to wild animals (e.g. bear, wolf). It is known, that the Copper Age man was making imitations of hard-to-get objects.<sup>44</sup>

### 14.3 DISTRIBUTION OF FINDS

Fifteen irrigation ditches were examined in the area of the excavation site Stare gmajne in 2002 and 2003; remains of piles of the Copper Age houses were discovered in eight of them (*Fig. 14.1*). It is possible to divide archaeologically positive ditches in two groups,<sup>45</sup> laying 120 metres apart. Available data show that both (parts of a) pile-dwelling(s) are more or less contemporary,<sup>46</sup> however, there are recognizable differences in spectrum of activities performed within each of them. For example, many finds connected to metallurgic activity were found in ditch 13 and its adjacent trench 3, while they are completely absent from ditches 1–6 and its adjacent trenches 1 and 2.<sup>47</sup> Faunal remains are also showing heterogeneous distribution; the number of particular remains of large mammals within individual drainage ditch varies between 31 and 296 (Me = 50), while discrepancies between individual ditches are considerable also in the total amount (i.e. identified and unidentified) of mammalian bones and teeth found (Me = 143; span: 89–762).<sup>48</sup>

What about spatial distribution of bone and antler artefacts? Projection of positions of individual tools *in situ* to the plan of examined irrigation ditches shows, that the majority of tools originates from ditch 1 and ditches 12 and 13 (*Fig. 14.1*). Nevertheless, while ditch 1 also contains the largest number of all faunal remains found (NISP = 296), it is impossible to show a relationship between the number of tools and the number of mammalian bones and teeth (*Fig. 14.33*) found in the

<sup>42</sup> Korošec, Korošec 1969, t. 87: 2–8; Bregant 1975, t. 8: 9; 12: 4,6; Harej 1976, t. 5: 7; Velušček 2004b, 46.

<sup>43</sup> Choyke 1982–1983, 32.

<sup>44</sup> Npr. Choyke 2001.

<sup>45</sup> Prvo skupino tvorijo jarki 1–6, drugo pa jarka 12 in 13 (*sl. 14.1*).

<sup>46</sup> Manjše število dendrokronološko datiranih vzorcev sicer nakazuje, da je na območju Starih gmajin – poleg intenzivne poselitve večje površine (jarki 1–6 in 12, 13 ter sondi 1 in 2) v času okrog 3150 let pr. Kr., ki je trajala skoraj 60 let – obstajala še neka do približno 170 let starejša, prostorsko omejena naselbina oz. gruča posameznih stavb (glej poglavje 7 v tem zborniku).

<sup>47</sup> Velušček 2008b in poglavje 1.2.1.1 v tem zborniku.

<sup>48</sup> Toškan, Dirjec, v pripravi.

<sup>42</sup> Korošec, Korošec 1969, Pl. 87: 2–8; Bregant 1975, Pls. 8: 9; 12: 4,6; Harej 1976, Pl. 5: 7; Velušček 2004b, 45.

<sup>43</sup> Choyke 1982–1983, 32.

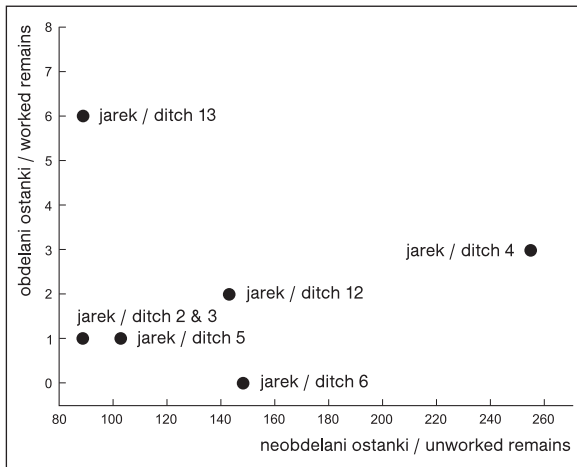
<sup>44</sup> E.g. Choyke 2001.

<sup>45</sup> Group 1: ditches 1–6, group 2: ditches 12 and 13 (*Fig. 14.1*).

<sup>46</sup> Some dendrochronologically dated samples indicate that, in the area of Stare gmajne – prior to extensive settlement area (ditches 1–6 and 12, 13 and trenches 1 and 2), lasting almost 60 years in c. 3150 BC – another c. 170 years older, smaller settlement/cluster of individual buildings existed (see Chapter 7 in this monograph).

<sup>47</sup> Velušček 2008b and Chapter 1.2.1.1 in this monograph.

<sup>48</sup> Toškan, Dirjec, in prep.



Sl. 14.33: Grafični prikaz odnosa med številom neobdelanih določljivih ostanke velikih sesalcev in številom obdelanih sesalskih ostanke iz posameznega drenažnega jarka na najdišču Stare gmajne. Podatki za jarek 1 (obdelani ostanke: N = 11; neobdelani ostanke: N = 296) niso prikazani.

Fig. 14.33: Graphic display of correlation between the number of taxonomically determined unworked remains of large mammals and the number of worked mammalian remains from individual irrigation ditches from Stare gmajne. Data for ditch 1 (worked remains: N = 11; unworked remains: N = 296) not shown.

značilna ( $p = 0,515$ ), tudi sicer pa je korelacijski koeficient razmeroma nizek (Spearmanov  $R = 0,27$ ). V pogostosti najdb orodij iz kosti in rogovij na posamezen jarek, tj. na posamezen del najdišča, torej odsevajo (tudi) dejavniki, ki so neodvisni od velikosti favnističnega vzorca kot takega. Drugače povedano: število artefaktov v npr. jarkih 12 in 13 ni nadpovprečno visoko (samo) zato, ker bi bilo v teh dveh jarkih pač nasploh najdenih več sesalskih kosti. Podobno tudi število orodij v npr. jarku 3 ni majhno (le) zato, ker bi bilo v tem jarku tudi sicer najdenih relativno pičlo število favnističnih ostanke.

Zgornjo ugotovitev še podkrepnjujejo podatki iz tabele 14.5. Čeprav je bila namreč površina sondažnega polja pri sondi 2 povsem enaka kot pri sondi 3, tj.  $15 \text{ m}^2$ , je bilo namreč v prvi najdenih bistveno več obdelanih kosti in rogovij. Pri tem velja poudariti, da so razlike le kvantitativne narave, tj. razlika je le v številu najdb. Če namreč obe sondi (pa tudi oba jarka, ob katerih sondi ležita) primerjamo po deležu posameznih taksonov velikih sesalcev v tam najdenem gradivu obdelanih oz. neobdelanih kosti, omembe vrednih razlik ni zaznati (tab. 14.5 in 14.6). Glede na sočasnost obeh delov naselbine to pravzaprav niti ni presenetljivo, saj so razlike v izboru surovin za izdelavo orodij iz živalskih ostanke v okviru iste skupnosti, celo iste kulture, praviloma zanemarljive. Odločitev o tem, katera živalska vrsta in kateri skeletni element je najprimernejši za izdelavo posameznega orodja oz. okraska, je bila namreč v prazgodovini tesno povezana s tradicijo posamezne skupnosti in se s časom ni veliko spreminjala.<sup>49</sup>

<sup>49</sup> Choyke 1982–1983, 31 s; Bartosiewicz, Choyke 1997, 248 s.

Tab. 14.5: Število obdelanih ostanke posameznih taksonov velikih sesalcev v gradivu iz sond 2 in 3 s Starih gmajn.

Tab. 14.5: Number of worked remains of individual taxa of large mammals in assemblage from trenches 2 and 3 from Stare gmajne.

Takson Taxon	Sonda 2 Trench 2	Sonda 3 Trench 3
<i>C. elaphus</i>	7 (3*)	5 (4*)
<i>C. capreolus</i>	1	3
<i>S. scrofa</i>	2	–
<i>B. taurus</i>	2	–
indet. species	11	4
<b>SKUPAJ / TOTAL</b>	<b>23</b>	<b>12</b>

\* Število obdelanih odlomkov rogovij. /Number of worked antler fragments.

case of other irrigation ditches. Correlation between the amounts mentioned is not statistically significant ( $p = 0,515$ ), correlation ratio being comparatively low in general (Spearman's  $R = 0,27$ ). Amount of bone and antler tools within individual ditch, i.e. particular part of the site, (also) reflects factors, independent from the size of the faunal sample as such. In other words: amount of artefacts in, for example, ditches 12 and 13, is not higher as the average (just) because we would generally find more mammalian bones in these two ditches. Similarly, the number of tools found in ditch 3, for example, is not small (only) because we would find relatively scarce number of faunal remains in this ditch.

The findings above are further supported by data from Tab. 14.5. Although the surface of trench 2 was the same size as trench 3, i.e.  $15 \text{ m}^2$ , elementarily more worked bones and antlers were found in the first. It has to be emphasized that differences are only of a quantitative nature, i.e. only the number of finds is different. Namely, if we compare shares of individual taxa of worked or unworked large mammal bones in material from both trenches (and both adjacent ditches), there is no noteworthy differences (Tabs. 14.5 and 14.6). This is not astonishing, considering that both parts of settlements were contemporary, as differences in selection of raw materials for tool-making from animal remains inside the same community, even inside the same culture, are negligible. In prehistory the decision about which animal species and which anatomical part is the most suitable for making an individual tool or ornament, was closely connected with tradition of individual community and did not change much in time.<sup>49</sup>

<sup>49</sup> Choyke 1982–1983, 31 f; Bartosiewicz, Choyke 1997, 248 f.

Tab. 14.6: Število neobdelanih ostankov posameznih taksonov velikih sesalcev v gradivu iz jarka 1 oz. jarkov 12 in 13 s Starih gmajn v primerjavi z zastopanostjo istih taksonov v vzorcu obdelanih ostankov iz istih jarkov. Podatki o deležu zastopanosti posameznih taksonov so povzeti po Toškan, Dirjec (v pripravi).

Tab. 14.6: Number of unworked remains of individual taxa of large mammals in assemblage from ditch 1 and ditches 12 and 13 from Stare gmajne in comparison to the share of the same taxa in the sample of worked remains from the same ditches. Data on the share of individual taxa after Toškan, Dirjec (in prep.).

Takson Taxon	Jarek 1 / Ditch 1			Jarka 12 in 13 / Ditches 12 & 13		
	NISP	% NISP	N <sub>obdelani / worked</sub>	NISP	% NISP	N <sub>obdelani / worked</sub>
<i>C. elaphus</i>	95	32,1	6	28	34,6	3
<i>C. capreolus</i>	20	6,8	–	8	9,9	–
<i>Sus</i> sp.	49	16,6	3	11	13,6	1
<i>B. taurus</i>	33	11,1	–	2	2,5	–
Caprinae	85	28,7	1	21	25,9	–
<i>C. familiaris</i>	9	3,0	–	5	6,2	1
Ostalo/Other	5	1,7	–	6	7,4	–
<b>SKUPAJ / TOTAL</b>	296	100	10	81	100	5
indet. species	466	–	1	153	–	2
<b>SKUPAJ / TOTAL</b>	762	–	11 (= 1,4 %)	234	–	7 (= 3,0 %)

#### 14.4 SKLEP

Seznam orodij iz kosti, rogovij in zob s Starih gmajn in Blatne Brezovice zadosti pričakovanjem tako v smislu zastopanosti sesalskih vrst oz. skeletnih elementov kot tudi tipov orodij. Kot surovino so namreč koliščarji preferenčno uporabljali kosti lovnih živali (predvsem komolčnice ter dlančnice/stopalnice), tipološko pa je bila večina izdelkov opredeljena kot šilo oz. bodalo (*sensu* Korošec, Korošec 1969). Skladno s pričakovanji je tudi razmeroma veliko število (pol)izdelkov iz rogovij, saj so bila ta v prazgodovini zelo cenjena surovina.

Analiza porazdelitve orodij v prostoru je v primeru kolišča Stare gmajne pokazala na razlike v bogastvu najdb med posameznimi deli najdišča. V zvezi s tem velja ponoviti, da število obdelanih živalskih ostankov v določenem jarku/sondi ni neposredno odvisno od števila vseh živalskih ostankov v istem jarku/sondi, ampak v njem odsevajo tudi od velikosti favnističnega vzorca neodvisni dejavniki.<sup>50</sup> Tako bi lahko bila heterogena porazdelitev orodij iz živalskih ostankov v prostoru posledica neenakomerne gostote naseljenosti kolišča<sup>51</sup> ali pa neenakega socialnega statusa njegovih prebivalcev.<sup>52</sup> Sicer zelo verjetne razlike v spektru dejavnosti, ki naj

#### 14.4 CONCLUSION

Repertoire of bone, teeth and antler tools from Stare gmajne and Blatna Brezovica reaches our expectations in the share of mammalian species or anatomical parts, as well as in types of tools. Dwellers preferentially used bones of wild animals (mostly ulnae and metacarpals/metatarsals) as raw materials. The majority of objects were typologically determined as awls or daggers<sup>50</sup>. As expected, there is also comparatively large number of antler tools/part-finished tools; antler was very much appreciated raw material in prehistory.

Analysis of distribution of tools at Stare gmajne revealed differences in the amount of finds between individual parts of the site. We must, again, emphasize that the number of worked animal remains within particular ditch/trench is not directly dependent on the number of all animal remains within the same ditch/trench, but also of factors that are independent of the amount of faunal sample within.<sup>51</sup> Heterogeneous spatial distribution of bone and antler tools could therefore be a consequence of uneven density of settlement within the pile-dwelling<sup>52</sup> or of unequal social status of its inhabitants.<sup>53</sup> Otherwise very probable differences in spectrum of activity

<sup>50</sup> Moteč vpliv neoptimalnega načina vzorčenja najdb pri pregledovanju dreznih jarkov naj pri tem ne bi bil odločilen. Razlike v številu orodij iz živalskih ostankov so bile namreč ugotovljene tudi ob primerjavi gradiva iz obeh sond, čeprav je bila njuna površina enaka, izkopani sediment pa v celoti spran skozi sita (tab. 14.5).

<sup>51</sup> Glej npr. Velušček, Čufar, Levanič 2000, sl. 8.

<sup>52</sup> Glej npr. Marciniak (2003) in Marti-Grädel et al. (2003).

<sup>50</sup> After Korošec, Korošec 1969

<sup>51</sup> Suboptimal sampling of finds at the examination of irrigation ditches should not be important here. Differences in the amount of tools made of animal bones were obvious also at the comparison of the material from both trenches; although the areas examined were identical and all of excavated sediments were sieved (Tab. 14.5).

<sup>52</sup> See e.g. Velušček, Čufar, Levanič 2000, Fig. 8.

<sup>53</sup> See e.g. Marciniak (2003) and Marti-Grädel et al. (2003).



bi jih koliščarji opravljali v različnih delih vasi,<sup>53</sup> naj v tem smislu ne bi igrale odločilne vloge. Tipološko se namreč izkopano orodje iz kosti in rogovij z vzhodnega dela najdišča ne razlikuje od tistega, ki izvira z njegovega zahodnega dela (*tab. 14.7*). Lokalno opravljanje specializiranih dejavnosti ne odseva niti v različnem deležu zastopanosti standardiziranih orodij (tj. orodij tipa 1 *sensu* Choyke 1982–1983, 17) na obeh delih najdišča.<sup>54</sup> Omembe vrednih razlik v izboru živalskih vrst oz. skeletnih elementov kot surovine za izdelavo orodij med vzhodnim in zahodnim delom Starih gmajn namreč ni zaznati (*tab. 14.5* in *14.6*).

Naj se ob koncu za hip ustavim še pri dveh zanimivostih: gre za ostanek ožganega koščene orodja iz sonde 2 (kv. 1, reženj 5; *sl. 14.34*) in pa obdelanega paročka jelenjega rogovja s sledmi glodanja malih sesalcev iz jarka 12 (odsek 27; *sl. 14.15*). Prvo orodje je ohranjeno v več odlomkih, ki pa so bili najdeni blizu skupaj. Izdelka sicer ni mogoče sestaviti v celoti, saj manjka drobec osrednjega dela, sta pa bila med terenskim raziskovanjem najdena tako njegov bazalni kot tudi terminalni konec. Iz tega izhaja, da je bilo orodje še nepoškodovano izpostavljeno ognju in da je do fragmentiranosti prišlo postsedimentno. V isto smer kaže tudi dejstvo, da je kompakta diafiznega dela kosti ožgana le na površini, tj. na obodu, čeprav je bila sicer na mestu loma neposredno izpostavljena zunanjim dejavnikom tudi njena "sredica". Ker ni pričakovati, da bi prebivalci Starih gmajn nepoškodovano orodje na ogenj odvrgli zavestno, se zdi njegovo ožganost smiselneje razložiti z nenamerno izpostavljenostjo močnemu viru toplote, kakršnega bi lahko predstavljal požar.<sup>55</sup>

Najdba orodja iz rogovja s sledmi glodanja malih sesalcev je zanimiva iz drugega razloga: nakazuje namreč možnost, da je bil poškodovan in torej domnevno ne več uporaben izdelek zavržen na kopnem. Če bi namreč koliščarji orodje odvrgli v jezero, to ne bi bilo dostopno malim sesalcem in ga ti tudi ne bi mogli oglodati. Obravnavani predmet je bil najden na zahodnem delu najdišča (v jarku 12, odsek 27), ki je bilo, tako lahko sklepamo iz tega, morda (vsaj delno) postavljeno na trdnih tleh. Je pa treba ob tem vendarle opozoriti tudi na možnost, da bi lahko do oglodanja rogovja prišlo že pred samo izdelavo orodja.<sup>56</sup> Kot že navedeno, so namreč koliščarji s Starih

<sup>53</sup> Tako naj bi bila metalurška dejavnost morda omejena na zahodni del najdišča (ali pa naj bi bila tam vsaj intenzivnejša), saj vse z metalurgijo povezane najdbe izhajajo iz jarka 13 in ob njem ležeče sonde 3 (glej Velušček 2008b in poglavje 1.2.1.1 v tem zborniku). Zanimiva je tudi ugotovitev, da je število sesalskih kosti in zob na zahodnem delu najdišča očitno manjše od števila tam najdenih ptičjih ostankov (F. Janžekovič, osebna komunikacija), medtem ko je stanje na vzhodnem delu obratno.

<sup>54</sup> Prim. Choyke 1982–1983, 35.

<sup>55</sup> Glej poglavji 3.1.2.2 in 3.3 v tem zborniku: *sl. 3.9*.

<sup>56</sup> V to smer kažejo sedimentološke analize profilov z obravnavanega najdišča, ki za časa odlaganja kulturne plasti na zahodnem delu Starih gmajn nakazujejo zamočvirjeno sedimentacijsko okolje (glej poglavje 2 v tem zborniku).

that dwellers would be perform in different parts of the pile-dwelling,<sup>54</sup> should not play a major role here. To be precise, bone and antler tools found in eastern part of the site do typologically not differ from the ones from the western part (*Tab. 14.7*). Furthermore, localisation of specialized activities is not reflected in different share of standardised tools (i.e. tools of type 1 after Choyke 1982–1983, 17) inside both parts of the site.<sup>55</sup> Namely, there are no noteworthy differences in selection of animal species or anatomical parts as raw materials for making tools between eastern and western part of Stare gmajne (*Tabs. 14.5* and *14.6*).

To finish, let me draw attention to two interesting objects: the first one being fragment of a burned bone tool from trench 2 (quadrant 1, section 5; *Fig. 14.34*) and the second one worked red deer tine with traces of gnawing of small mammals from ditch 12 (section 27; *Fig. 14.15*). The first one is fragmented with fragments found in the proximity to one another. It is not possible to assemble the whole object as a fragment of the central part is missing, but we have found its basal as well as its terminal end. Consequently, we can claim that the tool was exposed to fire undamaged and that destruction occurred post-sedimentary. Moreover, the compact bone tissue on diaphysis was only burned on the surface, i.e. on rim, although its "core" would have been exposed to outside factors (i.e. fire) if broken in half. It cannot be expected that inhabitants of Stare gmajne would have thrown an undamaged tool into fire deliberately; it appears that burns on it could be explained with unintentional exposure to powerful source of warmth, e.g. conflagration.<sup>56</sup>

Antler tool with traces of gnawing of small mammals is interesting for a different reason: namely, it indicates that the damaged and therefore useless tool might have been thrown away on dry land. If the dwellers had thrown the tool to the lake, it would have not been accessible to small mammals and they could not gnaw on it. The object studied was found on the western part of the site (i.e. ditch 12, section 27), which was perhaps, at least partially, solid ground. However, it is necessary to stress out a possibility that gnawing of antler could have happened before the tool was made.<sup>57</sup> As mentioned above, the dwellers from Stare gmajne, as their contemporaries

<sup>54</sup> Metalurgical activity was perhaps restricted (or more intense) to the western part of the site, as all metalurgically connected finds from ditch 13 and its adjacent trench 3 (see Velušček 2008b and Chapters 1.2.1.1 in this monograph). Interestingly, also the number of mammalian bones and teeth found in the western side of the site is obviously smaller as the number of bird-bones found in the same area (F. Janžekovič, pers. comm.), while the opposite is true for the eastern part.

<sup>55</sup> Cf. Choyke 1982–1983, 35.

<sup>56</sup> See Chapters 3.1.2.2 and 3.3 in this monograph: *Fig. 3.9*.

<sup>57</sup> Sedimentological analyses of profiles from the site studied indicate marshy sedimental environment at the time when the cultural layer was depositing on the western part of Stare gmajne (see Chapter 2 in this monograph).



gmajn tako kot tudi njihovi sodobniki drugje po Evropi orodja izdelovali tudi iz v naravi pobranih naravno odpadlih rogovij,<sup>57</sup> ki so bila kot taka vsaj neko omejeno obdobje pač "na razpolago" malim sesalcem. Same sledi, ki bi jih z glodanjem na površini kompakte pustili mali sesalci, namreč na trdnost in torej uporabnost rogovja niso imele omembe vrednega vpliva. Glede na dragocenost navedene surovine pa seveda ni pričakovati, da bi človek morebiten obglodani primerek zavrgel izključno iz "estetskih" razlogov.

#### Zahvala

Zahvaljujem se Janezu Dirjecu, ki je med pregledovanjem presejanega sedimenta odbral tudi artefakte iz živalskih ostan-kov. Dr. Anton Velušček je kritično komentiral prvo verzijo besedila. Pri pripravi grafičnega gradiva sta sodelovali Tamara Korošec in Mateja Belak.

## 14.5 KATALOG NAJDB / CATALOGUE OF FINDS

### 14.5.1 STARE GMAJNE

#### 14.5.1.1 OBDELANE KOSTI IN ZOBJE

1. Bodalo(?) iz odlomka proksimalne epifize in diafize stopalnice srne; terminalni del orodja je odlomljen; ohr. d. 9,5 cm; š. 1,9 cm;<sup>58</sup> mikrolokacija: sonda 3, 1. reženj (humus); *sl. 14.8.*

2. Bodalo iz odlomka diafize stopalnice jelena; terminalni del orodja je odlomljen; ohr. d. 23,2 cm; š. 2,3 cm; mikrolokacija: jarek 13, odsek 37.

3. Bodalo iz komolčnice domačega goveda; kljunasti odrastek (*olecranon*) manjka; ohr. d. 16,0 cm; š. 4,9 cm; mikrolokacija: sonda 2, kv. 14, 5. reženj; *sl. 14.2.*

4. Šilo iz odlomka diafize dolge cevaste kosti nedoločene živali; ohranjena je le konica; ohr. d. 2,6 cm; š. 0,7; mikrolokacija: sonda 2, kv. 4, 3. reženj.

5. Šilo iz odlomka diafize nedoločene živali; konica je odlomljena; ohr. d. 1,6 cm; š. 0,4 cm; mikrolokacija: sonda 2, kv. 6, 4. reženj.

6. Šilo (sveder *sensu* Bregant 1975, t. 7: 10) iz odlomka diafize dolge kosti nedoločene živali; ohr. d. 4,2 cm; š. 0,7 cm; mikrolokacija: sonda 2, kv. 2, 6. reženj.

7. Bodalo iz odlomka dolge kosti nedoločene živali (verjetno gre za komolčnico jelena); ohranjena je le konica; ohr. d. 3,6 cm; š. 1,5 cm; mikrolokacija: sonda 2, kv. 2, 4. reženj.

8. Šilo iz odlomka diafize dolge kosti nedoločene živali; ohranjena je le konica, ki je ožgana; ohr. d. 1,6 cm; š. 0,6 cm; mikrolokacija: sonda 2, kv. 14, 5. reženj.

9. Šilo (igla?) iz odlomka diafize kosti nedoločene živali; ohranjena je le konica; ohr. d. 2,2 cm; š. 0,3 cm; mikrolokacija: sonda 2, kv. 1, 4. reženj.

10. Šilo iz odlomka diafize dolge cevaste kosti nedoločene živali; ohranjena je le konica; ohr. d. 3,3 cm; š. 0,8 cm; mikrolokacija: sonda 2, kv. 7, 4. reženj.

<sup>57</sup> Ker je bilo obravnavano orodje izdelano iz parožka, žal ni mogoče oceniti, ali je bilo pri tem uporabljeno rogovje uplenjene živali ali pa nemara naravno odpadel primerek.

<sup>58</sup> Definicija merjenih dimenzij kot dolžina in širina je pogojna, saj izbrani osi ne odražata nujno anatomske orientacije merjene kosti.

*Tab. 14.7:* Tipološka klasifikacija orodij iz kosti in rogovij z dveh predelov najdišča Stare gmajne: cona A (obsega jarke 1–6 in ob njih ležečo sondo 2) ter cona B (obsega jarka 12 in 13 ter ob njiju ležečo sondo 3). Skupina "ostalo" vključuje tudi polizdelke. Pri tipološki klasifikaciji sem sledil smernicam, ki sta jih objavila P. in J. Korošec (1969).

*Tab. 14.7:* Typological classification of bone and antler tools from two parts of Stare gmajne: zone A (comprises ditches 1–6 and adjacent trench 2) and zone B (comprises of ditch 12 and 13 and adjacent trench 3). The category "other" also includes part-finished products. The typological classification follows guidelines published by P. and J. Korošec (1969).

Orodje Tool	Cona A Zone A	Cona B Zone B
Šilo / Awl	17	10
Bodalo / Dagger	9	2
Gladilo / Polisher	1	–
Sekira / Axe	} 5	} 5
Dleto / Chisel		
Okrasek / Ornament	0	2
Ostalo / Rest	9	1



*Sl. 14.34:* Ožgan koščeni artefakt s Starih gmajn (mikrolokacija: sonda 2, kv. 1, 5. reženj). Foto: M. Zaplatil.

*Fig. 14.34:* Burned bone artefact from Stare gmajne (micro-location: trench 2, quadrant 1, deepening 5). Photo: M. Zaplatil.

elsewhere in Europe, made tools also from naturally shed antler,<sup>58</sup> that were, at least for a limited period, "available" to small mammals. Traces left on the surface of the compact bone tissue with gnawing of small mammals, did not have an impact on strength and usability of antlers. Considering antler as valuable raw material, we can of course not expect that one would throw away gnawed specimen solely for "aesthetic" reasons.

<sup>58</sup> As the tool was tine-made, it is unfortunately not possible to assess if the antler was cut-off or shed.

11. Orodje iz odlomka lopatice jelena; sprednji rob (*margo cervicalis*) je od grče lopatičnega trna (*tuber scapulae*) distalno v vsej ohranjeni dolžini poudarjeno zglajen; ohr. d. 12,8 cm; š. 5,2 cm; mikrolokacija: jarek 4, odsek 42.

12. Šilo (igla?) iz odlomka diafize kosti nedoločene živali; bazalni in terminalni del orodja sta odlomljena; ohr. d. 2,6 cm; š. 0,5 cm; mikrolokacija: sonda 2, kv. 5, 4. reženj.

13. Orodje iz odlomka spodnjega podočnika divjega prašiča; ohr. d. 9,7 cm; š. 1,4 cm; mikrolokacija: sonda 2, kv. 6, 4. reženj; *sl. 14.24.*

14. Šilo (sveder *sensu* Bregant 1975, t. 7: 10) iz odlomka diafize kosti nedoločene živali; ohranjena je le konica; ohr. d. 2,5 cm; š. 0,4 cm; mikrolokacija: sonda 2, kv. 3, 4. reženj.

15. Šilo iz epifize in diafize dolge kosti specifično nedoločene ptice; ohr. d. 11,2 cm; š. 10,3 cm; mikrolokacija: sonda 2, najdeno med čiščenjem zahodnega profila.

16. Bodalo iz odlomka obsklepnega dela epifize dlančnice domačega goveda; bazalni del orodja je odlomljen; ohr. d. 8,6 cm; š. 2,4 cm; mikrolokacija: sonda 2, kv. 12, 3. reženj.

17. Orodje (šilo?) iz odlomka diafize dolge cevaste kosti nedoločene živali; terminalni in bazalni del orodja sta odlomljena; ohr. d. 1,3 cm; š. 0,7 cm; mikrolokacija: sonda 2, kv. 6, 3. reženj.

18. Šilo iz odlomka diafize dolge kosti specifično nedoločene ptice; bazalni del orodja je odlomljen; ohr. d. 13,8 cm; š. 1,1 cm; mikrolokacija: sonda 3, kv. 5, 8. reženj.

19. Šilo ali bodalo iz odlomka diafize dlančnice/stopalnice jelena; bazalni del orodja je odlomljen; ohr. d. 13,6 cm; š. 1,4 cm; mikrolokacija: sonda 3, kv. 3, 6. reženj.

20. Obesek iz zgornjega podočnika psa (odprtina za obešanje je zvrtna v bazalni del korenine); ohr. d. 3,7 cm; š. 0,9 cm; mikrolokacija: jarek 13, odsek 30; *sl. 14.22.*

21. Šilo iz odlomka distalne epifize in diafize stopalnice do poldrugega leta<sup>59</sup> stare srne; ohr. d. 3,6 cm; š. 1,0 cm; mikrolokacija: sonda 3, kv. 11, 5. reženj.

22. Šilo iz odlomka proksimalne epifize in diafize stopalnice jelena; ohr. d. 15,0 cm; š. 2,4 cm; mikrolokacija: sonda 2, kv. 8, 5. reženj; *sl. 14.12.*

23. Bodalo iz odlomka obsklepnega dela diafize dolge cevaste kosti nedoločene živali; bazalni del orodja je odlomljen; ohr. d. 8,4 cm; š. 2,2 cm; mikrolokacija: sonda 2, kv. 3, 5. reženj; *sl. 14.6.*

24. Bodalo iz odlomka proksimalne epifize in diafize stopalnice jelena; ohr. d. 15,3 cm; š. 2,7; mikrolokacija: sonda 2, kv. 6, 5. reženj.

25. Šilo iz odlomka proksimalne epifize in diafize dlančnice jelena; ohr. d. 12,8 cm; š. 2,2 cm; mikrolokacija: jarek 13, odsek 23–24; *sl. 14.9.*

26. Bodalo iz odlomka diafize komolčnice jelena; bazalni del orodja je odlomljen; ohr. d. 11,9 cm; š. 4,9 cm; mikrolokacija: jarek 1, odsek 126; *sl. 14.3.*

27. Šilo iz odlomka diafize dolge cevaste kosti nedoločene živali; bazalni del orodja je odlomljen; ohr. d. 6,7 cm; š. 0,7 cm; mikrolokacija: sonda 3, kv. 6, 6. reženj.

28. Bodalo iz komolčnice do poltretjega leta<sup>60</sup> stare ovce; ohr. d. 7,4 cm; š. 2,3 cm; mikrolokacija: jarek 1, odsek 129; *sl. 14.4.*

29. Šilo iz odlomka diafize dolge cevaste kosti nedoločene živali; bazalni del orodja je odlomljen; ohr. d. 6,9 cm; š. 0,8 cm; mikrolokacija: njive vzhodno od jarka 4; *sl. 14.5.*

30. Orodje iz odlomka spodnjega podočnika divjega prašiča; ohr. d. 9,2 cm; š. 2,2 cm; mikrolokacija: jarek 1, odsek 129; *sl. 14.25.*

<sup>59</sup> Distalna epifiza še ni bila zraščena z diafizo, kar se pri recentnih srnah sicer zgodi pri starosti med 13 in 15 meseci (Tomé, Vigne 2003, 169).

<sup>60</sup> Kljunasti odrastek komolčnice (*olecranon*) še ni bila zraščena z diafizo (*corpus ulnae*), kar se pri recentnih ovcah sicer zgodi pri starosti približno dve in pol leti (Silver 1972, 285).

31. Orodje iz odlomka spodnjega podočnika divjega prašiča; bazalni del orodja je odlomljen; ohr. d. 4,9 cm; š. 1,7 cm; mikrolokacija: jarek 1, odsek 131; *sl. 14.26.*

32. Orodje iz odlomka spodnjega podočnika divjega prašiča; ohr. d. 10,4 cm; š. 2,4 cm; mikrolokacija: jarek 1, odsek 131; *sl. 14.27.*

33. Bodalo iz odlomka diafize komolčnice jelena; bazalni del orodja je odlomljen; ohr. d. 10,8 cm; š. 5,6 cm; mikrolokacija: jarek 1, odsek 133.

34. Šilo iz proksimalne epifize in diafize piščali divjega prašiča; ohr. d. 12,4 cm; š. 2,1 cm; mikrolokacija: jarek 13, odsek 35; *sl. 14.10.*

35. Šilo iz odlomka diafize dolge cevaste kosti nedoločene živali; bazalni del orodja je odlomljen; ohr. d. 6,7 cm; š. 1,5 cm; mikrolokacija: sonda 1.

36. Šilo iz odlomka diafize dolge cevaste kosti nedoločene živali; bazalni del orodja je odlomljen; ohr. d. 5,8 cm; š. 0,8 cm; mikrolokacija: jarek 13, odsek 30.

37. Šilo (sveder *sensu* Bregant 1975, t. 7: 10) iz odlomka epifize in diafize dolge cevaste kosti nedoločene živali; ohr. d. 4,0 cm; š. 0,9 cm; mikrolokacija: jarek 13, odsek 30.

38. Šilo iz odlomka diafize dolge cevaste kosti nedoločene živali; ohranjena je le konica; ohr. d. 5,9 cm; š. 0,9 cm; mikrolokacija: jarek 12, odsek 28.

39. Šilo ali bodalo iz odlomka proksimalne epifize in diafize stopalnice jelena; ohr. d. 17,7 cm; š. 3,9; mikrolokacija: jarek 2, odsek 96.

40. Šilo iz odlomka diafize dolge cevaste kosti nedoločene živali; bazalni del orodja je odlomljen; ohr. d. 10,0 cm; š. 0,8 cm; mikrolokacija: jarek 4, odsek 39.

41. Šilo iz odlomka obsklepnega dela diafize dolge cevaste kosti nedoločene živali; bazalni del orodja je odlomljen; ohr. d. 9,7 cm; š. 1,7 cm; mikrolokacija: sonda 2, kv. 2, 5. reženj; *sl. 14.7.*

42. Bodalo iz odlomka proksimalne epifize in diafize stopalnice jelena; ohr. d. 18,5 cm; š. 2,2 cm; mikrolokacija: jarek 1, odsek 131; *sl. 14.11.*

43. Gladilo iz odlomka proksimalne epifize in diafize stopalnice jelena; orodje je ožgano, najbolj očitno epifiza; ohr. d. 8,5 cm; š. 1,9 cm; mikrolokacija: sonda 2, kv. 1, 5. reženj.

44. Orodje iz odlomka spodnjega podočnika divjega prašiča; ohr. d. 9,3 cm; š. 2,0 cm; mikrolokacija: sonda 2, kv. 1, 5. reženj.

45. Šilo iz obsklepnega dela diafize stopalnice srne; bazalni del orodja je odlomljen; ohr. d. 8,1 cm; š. 1,3 cm; mikrolokacija: sonda 2, kv. 1, 5. reženj.

46. Šilo iz odlomka diafize stopalnice srne; ohranjena je le konica; ohr. d. 4,6 cm; š. 0,9 cm; mikrolokacija: sonda 3, kv. 15, 5. reženj.

47. Ogrična cevka iz odlomka diafize dolge kosti specifično nedoločene ptice; ohr. d. 1,3 cm; š. 0,5 cm; mikrolokacija: sonda 3, kv. 5, 6. reženj; *sl. 14.23.*

#### 14.5.1.2 ARTEFAKTI IZ ROGOVIJ

1. Obdelan odlomek korteksa rogovja jelena; proksimalni in distalni del sta preoblikovana v topi konici; ohr. d. 13,0 cm; š. 1,6 cm; mikrolokacija: jarek 1, odsek 132.

2. Steblo rogovja jelena (dvanajsterak); vsi trije paroški krone ter bazalni del stebela so bili odrezani; srednjik je bil odlomljen; ohr. d. 51,5 cm; mikrolokacija: sonda 3, kv. 1, iz profila.

3. Orodje iz paroška rogovja jelena; distalni del je dletasto preoblikovan; korteks je mestoma zglajen; praožek je bil navpično odrezan od stebela rogovja; ohr. d. 14,7 cm; š. 2,5 cm; mikrolokacija: sonda 3, kv. 6, 7. reženj; *sl. 14.13.*

4. Polizdelek iz baze stebela rogovja jelena; rogovje je priraščeno na čelnico (*os frontale*); sivček in srednji del stebela s krono sta odrezana; sledovi rezanja oz. fasetiranja so vidni tudi na medialni strani baze nadočnika; vsi rezi so pravokotni

na vzdolžno os stebila/parožka; na bazi stebila so na medialni in lateralni strani vidni sledovi dolbenja z namenom izdelave okrogle odprtine za nasajanje orodja; ohr. d. 32,4 cm; š. 30,6 cm; obseg r. nad rožo 18,6 cm; obseg rože 20,9 cm; obseg nast. čelnice pod rožo 14,4 cm; mikrolokacija: jarek 4, odsek 40; *sl. 14.16.*

5. Polizdelek iz parožka jelena; korteks je obrabljen, zglajen; parožek je bil navpično odrezan od stebila rogovja – vidni so sledovi vrezov; ohr. d. 6,2 cm; š. 1,4 cm; mikrolokacija: sonda 2, 2. reženj.

6. Orodje iz baze stebila rogovja jelena (deseterak); rogovje je priraščeno na čelnico; srednji del stebila s krono, sivček in nadočnik so odrezani; vsi rezi so pravokotni na vzdolžno os stebila/parožka; distalni del stebila je poškodovan; nastavek za rogovje na čelnici je preoblikovano v topo konico; v medialno-lateralni osi je v bazi stebila neposredno nad rožo okrogla odprtina za nasajanje; ohr. d. 15,8 cm; š. 7,9 cm; pr. luknje 1,7–1,8 cm; obseg r. nad rožo 19,8 cm; obseg rože pribl. 21,4 cm; obseg nast. čelnice pod rožo 15,6 cm; mikrolokacija: jarek 1, odsek 122; *sl. 14.17.*

7. Orodje iz baze stebila odpadlega rogovja jelena; primerek je fragmentiran; srednji del stebila s krono in nadočnik sta bila odrezana; distalni del stebila je preoblikovan v nekoliko obrabljen, medialno-lateralno potekajoč dletast rob; v isti osi (tj. medialno-lateralno) je v bazi stebila neposredno nad rožo ostanek okrogle odprtine za nasajanje; ohr. d. 15,7 cm; š. 6,6 cm; pr. luknje pribl. 2,4 cm; mikrolokacija: jarek 5, odsek 5.

8. Orodje iz baze stebila rogovja jelena (deseterak); rogovje je priraščeno na čelnico (*os frontale*); nadočnik in sivček sta bila navpično odrezana od stebila; ravno je bil odrezan tudi srednji del stebila s krono, a so zaradi naknadne poškodbe značilni poševni sledovi rezanja v obliki črke V vidni le še na manjšem delu oboda; v medialno-lateralni osi je v bazi stebila neposredno nad rožo okrogla odprtina za nasajanje; nastavek za rogovje na čelnici je dletasto preoblikovan; rezilo, ki poteka v medialno-lateralni smeri, je terminalno skrhano; ohr. d. 19,7 cm; š. 7,8 cm; pr. luknje 2,7–2,8 cm; obseg r. nad rožo 19,7 cm; obseg nast. čelnice pod rožo 16,7; mikrolokacija: sonda 2, kv. 1, 6. reženj; *sl. 14.18.*

9. Orodje iz parožka rogovja jelena; distalni del je dletasto preoblikovan; robovi so bleščeče gladki; parožek je bil navpično odrezan od stebila rogovja; v medialno-lateralni osi je v proksimalnem delu parožka okrogla odprtina za nasajanje; ohr. d. 17,3 cm; š. 3,1 cm; pr. luknje 1,4–1,5; mikrolokacija: jarek 1, odsek 131; *sl. 14.14.*

10. Orodje iz baze stebila rogovja jelena; nadočnik, sivček in srednji del stebila s krono so odrezani; vsi rezi so pravokotni na vzdolžno os stebila/parožka; rob na stebelu je bleščeče

gladek; proksimalni del stebila je preoblikovan v topo grčo; površina korteksa je praviloma močno zglajena (opazne so sicer posamezne globlje raze); v antero-posteriorni osi je v bazi stebila nad rožo okrogla odprtina za nasajanje; anteriorno se odprtina odpira natanko na mestu izraščanja sivčka; ohr. d. 10,9 cm; š. 7,3 cm; pr. luknje 2,1–2,2 cm; mikrolokacija: sonda 3, kv. 15, 7. reženj.

11. Orodje iz stebila rogovja jelena; primerek je fragmentiran; ohranjen je del korteksa in le sledi spongioze; poškodovan proksimalni del stebila je klinasto preoblikovan; na distalnem delu je ohranjen oster dletast rob; v korteksu so vidni ostanki dveh nasproti si ležečih okroglih odprtin; ohr. d. 15,3 cm; š. 5,7 cm; mikrolokacija: sonda 3, kv. 2, 7. reženj.

12. Orodje iz baze stebila odpadlega rogovja jelena (osmerak); srednji del stebila s krono in nadočnik sta bila odrezana; distalni del stebila je preoblikovan v nekoliko obrabljen (v osnovi sicer zglajen), medialno-lateralno potekajoč dletast rob; v isti osi (tj. medialno-lateralno) je v bazi stebila neposredno nad rožo okrogla odprtina za nasajanje; ohr. d. 12,3 cm; š. 7,4 cm; pr. luknje 2,3 mm; obseg r. nad rožo 16,9 cm; mikrolokacija: jarek 3, odsek 60; *sl. 14.19.*

13. Orodje iz parožka rogovja jelena; distalni del je odlomljen; proksimalni del je zaradi poškodbe klinasto preoblikovan; v medialno-lateralni osi je v proksimalnem delu parožka ostanek okrogle odprtine; na korteksu so vidne številne sledi glodanja s strani malih sesalcev; ohr. d. 11,2 cm; š. 2,9 cm; pr. luknje pribl. 1,2 cm; mikrolokacija: jarek 12, odsek 27; *sl. 14.15.*

14. Orodje iz baze stebila odpadlega rogovja jelena (osmerak); primerek je fragmentiran; srednji del stebila s krono in nadočnik sta bila odrezana; distalni del stebila je preoblikovan v oster, medialno-lateralno potekajoč dletast rob; v isti osi (tj. medialno-lateralno) je v bazi stebila neposredno nad rožo odprtina za nasajanje; ohr. d. 17,7 cm; š. 5,7 cm; pr. luknje 2,7–2,8 cm; obseg r. nad rožo 20,2 cm; mikrolokacija: sonda 3, kv. 2, kulturna plast; *sl. 14.20.*

## 14.5.2 BLATNA BREZOVICA

1. Šilo iz odlomka distalne epifize in diafize koželjnice drobnice; ohr. d. 8,1 cm; š. 1,9 cm; *sl. 14.28.*

2. Gladilo iz obsklepnega dela epifize dlančnice/stopalnice jelena; terminalni del orodja je odlomljen; ohr. d. 6,1 cm; š. 1,8 cm; *sl. 14.30.*

3. Šilo iz odlomka diafize dolge cevaste kosti nedoločene živali; ohr. d. 15,2 cm; š. 2,4 cm; *sl. 14.29.*

4. Šilo iz odlomka epifize dolge cevaste kosti nedoločene živali; bazalni in terminalni del orodja sta odlomljena; ohr. d. 2,6 cm; š. 0,9 cm.

5. Šilo iz odlomka diafize dolge cevaste kosti nedoločene živali; ohranjena je le konica; ohr. d. 2,6 cm; š. 0,6 cm.



# 15. RAZISKAVE IN KONSERVIRANJE PREJE Z LJUBLJANSKEGA BARJA

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## Izvleček

Ostanki preje z eneolitske koliščarske naselbine Stare gmajne pri Verdu kažejo, da je verjetno spredena iz vlaken, ki jih najdemo v plodovih in steblih rastlin iz družine trav (*Poaceae*).

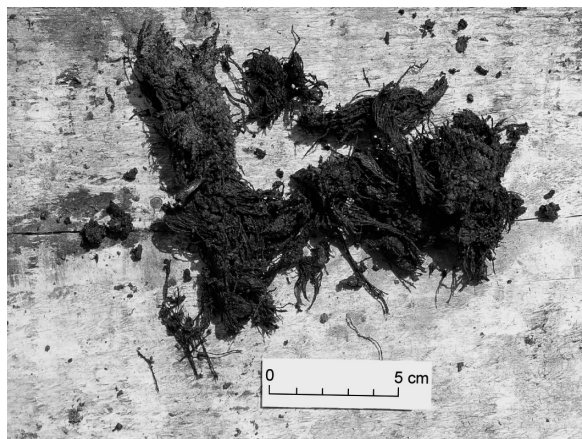
Ker so najdbe tekstila ali prej v Sloveniji redke in ker tudi izkušenj pri delu s tovrstnim materialom nimamo, se povezava z naravoslovnimi vedami pokaže kot nujna. Izsledki raziskav so osnova za nadaljnje delo pri ohranjanju artefakta ne glede na to, ali bo ta konserviran ali restavriran.

Še posebej problematično je, ko tako občutljiv artefakt pride v muzej in ga je treba zaščititi tudi v depozu. Poleg stalne kontrole relativne vlage, temperature in svetlobe je treba tak artefakt zaščititi tudi pred umazanijo.

**Ključne besede:** preja, raziskave, konserviranje, hranjenje, Stare gmajne, eneolitik.

## 15.1 UVOD

V raziskavo, konserviranje in restavriranje smo dobili kepico blatne zemlje, v kateri so bili vidni organski ostanki – preplet niti, ki bi lahko predstavljali tkanino ali prejo (*sl. 15.1*).



# 15. ANALYSIS AND CONSERVATION OF THE LJUBLJANSKO BARJE YARN

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## Abstract

Remains of yarn from the Eneolithic pile-dwelling settlement Stare gmajne near Verd indicate that it was probably spun of fibre, which can be found in fruits and stems of plants from the family of grasses (*Poaceae*).

Textile or yarn finds are rare in Slovenia; consequently, we do not have much experience with working with such material and therefore the collaboration with natural sciences becomes vital. Findings of analysis form a base for further arrangements for preserving the artefact, regardless of whether the artefact is conserved.

The question of transportation of such a sensitive artefact to a museum and its protection while in storage, is emphasised. Besides permanent monitoring of relative humidity, temperature and light, the artefact also needs to be protected from soiling.

**Keywords:** yarn, examination, conservation, storage, Stare gmajne, Eneolithic.

## 15.1 INTRODUCTION

We received a small lump of soil – mud with visible organic remains – of spun thread, possibly textile or yarn, to be analysed, conserved and restored (*Fig. 15.1*).

It was found at excavation of the Institute of archaeology from ZRC SAZU, under supervision of A. Velušček, near Verd, at the archaeological site Stare gmajne to be precise. Anaerobic conditions, in which the find survived for millennia, helped to preserve the artefact. It is assumed that the find is approximately 5100 years old.<sup>1</sup>

All museum kept objects firstly rise a question of what kind of procedures have to be taken for preservation of the object: passive conservation or intervention.

<sup>1</sup> See Chapters 3 and 7 in this monograph.

*Sl. 15.1:* Stare gmajne, sonda 2, leto 2006. Ostanki preje takoj po odkritju. Foto: M. Turk.

*Fig. 15.1:* Stare gmajne, trench 2, 2006. Remains of the yarn at the discovery. Photo: M. Turk.



Najdba je iz okolice Verda, natančneje z arheološkega najdišča Stare gmajne, kjer so izkopavali arheologi Inštituta za arheologijo ZRC SAZU pod vodstvom A. Veluščka. K ohranitvi artefakta so pripomogli anaerobni pogoji, v katerih je najdba počivala tisočletja. Ocenjuje se namreč, da je stara približno 5100 let.<sup>1</sup>

Pri vseh muzejskih predmetih se najprej postavi vprašanje, za kakšne postopke se bomo odločili pri njihovi ohranitvi: za pasivno ali aktivno konservacijo.

Pasivne konservatorske metode puščajo objekt v naravnem stanju, vendar lahko pride pozneje do dodatne kontaminacije ali tudi uničenja samega artefakta,<sup>2</sup> še posebej, če gre za arheološke objekte organske narave.

Ker je najdba v našem primeru organskega izvora in je bila pomešana z blatom in vodo, je bilo samo po sebi umevno, da smo se odločili za aktiven konservatorski poseg.

## 15.2 RAZISKAVA

### 15.2.1 MORFOLOGIJA NAJDBE

Ob pridobitvi je bila najdba skoraj črne barve. To nas je navajalo na misel, da je bila izpostavljena visoki temperaturi in da je pooglenela, kar se je v nadaljevanju raziskave izkazalo kot pravilna hipoteza. Na mestu odkritja najdbe so namreč našli na debelo plast žganine in številne ostanke zoglenega žita, kar kaže, da je koliščarsko kolibo uničil požar.<sup>3</sup> Zoglenela žita, 18 zrn ječmena (*Hordeum vulgare*), smo ob restavriranju najdbe našli tudi med nitkami (sl. 15.2).

Najdbo sestavlja množica prepletenih niti. Pokazalo se je, da gre za prejo. Osnovo predstavljata dve tanjši niti, ki ju tvorijo izjemno fina vlakna in sta enakomerno spredeni s sukanjem v S-meri (sl. 15.3).<sup>4</sup> Red velikosti premera preje je 500 µm. Zdi se, da lahko tudi domnevamo, da je bila preja zvita v klopčič in pripravljena za tkanje platna oz. finejše tekstilije ali sukanje vrvi.<sup>5</sup>

### 15.2.2 METODE DELA

Ob prevzemu v obdelavo je bila barjanska preja shranjena v dveh polietilenskih vrečkah. Večja gmota je merila 9,5 × 3,8 cm, manjša pa 5,5 × 0,4 cm. Do začetka restavratorskih del smo vrečke hranili v hladilniku in se tako izognili biološki razgradnji ter s tem dodatni kontaminaciji artefakta.

<sup>1</sup> Glej poglavji 3 in 7 v tem zborniku.

<sup>2</sup> Abdel-Kareem 2004.

<sup>3</sup> Glej poglavje 3.3 v tem zborniku.

<sup>4</sup> Npr. Medard 2003.

<sup>5</sup> Glej npr. Leuzinger 2002b; Bazzanella, Mayr, Rast-Fisher 2003.

Passive conservation procedures preserve the object in its original condition, however, mechanically fragile objects may need consolidation. Moreover, degradation of the artefact itself,<sup>2</sup> especially if organic, is possible due to a variety of mechanisms.

The studied find is organic and it was mixed with mud and water. It was therefore understandable to use interventive conservation methods.

## 15.2 RESEARCH

### 15.2.1 MORPHOLOGY OF THE FIND

The find was almost black in colour when received. This indicated that it was exposed to high temperature and charred, which proved as correct doing the subsequent analyses. The place of discovery of the find was covered with a thick layer of burnt remains and numerous remains of charred grain. These indicate that a pile-dwelling house was destroyed by fire.<sup>3</sup> Charred grains, i.e. 18 barley grains (*Hordeum vulgare*), were found among threads during the treatment (Fig. 15.2).

The find is composed of a number of interwoven threads and turned out to be a yarn. The base is formed by two thin threads of exceptionally refined fibres that are evenly S spun throughout (Fig. 15.3).<sup>4</sup> The yarn has 500 µm in diameter. It appears it was wound into a ball and prepared for weaving of linen or a more refined textile, or for making a rope.<sup>5</sup>

### 15.2.2 METHODOLOGY

The Ljubljansko barje yarn was stored in two polyethylene bags when received for further handling. The larger lump measured 9.5 × 3.8 cm, and the smaller one 5.5 × 0.4 cm. Prior to treatment, the bags were stored in a refrigerator in order to avoid biological decomposition.

The admirable and, in our country, rare find, dictated an interdisciplinary scientific approach to its examination and treatment. After the obligatory photo-documentation was completed, did the following:

1. optical and SEM microscopy to identify the plant species
2. measurement of pH
3. chemical analysis of the content of metals in mud
4. microbiological analyses
5. restoration of artefact
6. arrangements for storage of the Ljubljansko barje yarn.

<sup>2</sup> Abdel-Kareem 2004.

<sup>3</sup> See Chapter 3.3 in this monograph.

<sup>4</sup> E.g. Medard 2003.

<sup>5</sup> See e.g. Leuzinger 2002b; Bazzanella, Mayr, Rast-Fisher 2003.

Častitljiva in pri nas redka najdba je za njeno opredelitev narekovala interdisciplinarni pristop k delu in vrsto naravoslovnih raziskav. Po obvezni fotodokumentaciji smo opravili:

1. optično in SEM-mikroskopijo ter poskus identifikacije rastlinske vrste
2. merjenje vrednosti pH
3. kemično analizo in določitev vsebnosti kovin v blatu
4. ugotavljanje prisotnosti mikroorganizmov
5. restavriranje artefakta
6. pripravo na hranjenje barjanske preje.

### 15.2.2.1 OPTIČNA IN SEM-MIKROSKOPIJA TER POSKUS IDENTIFIKACIJE

Poogleneli artefakti so še posebej zahtevni za obdelavo, predvsem zaradi krhkosti.<sup>6</sup> Vlakna pooglenelih prej oz. tekstilij, ki so bile izpostavljene procesu karbonizacije, je zelo težko identificirati.<sup>7</sup> To se je pokazalo tudi v našem primeru, ko s postopki optičnega mikroskopiranja nismo mogli določiti izvora preje. Mikroskopirali smo pri povečavah 160 ×, 250 × in 400 × na mikroskopu Leitz Diaplan. Šele na podlagi posnetkov elektronske SEM-mikroskopije,<sup>8</sup> pri kateri so podrobnosti na vlaknih vidnejše, lahko predvidevamo, da gre za vlakna celuloznega rastlinskega izvora, kajti vsa vlakna imajo lumen, značilen za celulozna vlakna, kar je potrdila tudi kemična analiza, ki je pokazala prisotnost celuloze. Slednje potrjuje, da gre za rastlinski material, odsotnost lignina pa kaže, da ne gre za olesenelo tkivo. V času kolišč so bila namreč za izdelavo tekstila pogosto uporabljena tudi vlakna skorje dreves.<sup>9</sup> Premer posameznih vlaken barjanske preje je od 6 μm do 10 μm (glej sl. 15.4). Posnetki elektronske SEM-mikroskopije so pokazali tri specifične znake rastlinskih vlaken:

1. daljša, ravna in gladka stebelna vlakna (sl. 15.4a)
2. krajša, gladka in na koncih ošiljena semenska vlakna (sl. 15.4b)
3. spiralne strukture (sl. 15.4c).

Omenjene tri specifične in dobro opazne znake smo skušali poiskati na neolesenelih vlaknih recentnih rastlin. Osredotočili smo se na nekaj potencialnih vrst, kot so lan (*Linum*), konoplja (*Cannabis*), stoklasa (*Bromus*), bodalica (*Stipa*) in oves (*Avena*).

Možnost, da bi bila barjanska preja iz lana (*Linum usitatissimum*), je izhajala iz dejstva, da smo na najdišču Stare gmajne, prvič odkar na Ljubljanskem barju raziskujemo kolišča, našli tudi ostanke lana – semena in fragmente semenskih kapsul, in iz dejstva, da je lan še danes izjemno primerna rastlinska vrsta za pridobivanje tekstilnih vlaken. Poleg tega je znano, da je bila vrsta v

<sup>6</sup> Rottoli 2005.

<sup>7</sup> Rottoli 2005.

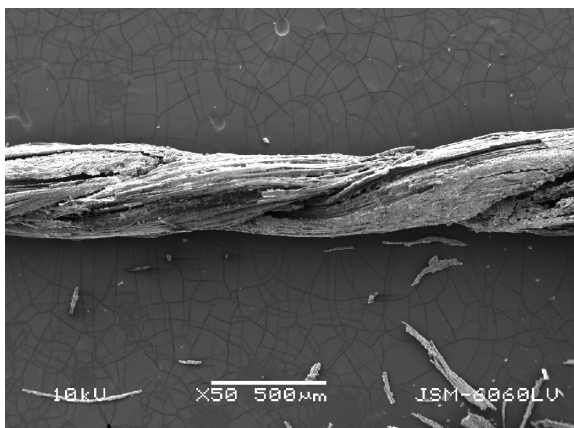
<sup>8</sup> Npr. Rast-Fisher 2003; France 2005.

<sup>9</sup> Npr. Müllauer, Ramsel 2007; Reichert 2007 idr.



Sl. 15.2: Zrna ječmena (*Hordeum vulgare*), najdena med nitkami. Foto: T. Lauko.

Fig. 15.2: Barley grains (*Hordeum vulgare*), found among threads. Photo: T. Lauko.



Sl. 15.3: Posamezna enota pooglenele preje je sestavljena iz dveh niti, ki ju tvorijo izjemno fina vlakna in sta enakomerno spredeni s sukanjem niti v S-smeri. Foto: D. Đorđević.

Fig. 15.3: Individual unit of charred yarn is formed by two thin threads of exceptionally refined fibres that are evenly S spun throughout. Photo: D. Đorđević.

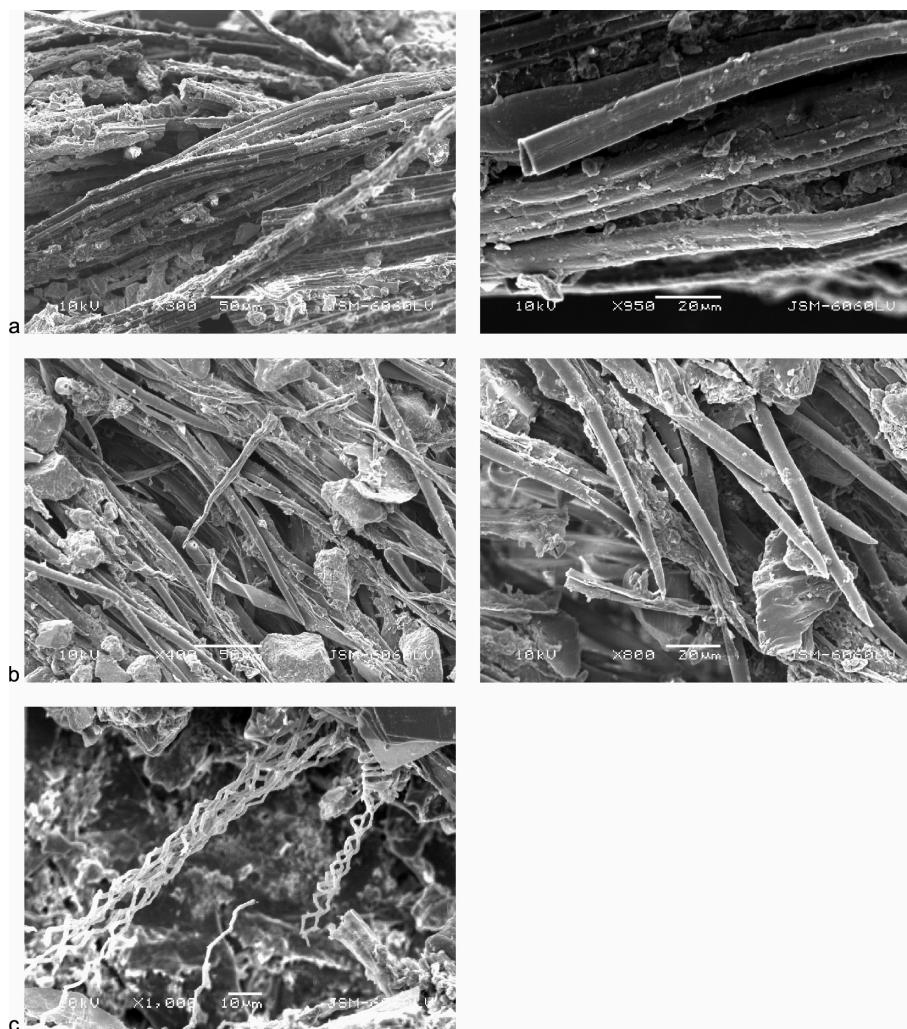
### 15.2.2.1 OPTICAL AND SEM MICROSCOPY AND AN ATTEMPT OF IDENTIFICATION

Charred artefacts require especially demanding treatments, principally because of their fragility.<sup>6</sup> It is very difficult to identify charred yarn or textile fibres, which were exposed to carbonisation.<sup>7</sup> This was also true in our case, as we could not determine the origin of the yarn with optical microscopy procedures, with certainty. We used Leitz Diaplan microscope with magnifications of ×160, ×250 and ×400. Based on SEM (Scanning Electronic Microscope) images,<sup>8</sup> where fibre details are

<sup>6</sup> Rottoli 2005.

<sup>7</sup> Rottoli 2005.

<sup>8</sup> E.g. Rast-Fisher 2003; France 2005.



Sl. 15.4: Stare gmajne, preja; daljša, ravna in gladka stebelna vlakna (a), krajša, gladka in na koncih ošiljena semenska vlakna (b) in spiralne strukture med vlakni (c) pod elektronskim mikroskopom SEM. Foto: D. Đorđević.

Fig. 15.4: Stare gmajne, yarn; longer, straight and smooth stem fibres (a), shorter, smooth and pointed seed fibres (b) and spiral structures between fibres (c) as seen under SEM. Photo: D. Đorđević.

obdobju kolišč dobro znana in tudi gojena oz. kultivirana, poleg prehrane tudi z namenom pridobivanja tekstilnih vlaken.<sup>10</sup> V primeru preje s Starih gmajn pa je že prvi pogled posnetkov elektronske SEM-mikroskopije izključil možnost lana,<sup>11</sup> saj v nodijih ni opaznih odebelitev, lumni vlaken so preveliki (sl. 15.4a), konci vlaken so zašiljeni in gladki (sl. 15.4b).

Zaradi izredno ravnih, gladkih in na pogled svilnatih vlaken z velikimi lumni, ošiljenimi konci ter neodebeljenimi nodiji se je pokazal sum na konopljo (*Cannabis sativa*), katere ostankov pa na koliščih iz 4. tisočletja pr. Kr. na Ljubljanskem barju doslej še nismo odkrili. Dvom o konoplji podaja tudi kemična analiza – odsotnost lignina in očitna prisotnost posamičnih krajših, ošiljenih, svilnatih vlaken z izredno dobro vidnim narastiščem (sl. 15.4b), kar pa je značilnost semenskih

vidnih, we can assume that they are cellulosic of plant origin. The fibre lumen is namely characteristic. This was further confirmed by chemical analysis, which verified the presence of cellulose. The absence of lignin indicates that tissue was not of wood origin. Bark fibres were often used for production of textile during the pile-dwelling period.<sup>9</sup> Individual fibres of the Ljubljansko barje yarn have 6–10 μm in diameter (see Fig. 15.4). SEM images confirmed three specific vegetal fibres:

1. longer, straight and smooth stem fibres (Fig. 15.4a)
2. shorter, smooth and pointed seed fibres (Fig. 15.4b)
3. spiral structures (Fig. 15.4c).

We searched for the three specific fibre types among the non-lignin containing fibres of present-day plants. We focussed on a few potential species, such as flax (*Linum*), hemp (*Cannabis*), brome grass (*Bromus*), needle grass (*Stipa*) and oats (*Avena*).

<sup>10</sup> Npr. Schibler 1997; Leuzinger 2002b; Baldia 2004 idr.

<sup>11</sup> A. Rast, osebna komunikacija.

<sup>9</sup> E.g. Müllauer, Ramsel 2007; Reichert 2007 etc.



vlaknen in ne stebelnih, ki so daljša in sestavljena iz več krajših, med seboj tesno povezanih celic, nanizanih ena na drugo (sl. 15.4a).

Zaradi zgoraj opisanih dveh različnih prepletov vlaknen smo prišli do sklepa, da gre morda za dva različna rastlinska dela iste rastlinske vrste: semena s semenskimi vlakni in stebela s stebelnimi vlakni. Posamezna ošiljena in gladko svilnata semenska vlakna (sl. 15.4b) bi tako lahko pripadala semenom, ki so obdana s plevami in resami, kot so na primer semena trav (*Poaceae*) (sl. 15.5). Glede na to, da so iz njih izdelovali tekstilno prejo, smo predvidevali, da naj bi bila ta semenska vlakna pridobljena iz rastlinske vrste, ki ima semena obdana z daljšimi plevami in resami, zato smo v nadaljnjo raziskavo vzeli tri takšne potencialne vrste:

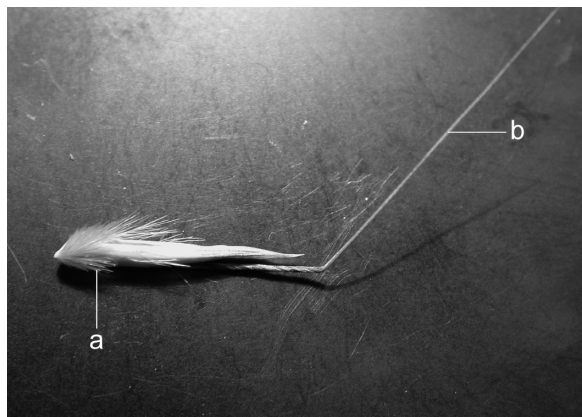
1. Stoklaso (*Bromus* sp.), ker smo v arheobotaničnih vzorcih iz kulturne plasti na Starih gmajnah našli veliko zoglenelih semen, kar pomeni, da je bila rastlina zagotovo na kolišču v vsakdanji rabi.

2. Bodalico (*Stipa* sp.), ker ima zelo dolga semenska vlakna – rese, vendar je njeno rastišče iskati predvsem na suhih kraških travnikih in ne na mokrotnih barjanskih. Toda glede na to, da so dosedanje raziskave pokazale, da so bili koliščarji tudi popotniki, stiki po poteh čez Kras do morja oz. z območji v smeri Jadranskega morja so namreč dokazani,<sup>12</sup> vrste ne gre izključiti.

3. Oves (*Avena fatua*), ki ima tudi zelo dolga semenska vlakna – rese (sl. 15.5), pa smo vzeli v raziskavo zgolj kot testno rastlinsko vrsto, da bi naredili primerjavo s potencialnima vrstama, saj oves v obdobju kolišč na Ljubljanskem barju ni bil prisoten in ga tako lahko iz obravnave izključimo.

Vlakna, tako semenska kot tudi stebelna, zgoraj navedenih rastlinskih vrst pod elektronskim mikroskopom kažejo na nekaj podobnosti z vlakni obravnavane preje.

<sup>12</sup> Npr. Pavšič, Dirjec 2004 in poglavje 12 v tem zborniku.



Sl. 15.5: Seme ovsa (*Avena fatua*) kot primer semena trav (*Poaceae*), obdana s plevami (a) in daljšo reso (b). Foto: T. Tolar.  
Fig. 15.5: Oat seed (*Avena fatua*), as an example of grass seed (*Poaceae*), surrounded with chaff (a) and longer heather (b). Photo: T. Tolar.

The possibility that the Ljubljansko barje yarn would be made of flax (*Linum usitatissimum*) was based on the fact that remains of flax-seeds and parts of seed-capsules were found at the Stare gmajne; these have not yet been found at the Ljubljansko barje pile-dwellings. Moreover, flax is, to this day, an exceptionally suitable plant species for production of textile fibres. It is also known, that this species was well-known in the times of pile-dwellings; it was cultivated, used in the diet as well as in the production of textile fibres.<sup>10</sup> However, the first examination of SEM images excluded flax,<sup>11</sup> as the nodes do not have any noticeable swellings, the fibre lumens are too big (Fig. 15.4a) and the fibres are pointed and smooth (Fig. 15.4b).

Extremely straight, smooth and silky fibres with large lumens, pointed ends and unswollen nodes indicated that these are remains of hemp (*Cannabis sativa*), which has not yet been found on the Ljubljansko barje pile-dwellings from the 4<sup>th</sup> millennium BC. The presence of hemp is, however, doubtful on the basis of chemical analysis – absence of lignin, obvious presence of desultory short, pointed, silky fibres with obvious attachments (Fig. 15.4b); which are characteristic for seed, as opposed to stem, fibres, which are longer and consist of several shorter, closely attached cells, strung to one another (Fig. 15.4a).

Because of two different interweaves of fibres, described above, we can conclude that these are two different vegetal parts of the same species: seeds with seed fibres and stems with stem fibres. Individual, pointed and smooth silky seed fibres (Fig. 15.4b) could be parts of seeds with chaff and heather, such as grass seeds (*Poaceae*) for example (Fig. 15.5). Considering that textile yarn was made of them, seed fibres would be collected from plant species that have their seeds surrounded by longer chaff and heather. Therefore, three potential species were considered in further research:

1. Brome grass (*Bromus* sp.), because a lot of charred seed was found in archaeo-botanical samples from the cultural layer at the Stare gmajne, which means that the plant was definitely used daily.

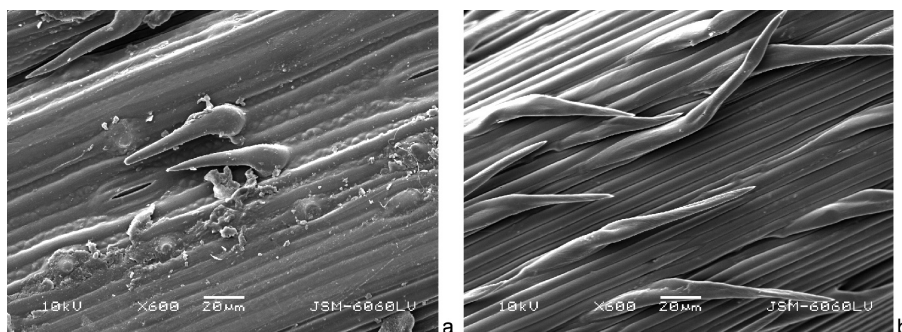
2. Needle grass (*Stipa* sp.), due to its very long seed fibres – chaff; but its habitat is predominantly dry Karstic and not wet marshy meadow. However, considering previous research, which showed that dwellers were also travellers; contacts with routes over the Karst/Kras to the sea/with areas in the direction of the Adriatic Sea are proved;<sup>12</sup> this species cannot be excluded.

3. Oat (*Avena fatua*), that also has very long seed fibres – chaff (Fig. 15.5), was included into the research only as a testing plant species, to make comparison with potential species, as oats were not present at the Ljubljansko barje in the period of pile-dwellings and can therefore be excluded from the study.

<sup>10</sup> E.g. Schibler 1997; Leuzinger 2002b; Baldia 2004 etc.

<sup>11</sup> A. Rast, pers. comm.

<sup>12</sup> E.g. Pavšič, Dirjec 2004 and Chapter 12 in this monograph.



Sl. 15.6: Stebelna vlakna stoklase (*Bromus* sp.) (a) in semenska vlakna bodalice (*Stipa* sp.) (b) pod elektronskim mikroskopom SEM kažejo na nekaj podobnosti z vlakni preje s Starih gmajn. Foto: D. Đorđević.

Fig. 15.6: Stem fibres of brome grass (*Bromus* sp.) (a) and seed fibres of needle grass (*Stipa* sp.) (b) show some resemblance with fibres of the yarn from Stare gmajne, when investigated under SEM. Photo: D. Đorđević.

Dobro so opazne razlike med stebelnimi in semenskimi vlakni. Opazni so tudi zašiljeni konci svilnato gladkih semenskih vlaken (sl. 15.6).

Toda za zanesljivejšo identifikacijo smo iskali še tretji zelo dobro prepoznavni znak, to so spiralne strukture med vlakni (sl. 15.4c), na katere pa nismo naleteli pri nobeni od potencialnih raziskovanih rastlinskih vrst. Pač pa smo jih našli pri Herzogu,<sup>13</sup> in sicer v ksilemskih žilah listov agave (*Agave rigida*), vendar je zelo malo verjetno, da gre za vrsto, iz katere so bile spredene preučevane niti.

Spiralne strukture (sl. 15.4c) so ligninske spiralne ojačitve ksilemskih celic, ki jih lahko najdemo v žilah različnih rastlin iz praktično vseh skupin višjih rastlin, zato je nam ta znak ne omogoča natančnejše identifikacije vrste. Za natančnejšo določitev bi potrebovali zbirko referenčnih vlaken znanih rastlin, posnetih na enak način, tega pa žal za zdaj še nimamo, zato ostaja natančnejša identifikacija rastlinske vrste še neodkrita, nagibamo pa se k vrsti iz družine trav (*Poaceae*).

Po mnenju nekaterih arheobotanikov<sup>14</sup> je preja s Starih gmajn izredno dobro in kakovostno obdelana, saj so tako lepo vidna posamezna vlakna prava redkost med arheološkimi prejami, iz katerih so delali tekstil. Recentna oz. sveža vlakna, kot jih je uporabljal tudi koliščar, se namreč držijo tesno skupaj in jih je izredno težko ločevati na posamezna vlakna.

#### 15.2.2.2 MERJENJA VREDNOSTI pH

Vrednost pH predmetov iz celuloze je pomemben podatek za konservatorja.<sup>15</sup> V kislem se namreč celulozna vlakna sorazmerno hitro razgrajujejo zaradi procesov kislinsko katalizirane hidrolize celuloze. V zmerno alkalnem območju je celuloza neprimerno bolj stabilna,

When investigated under electronic microscope, fibres, seed and stem, of plant species listed, show some resemblance with fibres of the yarn examined. Differences between stem and seed fibres are noticeable, as well as pointed ends of silky smooth seed fibres (Fig. 15.6).

But we were still looking for the third, well recognizable, sign for even more reliable identification; these are spiral structures between fibres (Fig. 15.4c), which were not present in any of the examined plant species. On the other hand, we found them in the publication by Herzog,<sup>13</sup> in xylem nervures of agave leaves (*Agave rigida*). However, it is very unlikely that this was the species from which the threads studied here were spun.

Spiral structures (Fig. 15.4c) are lignin spiral reinforcement xylem cells that are present in nervures of different plants in most embryophytes. This information does therefore enable precise identification of species. In order to make accurate designation, we would need a collection of identically photographed reference fibres of known plants. Unfortunately, we do not have this yet and more accurate classification of vegetal species stays unidentified, but we do assume that it is a species belonging to the family of grasses (*Poaceae*).

According to some archaeo-botanists,<sup>14</sup> the yarn from Stare gmajne is of an extraordinarily good quality, as clear visibility of individual fibres is rare in archaeological yarns, which were used for making textile. Fresh fibres, also used by dwellers, are attached to one another and are extremely hard to separate to individual fibrils.

#### 15.2.2.2 pH MEASUREMENTS AND PRELIMINARY DRYING EXPERIMENTS

The pH of cellulosic materials is an important piece of information to the conservator.<sup>15</sup> Cellulose fibres decompose fast in an acidic environment, as acids

<sup>13</sup> 1955, t. 196.

<sup>14</sup> A. Rast, osebna komunikacija.

<sup>15</sup> Strlič, Kolar 2005.

<sup>13</sup> 1955, Pl. 196.

<sup>14</sup> A. Rast, pers. comm.

<sup>15</sup> Strlič, Kolar 2005.



zato je eden osnovnih konservatorsko-restavratorskih posegov pri ohranjanju papirja razkisljenje.

Merjenje pH opravimo s kombiniranimi steklenimi pH-elektrodami. Barjanska preja je ležala v vodi, ki je že predstavljala primeren ekstrakt, v katerem je bila določitev pH enostavna. Določili smo pH 7,4, kar je primerno za dolgotrajno ohranitev celuloze.

S preliminarnimi poskusi sušenja, ki smo jih opravili z majhnimi vzorčki, smo ugotovili, da je suha barjanska preja zelo prhka.

Dejstvo, da je bila preja močno pooglenela in v suhem stanju izredno prhka, nas je vodilo pri odločanju o izboru konservatorsko-restavratorskih postopkov, metod in sredstev.

### 15.2.2.3 KEMIČNA ANALIZA IN DOLOČITEV VSEBNOSTI KOVIN V MIKROOKOLJU

S pomočjo atomske absorpcijske spektroskopije smo določili, da voda, v kateri je bila najdena preja, vsebuje povečano koncentracijo železovih ionov. Ti lahko povzročijo pospešeno oksidativno razgradnjo organskega materiala, zato smo priporočili dolgotrajno spiranje preje v deionizirani vodi. Hkrati je prisotnost železa verjetno povzročilo vezavo huminskih kislin na celulozno vlakno, huminske kisline pa so intenzivno rjave do črne barve.

S FT-IR-spektroskopijo vlakna smo lahko ugotovili, da je vlakno celuloznega izvora. Za celulozo značilni absorpcijski vrhovi pa so bili zelo šibki, zato domnevamo, da je večina vlakna pooglenela.

### 15.2.2.4 PRISOTNOST MIKROORGANIZMOV

V ostankih preje smo ugotovili prisotnost različnih vrst bakterij, med katerimi prevladujeta *Acinetobacter* spp. in *Moraxella* spp., obe grama negativni bakteriji, ki spadata v drevo *Proteobacteria*. Vrste rodu *Acinobacter* so striktni aerobni nefermentativni bacili z kokobacilno morfologijo, ki so pogosto kolonizirani v vodi in zemlji.<sup>16</sup> Bakterije in drugi mikroorganizmi razgrajujejo celulozo z delovanjem encimov. Najpogostejše kemijske reakcije, ki se dogajajo v vlažnih pogojih, so v prisotnosti encimov močno pospešene. Hidroliza encimov je pogost pojav pri celulozi. Mnoge bakterije in mikroorganizmi pri razgradnem procesu proizvajajo vodikov peroksid. Vlažni pogoji in prisotnost zemlje te procese še pospešujejo.<sup>17</sup> Dezinfekcija barjanske preje v kopeli 0,1 % vodikovega peroksida (H<sub>2</sub>O<sub>2</sub>) s 5-minutnim namakanjem je bila zato nujna.

<sup>16</sup> O. Bregar, osebna komunikacija.

<sup>17</sup> Timár-Balázs, Eastop 1998.

induce acid catalysed hydrolysis of cellulose. Cellulose is more stable in a slightly alkaline environment; which is why deacidification is one of the basic conservation-restoration procedures in preservation of paper.

The pH was measured with a combined pH glass electrode. The Ljubljansko barje yarn was preserved in water, the pH of which was 7.4, a suitable medium for long-term preservation of cellulose.

The preliminary drying experiments, which were carried out on small samples, confirmed that dry Ljubljansko barje yarn was extremely brittle. The fact that the yarn was charred and extraordinarily brittle when dry, was the main factor for selection of the intervention procedure.

### 15.2.2.3 CHEMICAL ANALYSIS OF THE CONTENT OF METALS

With Atomic Absorption Spectroscopy (AAS) we determined that water, in which the yarn was found, contained an increased concentration of iron ions. These could cause accelerated oxidative decomposition of organic material once exposed to air, which is why we recommended long-term washing of yarn in deionised water. Consequently, the presence of iron could possibly cause strong binding of humic acids to cellulose fibres to take place; namely, humic acids are intensely brown to black.

FT-IR spectroscopy of the fibre also revealed that the fibre is of cellulosic origin. However, absorption peaks, characteristic for cellulose, were very weak, and on the basis of this we suppose that the majority of the fibre was charred.

### 15.2.2.4 PRESENCE OF MICROORGANISMS

Different bacterial species were present in the remains of the yarn, with *Acinetobacter* spp. and *Moraxella* spp., both Gram-negative bacteria of *Proteobacteria* group, prevailing. *Acinobacter* are consistent aerobic non-fermentative bacilli with cocobacillus morphology that are often colonised in water and land.<sup>16</sup> Bacteria and other microorganisms decompose cellulose with their enzymes. Certain degradation reactions are often accelerated in the presence of enzymes. Enzymatic hydrolysis of cellulose is such an example. Damp conditions and the presence of soiling speed up these processes.<sup>17</sup> It was therefore crucial to disinfect the Ljubljansko barje yarn in a bath of 0.1 % hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) for 5 minutes.

<sup>16</sup> O. Bregar, pers. comm.

<sup>17</sup> Timár-Balázs, Eastop 1998.



Sl. 15.7: Preja s Starih gmajn po restavriranju (a) in detajl (b). Foto: T. Lauko.  
 Fig. 15.7: Yarn from Stare gmajne after restoration (a) and detail (b). Photo: T. Lauko.

#### 15.2.2.5 RESTAVRIRANJE NAJDBE

Literatura nam je ponujala številne možnosti in metode,<sup>18</sup> ki so na nekaterih inštitutih, specializiranih za restavriranje arheoloških tkanin, že utečeni postopki. Za sušenje se pogosto uporablja liofilizacija, za mehansko utrditev pa PEG – polietilenglikol 400, na voljo pa so tudi številna druga sredstva.

Po tehtnem premisleku smo se odločili za kar se da previdno čiščenje v demineralizirani vodi, pri čemer smo prejo v vodo pomakali z uporabo cedila, za primerno kroženje vode pa smo poskrbeli z magnetnim mešalom in tako ustvarili rahlo vrtnčenje ter dinamiko vodne kopeli. Blato in umazanijo, ki se je zlagoma nalagala na prejo, smo odstranjevali z mehkim čopičem.

Po večkratnem splahovanju smo prejo dezinficirali v kopeli 0,1 % vodikovega peroksida ( $H_2O_2$ ) s 5-minutnim namakanjem. Sledilo je ponovno večkratno spiranje v demineralizirani vodi, nato razkisljenje v kopeli 0,005 mol/L raztopine kalcijevega hidrogenkarbonata  $Ca(HCO_3)_2$ , ki je trajalo 10 minut.

Zaradi izredne občutljivosti, celo prhkosti, smo se odločili, da bomo barjansko prejo nekoliko utrdili z namakanjem v 0,5 % raztopini metilceluloze, ki je dolgotrajno stabilna. Prejo smo namakali 6 ur, pri čemer smo pazili, da po sušenju metilceluloza ne ustvari vidnega filma na preji in s tem nezaželenega učinka svetlikanja. Uporabili smo dve vrsti metilceluloze: z daljšimi in krajšimi makromolekulskimi verigami, da bi krajše lahko prodrle v strukturo vlaken, s čimer bi dosegli utrditev od znotraj, daljše makromolekule pa bi z nalaganjem na vlakna te utrdile na površini.

Kljub številnim možnostim za sušenje (z zamrzovanjem, v hladnem, na zraku itd.) smo se odločili za počasno sušenje na zraku pri sobni temperaturi 22 °C. S počasnim sušenjem preprečimo morebitne napetosti v materialu, ki bi lahko povzročile pokanje. Za liofilizacijo se nismo odločili, ker literatura navaja poudarjene spremembe strukture površine mehkih organskih materialov pri tem postopku.

#### 15.2.2.5 TREATMENT

There are a number of publications on possible treatments for conservation of archaeological fibres<sup>18</sup>. Lyophilisation is often used for drying, and PEG – polyethylen glycol 400 for consolidation; other procedures are also available.

After due consideration, we decided for careful cleaning in demineralised water, with the yarn immersed in water but contained in a strainer. Suitable circulation of water was ensured using a magnetic stirrer at a very low speed. The yarn was cleaned of mud and dirt with a soft brush.

We disinfected the yarn with multiple rinsing in 0.1 % hydrogen peroxide ( $H_2O_2$ ), each time for 5 minutes. Multiple elution in demineralised water followed, and a 10 minutes deacidification in a bath of 0.005 mol/L solution of calcium hydrogen carbonate  $Ca(HCO_3)_2$  was performed subsequently.

Because of the extraordinary fragility we decided to consolidate the Ljubljansko barje yarn using a 0.5 % solution of methylcellulose, a durable semi-synthetic polymer. We soaked the yarn for 6 hours, while the concentration of the solution was adjusted so that the dry methylcellulose did not create a visible film on the yarn, giving it a shiny appearance. We used two types of methylcellulose, with longer and shorter macromolecular chains, assuming that the shorter ones would penetrate into the structure of fibres and strengthen the fibres from the inside, while the longer macromolecules would attach themselves to the surface of fibres.

In spite of numerous drying possibilities (with freezing, in the cold, in room conditions etc.), we decided for slow air-drying at room temperature of 22 °C. Eventual tensions in the material, which could lead to cracking, are less likely with slow drying. We did not use lyophilisation, as some publications indicate possible changes of the surface structure especially on soft organic materials.

<sup>18</sup> Potthast, Riens 2003; Hiron, Ingoglia 2005; Hug 2005 idr.

<sup>18</sup> Potthast, Riens 2003; Hiron, Ingoglia 2005; Hug 2005 etc.

Zaradi izjemnosti artefakta smo se odločili, da pozornost posvetimo tudi izdelavi embalaže, v kateri se bo preja hranila, obenem pa po potrebi lahko tudi razstavljala ali celo posojala za določene razstave.

#### 15.2.2.6 PRIPRAVA NA HRANJENJE

Barjanska preja je izredno občutljiv material. Zato smo se odločili, da izdelamo posebno embalažo za hranjenje in tudi za razstavljanje. Epruvete in podobno laboratorijsko posodje za to vsaj dolgoročno ni primerno, saj mora embalaža omogočiti primeren pretok zraka in izmenjavo vlage med notranjostjo in zunanostjo. Še posebej, če takšen material ni na ogled za obiskovalce muzejev, saj se v muzejskih depojih neprimerno zaščiten material hitro založi.

Pri izbiri materiala za embalažo smo se odločili za preverjena materiala, kot sta steklo in brez kislinški papir. Preja je lahko v stiku samo s tema dvema materialoma. Hrastov les, ki je tudi del embalaže, s prejo ne pride v stik. Lahko bi uporabili tudi kak drug les ali celo kovino, vendar v estetskem smislu k barjanski preji nedvomno sodi hrastov les.

Za hranjenje in prezentacijo preje smo se odločili, da naredimo dva okvirja s tremi ležišči (sl. 15.8c). V vsakem okvirju so tri plasti stekla in ena plast brez kislinškega papirja. Spodaj je 3 mm debelo steklo, na njem leži brez kislinški papir, na njem pa 10 mm debelo steklo z izrezanimi ležišči. Večje ležišče ima premer 100 mm, dve manjši pa 50 mm. Na vrhu je še 3 mm debelo pokrivno steklo. Vsa tri stekla so visoka 300 mm in široka 200 mm (format A4). Zaprta so v hrastov okvir. Na spodnji strani okvirja so letve, ki z vijaki omogočajo stalen pritisk vseh treh stekel med seboj. Nekaj materiala je namreč prašnatega, kar pomeni, da bi lahko zašel med steklo in brez kislinški papir (sl. 15.8a).

Zaradi plasti brez kislinškega papirja hranjeni material ni neprepustno zaprt, zato se priporoča relativna vlaga okoli 50 %. Oba okvirja z barjansko prejo se transportirata v vodoravnem položaju. V tem položaju se tudi hranita v depoju, na razstavi pa sta okvirja lahko nagnjena pod kotom 30°. Seveda se priporoča čim manj premikanja.

Sl. 15.8: Sestavni deli zaščitne embalaže za hranjenje preje (a), vlaganje preje v ležišče (b) in končni videz (c). Foto: I. Ravbar.

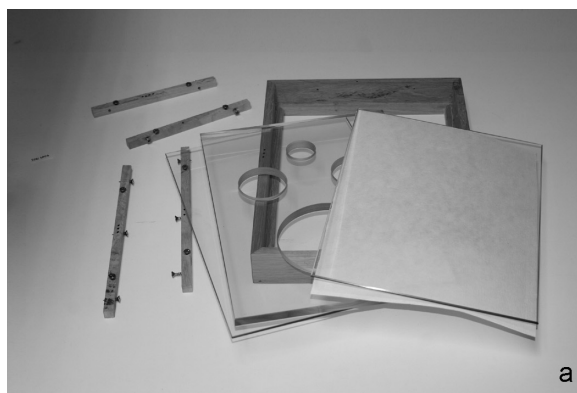
Fig. 15.8: Component parts of protective packaging for keeping the yarn (a), placing the yarn to partition (b) and final appearance (c). Photo: I. Ravbar.

Due to the exceptional value of the object, we also focused our attention on designing a storage case. At the same time, it had to be suitable for display and even for loans.

#### 15.2.2.6 STORAGE ARRANGEMENTS

The Ljubljansko barje yarn is an extremely sensitive material, which is why we decided to make a special case for storage and display. The packaging has to allow suitable air movement and exchange of moisture between the interior and the exterior.

We chose well tested materials to produce the case: glass and acid-free paper, as they were considered to be safe to be in contact with the yarn. Oak wood, which is



### 15.3 SKLEP

Raziskava ostankov preje z arheološkega najdišča Stare gmajne, ki naj bi služila za izdelavo vrvi,<sup>19</sup> verjetno tudi platna oz. finejših tekstilij, je dala zanimiv vpogled v dejavnost, ki je bila izvajana pred več kot 5000 leti na Ljubljanskem barju. Gre za zelo kakovostno prejo organskega izvora, verjetno spredeno iz vlaken, ki jih najdemo v plodovih in steblih rastlin iz družine trav (*Poaceae*).

Po drugi strani so ostanki preje izjemno občutljiv material, ki zahteva tehten premislek pred kakršnikoli posegom, še posebej ko konserviranje ni dovolj in se moramo odločiti za restavriranje artefakta. Po opravljenih konservatorsko-restavratorskih posegih je enako pomembno poskrbeti za varno shranjevanje artefakta tako v depoju kot pri razstavljanju, še posebej pa pri morebitnem transportu.

also part of the case, does not come in contact with the yarn and it was chosen as it is aesthetically appropriate to be used with the Ljubljansko barje yarn.

We decided to make two trays with three partitions (*Fig. 15.8c*) for storage and display of the yarn. There are three layers of glass and one layer of acid-free paper within each tray. The base is made of 3 mm thick glass. This is covered with acid-free paper and with 10 mm thick glass with cut-out partitions. The larger partition has 100 mm and the two smaller ones 50 mm in diameter. A 3-mm thick cover glass is placed on top. All three glasses are 300 mm high and 200 mm wide (A4 format). They are sealed with oak frames. Crossbars with screws on the frame underside create permanent pressure to all three glasses. This is to prevent migration of dust between the glass and acid-free paper (*Fig. 15.8a*).

The material is not impermeably closed because of a layer of acid-free paper, which is why stable external relative humidity of around 50 % is recommended. Both trays containing the Ljubljansko barje yarn, have to be transported horizontally. They also have to be kept in such a position during storage, while they can be tilted 30 ° during display. Of course, as little movement as possible is recommended.

### 15.3 CONCLUSION

Examination of yarn remains, which was perhaps used for making cord,<sup>19</sup> probably also linen or more refined textiles, from the archaeological site Stare gmajne, provided an interesting insight to the activity taking place at the Ljubljansko barje more than 5000 years ago. This is a high-quality yarn of organic origin, probably spun from fibres found in fruits and stems of plants belonging to the family of grasses (*Poaceae*).

The yarn remains are exceptionally sensitive material, which demands due consideration before any intervention, especially when the passive conservation is not sufficient. After the conservation work is finished, it is equally important to provide safe storage and display of the object, and especially enable safe transportation.

<sup>19</sup> Glej npr. Leuzinger 2002b.

<sup>19</sup> See e.g. Leuzinger 2002b.



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Anton Velušček (ed.)

**HOČEVARICA - eneolitsko kolišče na Ljubljanskem barju**  
**HOČEVARICA - an eneolithic pile dwelling in the Ljubljansko barje**

The monograph presents the entire course of archaeological and dendrochronological investigations of two pile dwelling cycles at the Hočevarica site in the Ljubljansko barje, which occurred approximately in the 37th and the first half of the 36th century BC.

In addition to artefacts from Hočevarica (A. Velušček), the results from paleobotanical investigations (M. Jeraj), a classification of the material from a necklace ring (D. Skaberne and A. Mladenovič), analyses of metallurgic instruments (Ž. Šmit) as well as organic remains of mammals (B. Toškan and J. Dirjec), fish (M. Govedič, J. Pavšič and J. Dirjec) and birds (F. Janžekovič and V. Malez) are also presented.

Chapters concerning pottery remains (A. Velušček) are in the continuation. As such, the comparative pottery analyses from sites in central and eastern Slovenia provide the premise for defining the horizon of pottery with furrowed incisions, which is chronologically attributed to the second quarter of the 4th millennium BC on the basis of results from dendrochronological investigations and radiocarbon dating (K. Čufar, A. Velušček, B. Kromer and N. Martinelli). The dendrochronologically determined almost contemporaneity of the pile dwelling sites of Hočevarica in the Ljubljansko barje and Palù di Livenza in northern Italy is revealed (K. Čufar and N. Martinelli).

The determination that the first peak of local metallurgic activity and exploitation of local sources of raw materials in the southeastern Alpine area coincide with the Hočevarica period is also of some significance (A. Velušček).

PARALLEL BILINGUAL SLOVENE-ENGLISH EDITION

2004, (Opera Instituti Archaeologici Sloveniae 8), 328 pp, 208 b/w or color photos, figures and charts, 21 x 29.5 cm, hardcover, ISBN 961-6500-28-7.

Price: EUR 52.40



Ivan Turk (ed.)

**VIKTORJEV SPODMOL IN / AND MALA TRIGLAVCA**  
**Prispevki k poznavanju mezolitskega obdobja v Sloveniji**  
**Contributions to understanding the Mesolithic period in Slovenia**

The monograph, the first regarding the Mesolithic in Slovenia, presents a discussion of two exceptionally rich sites in the Karst in western Slovenia: Viktorjev spodmol and Mala Triglavca. Viktorjev spodmol is a newly discovered site, where only test excavations have been done, while research has been underway at Mala Triglavca for already a while.

The compilation primarily presents a detailed review of Viktorjev spodmol. The comparison of results from various field and post-field methods, which were applied at both Mala Triglavca and especially at Viktorjev spodmol, is particularly important.

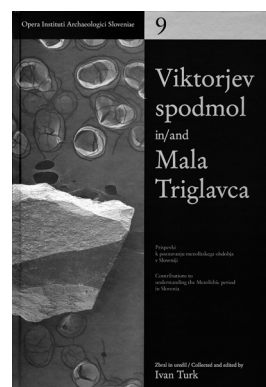
Individual chapters address the topic of microlithic tools attributed to the Sauveterrien-Castelovien complex, their typology and relations with other sites from this complex, and with a special emphasis on the chronology and chronological correlations between Mesolithic sites in northern Italy, including the Trieste karst, and western Slovenia (I. Turk in M. Turk).

The remaining chapters systematically present rare vegetal remains (M. Culiberg), the exceptionally rich collections of mollusc fauna (R. Slapnik, V. Mikuž), ectothermic vertebrates (M. Paunovič) and small mammals (B. Toškan, B. Kryštufek) as well as the remains of large mammals (B. Toškan). At Viktorjev spodmol about 58,000 remains of slowworm and 6,076 remains attributed to 103 other animal species were discovered upon a surface of two square metres in the Mesolithic layer. The same surface revealed 72 typologically classifiable microliths, 104 macrolithic tools and 12,708 debris.

BILINGUAL SLOVENE-ENGLISH EDITION

2004, 247 pp. + 20 plates, 64 b/w photos, drawings and maps, 21 x 29.5 cm, hardcover, ISBN 961-6500-54-6.

Price: EUR 42.40.



Anton Velušček (ed.)

**RESNIKOV PREKOP.**

**Najstarejša koliščarska naselbina na Ljubljanskem barju**

**RESNIKOV PREKOP.**

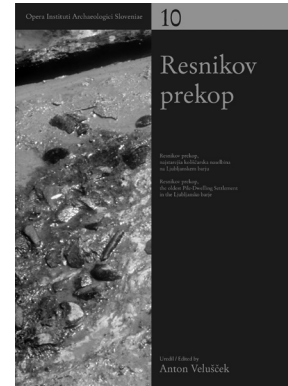
**The oldest pile-dwelling settlement in the Ljubljansko barje**

In the monograph the results of the most recent research of the prehistoric pile-dwelling settlement Resnikov prekop near Ig on the southeastern part of the Ljubljansko barje are presented.

The book is printed in two languages with the Slovenian and English texts flowing in parallel columns.

2006, (Opera Instituti Archaeologici Sloveniae, 10), 156 pp., 88 b/w drawings, photos, tables, graphs and maps, 21 x 29,5 cm, hardcover, ISBN 961-6568-40-X.

Price: EUR 40.00



Andrej Gaspari (ed.)

**ZALOG PRI VERDU.**

**Tabor kamenodobnih lovcev na zahodnem robu Ljubljanskega barja**

**ZALOG NEAR VERD.**

**Stone Age hunters' camp at the western edge of the Ljubljansko barje**

The Ljubljanica River with its tributaries has witnessed no less than a quarter of a century of organised underwater research. The latter has shown that the archaeological complex there unquestionably ranks among the most interesting ones in Slovenia with finds from the beds and banks of the waterways speaking of nearby settlements, cemeteries, forts, control points or cult places. These, together with various types of river vessels and other traces of water exploitation, improve in many ways the knowledge of the phenomenon that is the Ljubljansko barje as a cultural landscape as well as its specific dynamics closely related to the natural changes in the environment from the early periods of the prehistory onwards.

The book is printed in two languages with the Slovenian and English texts flowing in parallel columns.

2006, (Opera Instituti Archaeologici Sloveniae, 11), 233 pp., 37 drawings, photos, tables, graphs and maps, 99 b-w drawings, photos, tables, graphs and maps, 21 x 29,5 cm, hardcover, ISBN 961-6568-57-4.

Price: EUR 43.00.



Janez Dular, Sneža Tecco Hvala

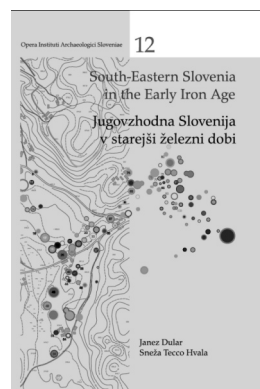
**SOUTH-EASTERN SLOVENIA IN THE EARLY IRON AGE.  
Settlement – Economy – Society  
JUGOVZHODNA SLOVENIJA V STAREJŠI ŽELEZNI DOBI.  
Poselitev – gospodarstvo – družba**

The topic of this monograph is southeastern Slovenia in the 1st millennium BC. The first part of the book deals with the history of research, data acquisition, with a critical discussion of archaeological sources, a geographic outline of the region, and an explanation of the chronological system used in the research.

The core of the treatise deals with the settlement structures and patterns in the Late Bronze Age and the Iron Age, as well as the dynamics of the colonization and integration processes, the relationship between lowland and upland settlements, and the issue of extra muros settlement in the vicinity of major centres.

The hierarchy of the settlements is also one focus of this publication. All the centres are fully described with maps, plans and images. Particular attention is paid to the density of the settlement network in relation to natural resources and communications, and in fact, to those factors that have a substantial impact on economic subsistence and social power. The last chapter is dedicated to the social organization and historical turning points that significantly marked the long-term development of this region.

The catalogue of sites at the end of the book contains 510 records with added ground-plans and bibliographic references.

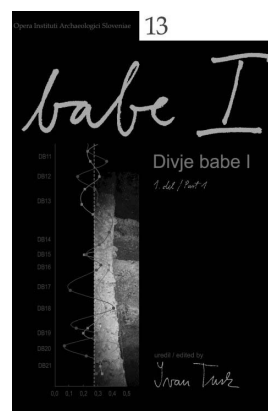


2007, (Opera Instituti Archaeologici Sloveniae, 12), 392 pp., 4 colour drawings and maps, 275 b-w drawings, photos, tables, graphs and maps, 21 x 29,5 cm, hardcover, ISBN 978-961-254-000-5.

Ivan Turk (ed.)

**DIVJE BABE I. Paleolitsko najdišče mlajšega pleistocena v Sloveniji. I. del  
DIVJE BABE I. Upper Pleistocene Palaeolithic site in Slovenia. Part I**

In the first part of the Divje babe I monograph, data from the fields of the natural sciences are presented, analysed and interpreted. This is primarily stratigraphic, sedimentological and chronological data and data about the remains of flora and fauna. The latter includes detailed analysis of charcoal from a number of hearths and the remains of small and large mammals, with an emphasis on cave bear. The series of absolute ESR datings and the climatogram of the site should be highlighted in particular, which shows the course of temperature and humidity by layers in the chronozone of the Early and Middle Würm or oxygen isotope stages OIS 5 and OIS 3. The remains of flora and fauna from OIS 3 in particular are analysed, which enables new insight into palaeo-environmental and climatic conditions of this poorly known chronological segment in Slovenia and neighboring regions. Archaeological finds, including Mousterian bone artefacts, will be presented in the planned second part of the monograph.



2007, (Opera Instituti Archaeologici Sloveniae, 13), 480pp, 10 colour photographs, 178 b-w drawings, photographs and maps, 89 tabs and 38 annexes; 21 x 29,5 cm, hardcover, ISBN



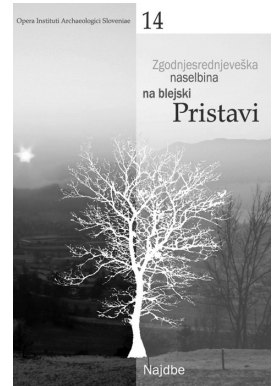
Andrej Pleterski

(Mit Beiträgen von Timotej Knific, Borut Toškan, Janez Dirjec, Benjamin Štular und von Mateja Belak)

### **Zgodnesrednjeveška naselbina na blejski Pristavi. Najdbe. Frühmittelalterliche Siedlung Pristava in Bled. Funde**

Pristava in Bled ist vielleicht die interessanteste Fundstelle im Ostalpenraum. Sie umfasst die gegenseitig stratigraphisch verflochtene Siedlung und das Gräberfeld. Im Ort begegneten sich die alteingesessenen Walchen und die neuangekommenen Slawen, die in den frühmittelalterlichen Bewohnern von Bled zusammenwuchsen. Diese doppelten Wurzeln sind in Gegenständen, Bestattungsarten und Hausformen ersichtlich. Das Buch stellt alle seit 1943 ausgegrabenen Siedlungsfunde vor und rekonstruiert slawische Brandgräber des 7. Jahrhunderts. Es entwickelt neue Methoden der taphonomischen Analyse, zeigt Gebäudereste und führt augenblicklich die größte Sammlung der frühmittelalterlichen Keramik in Slowenien vor.

2008, (Opera Instituti Archaeologici Sloveniae, 14), 276 Seiten., 52 Farbabbildungen, 140 s/w Abbildungen und Tabellen, 39 s/w Tafeln; 21 x 29,5 cm, feste Bindung, ISBN 978-961-254-072-2.  
Preis: EUR 51.00



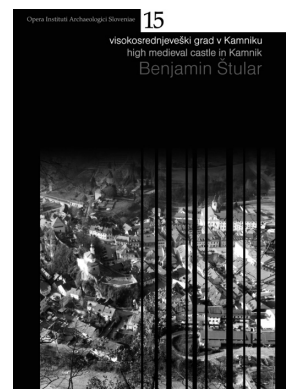
Benjamin Štular

### **MALI GRAD. Visokosrednjeveški grad v Kamniku MALI GRAD. High Medieval Castle in Kamnik**

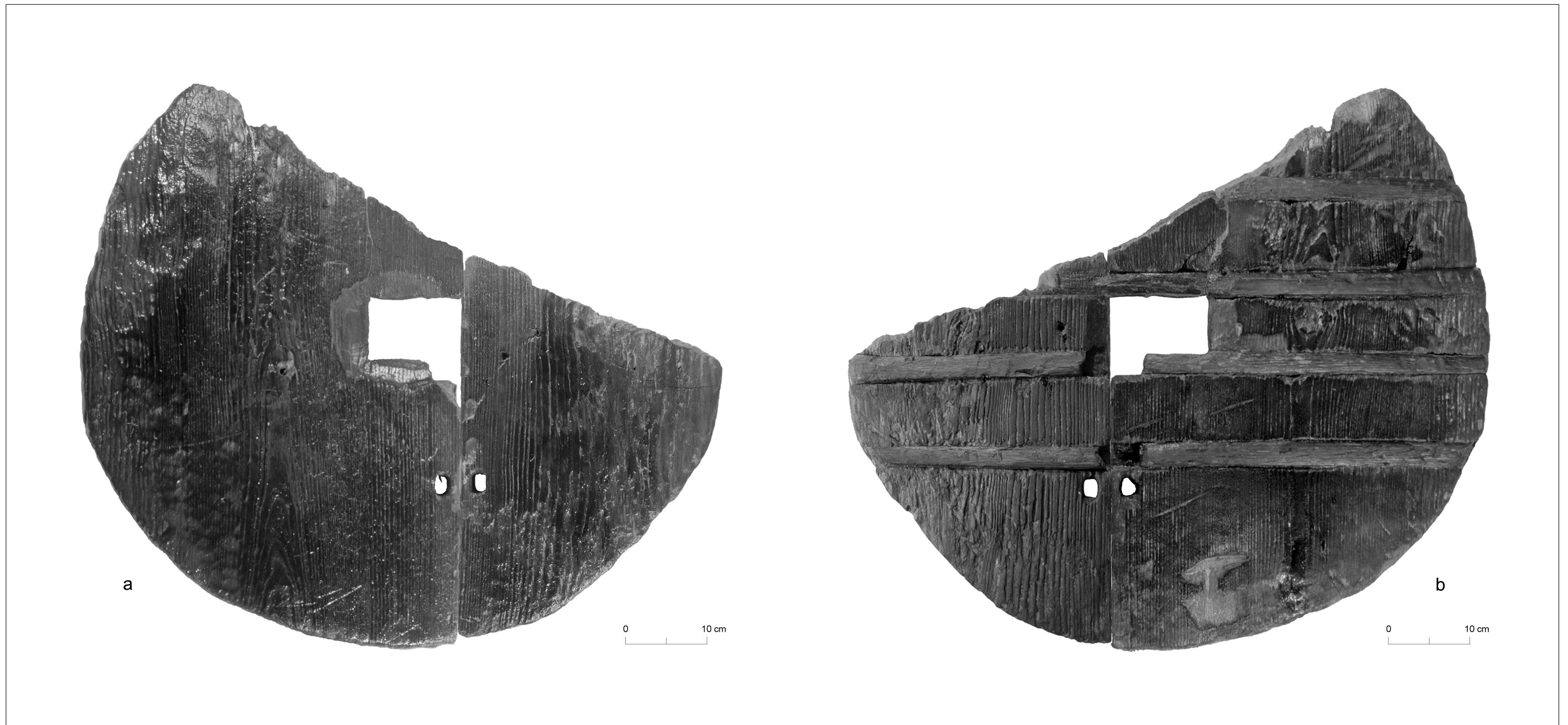
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2009, (Opera Instituti Archaeologici Sloveniae, 15), 256 pages, b-w drawings, photos, tables, graphs and maps, 25 tabs, 21 x 29,5 cm, hardcover, ISBN 978-961-254-111-8.  
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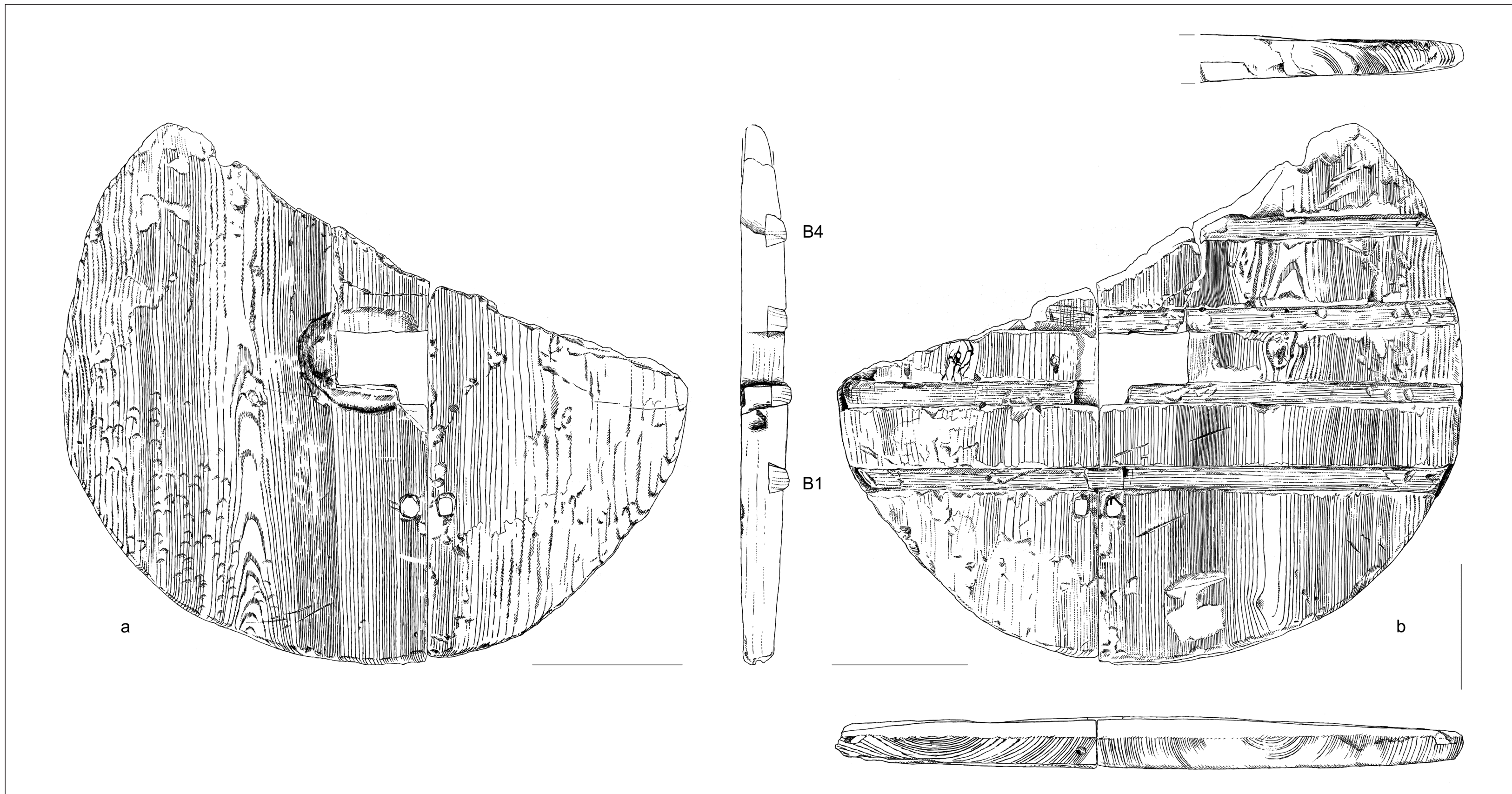






Sl. 8.10: Kolo. Notranja (a) in zunanja (b) stran. Foto: M. Zaplatil.  
Fig. 8.10: Wheel. Inner (a) and outer (b) surface. Photo: M. Zaplatil.



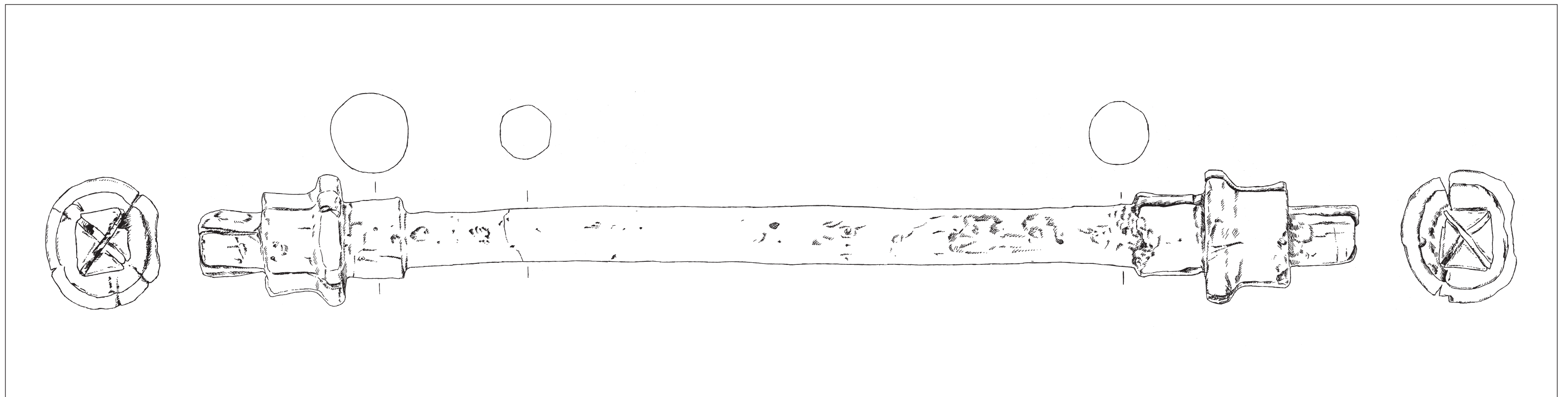


Sl. 8.11: Kolo. Notranja (a) in zunanja (b) stran s preseki. Risbe: T. Korošec. M = 1 : 4.

Fig. 8.11: Wheel. Inner (a) and outer (b) surface with cross-sections. Drawn by: T. Korošec. Scale = 1 : 4.



Sl. 8.22: Lesena os. Foto: M. Zaplatil.  
Fig. 8.22: Wooden axle. Photo: M. Zaplatil.



Sl. 8.23: Lesena os, različni pogledi in preseki. Risba: T. Korošec. M = 1 : 4.  
Fig. 8.23: Wooden axle, different views and cross-sections. Drawn by: T. Korošec. Scale = 1 : 4.



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