Assemblages from Marginal Spaces: The results of the excavations in Mala (Nova) Pećina near Muć and the Neolithic of Dalmatinska Zagora

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UDK 902
ISSN 1330-0644
VOL 35/2018.
ZAGREB, 2018.

Prilozi

Instituta za arheologiju u Zagrebu

Pril. Inst. arheol. Zagrebu
Str./*Pages* 1–328, Zagreb, 2018.

Pril. Inst. arheol. Zagrebu, 35/2018
Str./*Pages* 1–328, Zagreb, 2018.

Izdavač/*Publisher*
INSTITUT ZA ARHEOLOGIJU
INSTITUTE OF ARCHAEOLOGY

Adresa uredništva/*Address of the editor's office*
Institut za arheologiju/*Institute of archaeology*
HR–10000 Zagreb, Ulica Ljudevita Gaja 32
Hrvatska/*Croatia*
Telefon/Phone ++385/(0)1 61 50 250
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http://www.iarh.hr

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Tiskara Zelina d.d., Sv. I. Zelina

Naklada/*Issued*
400 primjeraka/*400 copies*

Prilozi Instituta za arheologiju u Zagrebu uključeni su u sljedeće indekse/
Prilozi Instituta za arheologiju u Zagrebu are included in following indices:
DYABOLA – Sachkatalog der Bibliothek – Römisch-Germanische Kommission des Deutschen Archaeologischen Instituts, Frankfurt a. Main
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SciVerse Scopus – Elsevier, Amsterdam

Pril. Inst. arheol. Zagrebu, 35/2018
Str./*Pages* 1-328, Zagreb, 2018.

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Nalazi iz marginalnih prostora: Rezultati istraživanja Male (Nove) pećine pokraj Muća i neolitik Dalmatinske zagore

Izvorni znanstveni rad
Prapovijesna arheologija

Original scientific paper
Prehistoric archaeology

UDK/*UDC* 903.4(497.5-3 Dalmatinska zagora)"634"

Primljeno/*Received*: 15. 01. 2018.
Prihvaćeno/*Accepted*: 04. 06. 2018.

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Mala (Nova) Pećina cave is located in Croatia, in the Dalmatian Hinterland (Dalmatinska Zagora), a mountainous region which is the contact zone between the eastern Adriatic coast and the interior. The excavations in Mala Pećina uncovered an Early and Late Neolithic cave site that might be key for a better understanding of the relationship between the coastal groups and the communities of the western Balkan interior. This paper aims to present the finds and contextual data from the 2016 excavations and the consequent 2017 study season. It presents an account of the pottery and lithic assemblages along with the zooarchaeological and archaeobotanical data from the cave. The preliminary evidence suggests that the cave was not used as a long term dwelling but rather as a temporary shelter, either for groups that were moving through the mountains or for groups that visited the cave for short term activities. The excavations have also shown a possible distinction between the use of the cave in the Early Neolithic, when people dwelled there and possibly engaged in ritual activities, and the Late Neolithic, when it was mostly used by shepherds. Mala Pećina is therefore particularly important as it offers the potential to better understand the interactions between the coast and the hinterland during the Neolithic.

Key words: Adriatic Neolithic, Cave Archaeology, Impressed Ware culture, Hvar culture, interaction between coast and hinterland

Špilja Mala (Nova) pećina smještena je u planinskome području dalmatinskoga zaleđu koje predstavlja dodirnu zonu između istočne jadranske obale i unutrašnjosti. U arheološkim iskopavanjima u Maloj pećini istražen je rano- i kasnoneolitički špiljski lokalitet koji bi mogao biti ključan za bolje razumijevanje odnosa između obalnih zajednica te onih smještenih u zapadnobalkanskoj unutrašnjosti. U članku će biti predstavljeni nalazi i kontekstualni podaci prikupljeni u istraživanju iz 2016. godine, kao i rezultati njihove obrade provedene 2017. godine, koji uključuju keramičke i litičke nalaze te zooarheološke i arheobotaničke analize. Preliminarni dokazi ukazuju da špilja nije korištena kao nastamba duži vremenski period, već kao privremeno sklonište od strane zajednica koje su se kretale kroz okolne planine ili onih koje su posjećivale špilju u sklopu kratkotrajnih aktivnosti. Iskopavanja su također ukazala na moguću razliku u korištenju špilje u ranome neolitiku s tragovima naseobinskih, ali i potencijalnih ritualnih aktivnosti, u odnosu na kasni neolitik s isključivo pastoralnom funkcijom. Mala pećina je stoga iznimno važna za bolje razumijevanje odnosa između obale i zaleđa u razdoblju neolitika.

Ključne riječi: jadranski neolitik, špiljska arheologija, Impresso kulturna skupina, hvarska kultura, interakcija obale i zaleđa

THE CAVE AND THE EXCAVATION

The spread of the Neolithic in South East Europe is now believed to have occurred through two major streams of diffusion; the Starčevo culture for the Balkan hinterland and the Pannonian plain and the Impressed Ware culture for the Adriatic coast (Borić, Price 2013; Budja 2001; 2010; Vander Linden et al. 2014: 21). The excavations at Mala Pećina were undertaken to shed light on the relationship that the coastal societies could have had with the hinterland groups and to test the dominant idea that the coastal Neolithisation was isolated from the events that happened in the Balkan hinterland (Biagi et al. 2005; Forenbaher, Miracle 2005). The main objectives of the 2016 campaign were to collect information about the occupation periods of the cave, to understand the role of caves for the local Neolithic communities, and to investigate if the cave was part of a route that connected the Eastern Adriatic coast with the western Balkans hinterland during the 6th millennium BC.

Mala Pećina (or Nova Pećina, as it was named in the late 19th century publication) is located in southern Croatia, in the hinterland of the region of central Dalmatia. The cave is located deep in the hills, almost a kilometer south from the road that connects the town of Sinj with the village of Gornji Muć (Fig. 1a). The cave was discovered in the late 19th century by Don Miho Granić, a local priest and the commissioner of the National Museum in Zagreb, and its survey was the first cave survey to be published in a Croatian scientific journal (Granić 1882). It wasn't until 1998 and 2003 that the site sparked new archaeological interest when D. Kliškić from the Archaeological Museum in Split conducted a basic cave survey of the site (Kliškić 2004). In October 2010, the site was revisited by the Speleological Society for the Filming and Survey of Karst Phenomena from Zagreb. During the 2010 survey the team made a detailed map of the cave using a Leica total station and discovered Early Neolithic (EN) and probably Bronze Age pottery and an articulated bone fragment in the lower passage between the second and the third chamber (the later position of Trench 2).[1] The bone fragment was dated by Beta Analytic Laboratory, USA, and provided a date between 5780 and 5650 cal

1 Positions of the colected pottery are marked in Fig. 2 (positions 1–8).

ŠPILJA I ISKOPAVANJA

Širenje neolitika u jugoistočnoj Europi odvijalo se, prema današnjim interpretacijama, preko dva glavna pravca širenja: starčevačkom kulturom na prostoru Balkana i Panonske nizine te *Impresso* kulturnom skupinom na jadranskoj obali (Borić, Price 2013; Budja 2001; 2010; Vander Linden et al. 2014: 21). Iskopavanja u Maloj (Novoj) pećini nastojat će utvrditi odnos koji su obalne zajednice imale s populacijama iz zaleđa i testirati dominantnu tezu da je neolitizacija u obalnome prostoru izolirana od događaja koji su se odvijali u balkanskome zaleđu (Biagi et al. 2005; Forenbaher, Miracle 2005). Glavni ciljevi istraživanja iz 2016. godine bili su prikupljanje podataka o razdobljima ljudskoga boravka u špilji, razumijevanje uloge objekta za lokalne neolitičke zajednice, kao i njene pozicije na komunikaciji koja je povezivala istočnu jadransku obalu sa zapadnobalkanskim zaleđem tijekom 6. tisućljeća pr. Kr.

Mala pećina (ili Nova pećina kako se spominje u objavi iz kasnoga 19. stoljeća) nalazi se na jugu Republike Hrvatske, u zaleđu prostora središnje Dalmacije. Špilja je smještena duboko u brdima, oko kilometar južno od ceste koja povezuje Sinj s Gornjim Mućem (sl. 1a). Špilju je krajem 19. st. otkrio don Miho Granić, lokalni svećenik i povjerenik Narodnoga muzeja u Zagrebu, a rezultati njegovoga terenskog pregleda predstavljaju prvu objavu neke špilje u hrvatskoj znanstvenoj literaturi (Granić 1882). Objekt se u arheološki fokus ponovno vratio tek 1998., odnosno 2003. godine kada je Damir Kliškić iz Arheološkoga muzeja u Splitu proveo površinski pregled na lokalitetu (Kliškić 2004). Članovi Društva za istraživanje i snimanje krških fenomena iz Zagreba ponovno su posjetili lokalitet u listopadu 2010. godine, pri čemu je korištenjem totalne stanice Leica izrađen detaljan nacrt objekta te su prikupljeni površinski nalazi keramičkih ulomaka iz ranoga neolitika i vjerojatno brončanoga doba. Također, u hodniku koji spaja drugu i treću dvoranu (na poziciji kasnije Sonde 2)[1] pronađen je ulomak životinjske kosti koji je u Beta Analytics laboratoriju datiran u razdoblje između 5780. i 5650. godine pr. Kr. (Beta-287818). Rezultati

1 Pozicije prikupljene keramike označene su na Sl. 2 (pozicije 1–8).

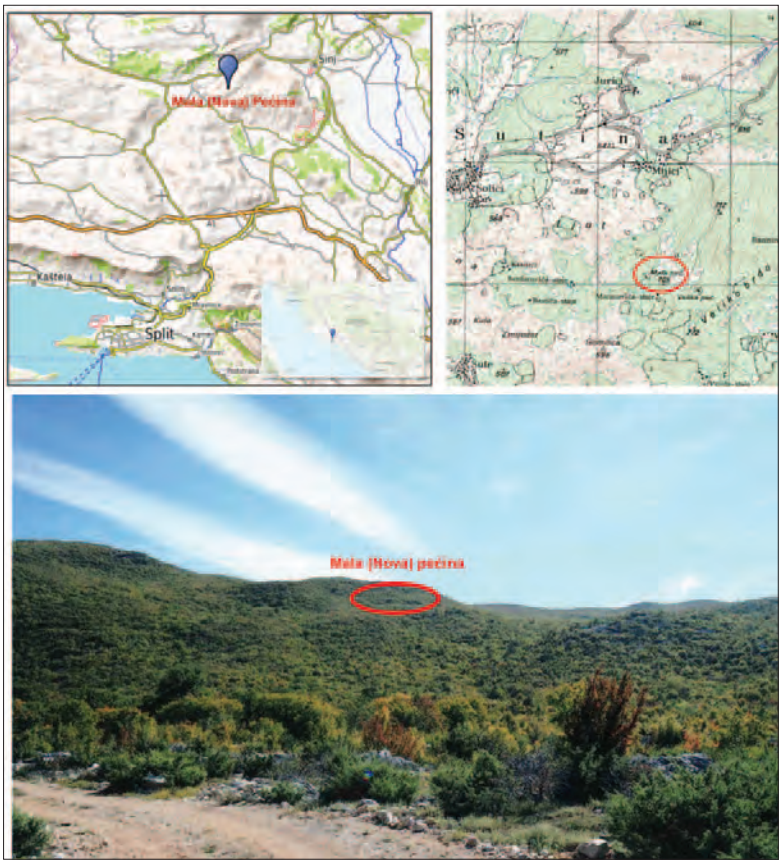


Fig. 1a Geographical position of Mala (Nova) Pećina cave (Geoporta; photo: M. Garašić)
Sl. 1a Položaj Male (Nove) pećine (Geoportal; foto: M. Garašić)

Fig. 1b Cave entrance (photo: K. P. Trimmis)
Sl. 1b Špiljski ulaz (foto: K. P. Trimmis)

BC (Beta-287818). The results of the survey were presented at The First Croatian Speleological Congress held in Poreč in November 2010 (Drnić et al. 2010).

The entrance of the cave is located in a small valley and is more of a narrow short shaft measuring 1 x 1.5 m and with a depth of 2 m (Fig. 1b). The shaft leads to a small chamber 5.5 m long and 3 m wide. At the end of the "hallway", as the chamber was named by the members of the excavation team, there is a narrow passage that can be accessed only by crawling and that leads to the first chamber of the cave with the maximum dimensions of 12 x 5 m. At the northeast corner of Chamber 1, another passage leads to the second chamber, which is the largest of the cave, with the maximum dimensions of 21 x 7 m; 12 m before the northwest end of the second chamber, there begins a low passage (1.1 m maximum height) that is 13 meters long, leading north to the third and final chamber of the cave. Chamber 3 is the smallest chamber of the cave, with the maximum dimensions of 13 x 7 m. However, Chamber 3 is the tallest of the cave, with a second, vertical entrance above it like a "skylight" for the chamber (Fig. 3).

The excavations in Mala Pećina were conducted during the summer of 2016, between the 11th of June and the 8th of July, as a joint project between the Cardiff University and the Archaeological Museum in Zagreb. Three trenches were opened; Trench 1 at the end of the first chamber, Trench 3 at the southern part of the second chamber, and Trench 2 at

opisanoga pregleda predstavljeni su na Prvome hrvatskom speleološkom kongresu održanom u studenom 2010. u Poreču (Drnić et al. 2010).

Ulaz u špilju je smješten u maloj dolini i predstavlja uzak i kratak prolaz, dimenzija 1 x 1,5 m i dubine 2 m (sl. 1b). Prolaz/okno vodi do male komore dužine 5,5 i širine 3 metra. Na završetku „predvorja", kako je komora nazvana od strane istraživačkoga tima, nalazi se uzak prolaz kroz koji se može proći samo puzanjem, a koji vodi do prve špiljske dvorane, dužine 12 metara i najveće širine 5 metara. U sjeveroistočnome dijelu dvorane 1 drugi prolaz vodi do druge, najveće dvorane dimenzija 21 x 7 metara. Dvanaest metara prije sjeverozapadnoga završetka dvorane započinje nizak (najveća visina 1,1 m) i 13 metara dugačak hodnik koji vodi do treće i posljednje špiljske dvorane, dimenzija 13 x 7 metara. Iako je najmanja, dvorana 3 je najviša u objektu s drugim, vertikalnim ulazom na vrhu stropa kroz koji u špilju dopire danje svjetlo (sl. 3).

Iskopavanja u Maloj pećini provedena su tijekom ljeta 2016. godine, između 11. lipnja i 8. srpnja, kao zajednički projekt Sveučilišta u Cardiffu i Arheološkoga muzeja u Zagrebu. Istražene su tri sonde: Sonda 1 na kraju prve dvorane, Sonda 3 na južnome dijelu druge dvorane i Sonda 2 u niskome hodniku neposredno prije dvorane 3 (sl. 2). Na poziciji Sonde 2 u pregledu iz 2010. godine prikupljeni su ulomci *impresso* keramike, kao i datirani ulomak životinjske

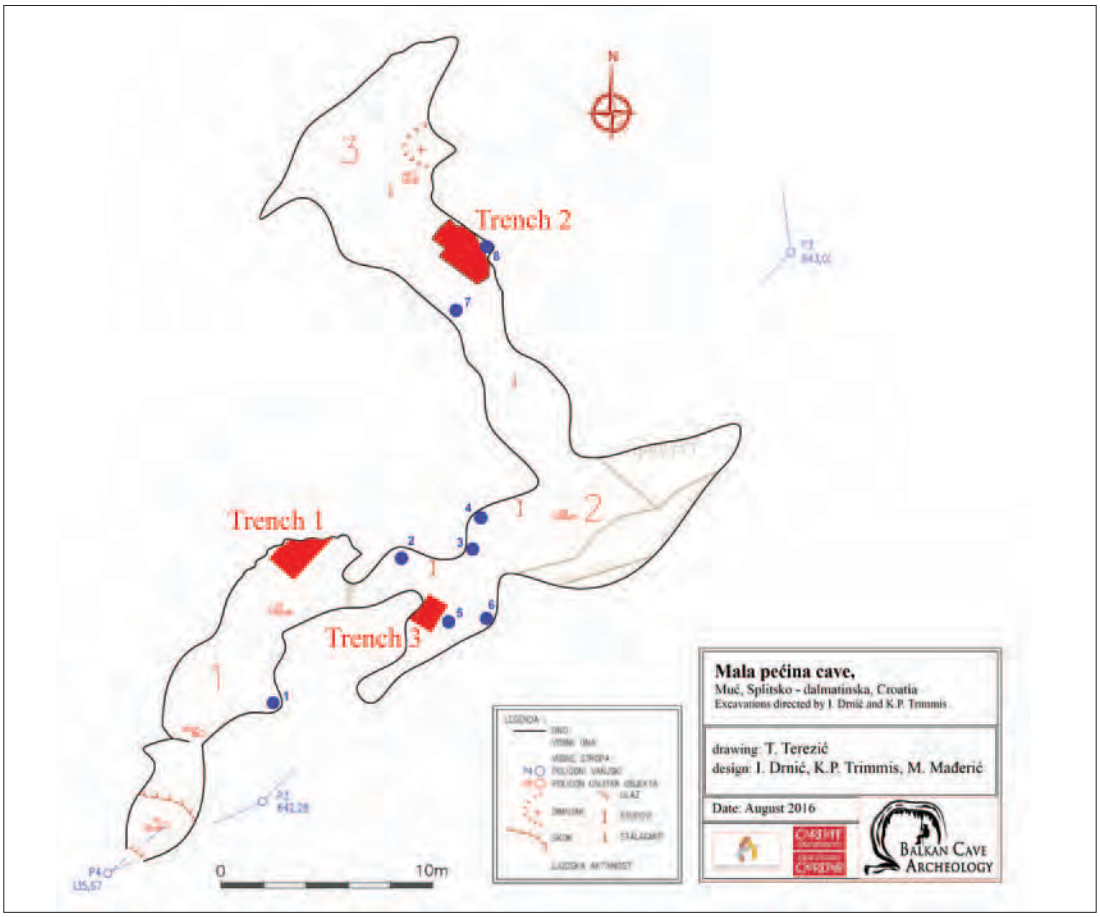


Fig. 2 Map of Mala Pećina with the positions of the pottery finds from the 2010 survey (blue dots) and trenches from the 2016 excavation (original drawing: T. Terzić; graphics: I. Drnić, K. P. Trimmis, M. Mađerić)

Sl. 2 Plan Male pećine s pozicijama nalaza keramičkih ulomaka prikupljenih u pregledu iz 2010. godine (plave točke) i sondi iz iskopavanja iz 2016. godine (izvorni crtež: T. Terzić; grafička obrada: I. Drnić, K. P. Trimmis, M. Mađerić)

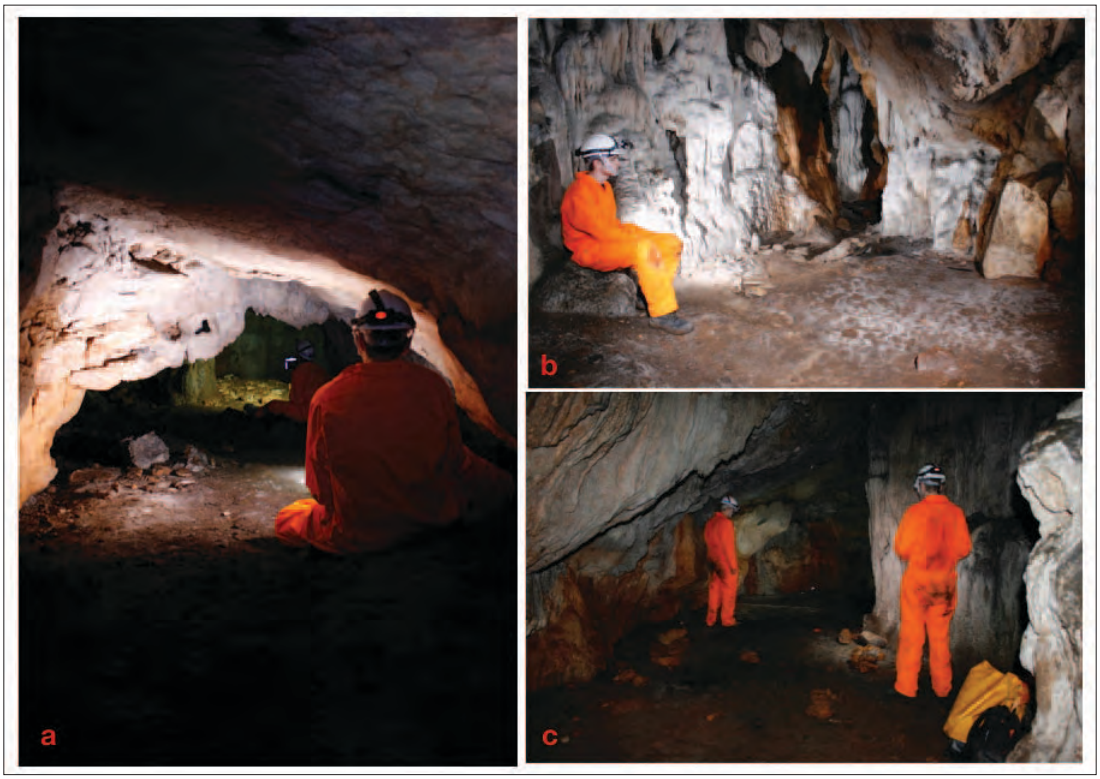


Fig. 3 a) Passage between Chambers 2 and 3; b) chamber 2; c) chamber 1 (photo: K. P. Trimmis)

Sl. 3 a) Hodnik između dvorna 2 i 3; b) dvorana 2; c) dvorana 1 (foto: K. P. Trimmis)

the point where the lower passage leads to Chamber 3 (Fig. 2). This is also the same place where the 2010 team collected impressed pottery and the dated bone sample (position 8 in Fig. 2). The excavations at Mala Pećina were an organizational and logistical challenge because of the rough terrain, the low temperature inside the cave (10.1°C on the average), the high humidity (98.7% on the average), and the absolute darkness.

THE EXCAVATION OUTCOMES

The Stratigraphic Narrative in Trenches 1–3

The upper layers of Trench 1, sealed with 5–10 cm of sterile cave sediment (MP1 001), were the only layers in the cave with Late Neolithic (LN) occupation (**structure 1**), dated with a few sherds characteristic for the Hvar pottery style (Pl. 2: 1–4). The majority of the relatively rare ceramics and bones were concentrated around a hearth. The hearth was comprised of three layers, a light grey-white layer of ash (MP1 003) that overlays a dark brown and black deposit of burnt soil (MP1 004) (Fig. 4a). The burnt deposits were based on a few circularly arranged burnt stones (MP1 005). The hearth lay on the brown layer, with the inclusions of the crust (MP1 006) indicating a certain time gap between structures 1 and 2.

A layer of red-brown soil under the hearth (MP1 027) with mixed EN and LN ceramic material, similar in composition to the sterile surface layer, sealed two Early Neolithic occupation layers. The first one, defined as **structure 2**, was comprised of several postholes, a pit, a hearth and a pebble deposit placed in an oval pit (MP1 037–042) (Fig. 4b), indicating intense activity in this part of the cave. The postholes could have served as foundations for the vertical beams used to build a provisional shelter in connection to the hearth, with pebbles serving as "post packing" that was deliberately placed in order to support a large main beam/post. For example, similar features with stone and daub deposits at the EN open site at Crno Vrilo have been interpreted as the foundations of the vertical elements of the wall construction (Marijanović 2009a: 39, Fig. 41–42). This was followed by the earliest occupation layer in Trench 1 with several postholes, a few of them with preserved charred wood remains, placed mostly next to the cave wall **(structure 3).** Also, three smaller pits were excavated in this feature with a few Impressed Ware pottery sherds in the fills (Pl. 3: 4). No evidence of a "floor" surface or an organized hearth was found in this layer, but the postholes probably had the same function as in the previous phase. The human-made stratigraphy, 20–40 cm thick (Fig. 5), was based on a thick alluvium sterile layer that overlaid the natural bedrock (Fig. 6).

The most distinct and important feature in Trench 2 represents what is most likely a burnt, stone-built, simple semi-circular structure (MP2 008), dated with the Impressed Ware pottery to the EN period (Fig. 7).[2] Interestingly, the

2 The previously mentioned bone sample, dated to 5780–5640 BC, was collected in a disturbed cave sediment just above the structure.

kosti (pozicija 8 na sl. 2). Zbog negostoljubivoga terena, niske temperature (prosjek 10,1 °C), visoke vlage (prosjek 98,7 %) te potpunoga mraka, istraživanje u Maloj pećini predstavljalo je organizacijski i logistički izazov.

REZULTATI ISTRAŽIVANJA

Stratigrafija u Sondama 1–3

Gornji slojevi u Sondi 1, prekriveni s 5–10 cm sterilnoga špiljskog sedimenta (MP1 001), jedini su slojevi u špilji s tragovima kasnoneolitičkoga korištenja objekta (**struktura 1**), datirani s nekoliko keramičkih ulomaka karakterističnih za hvarsku kulturu (T. 2: 1–4). Većina relativno malobrojnih ulomaka keramičkih posuda i kostiju nađena je oko ostataka istraženoga ognjišta. Ognjište se sastojalo od tri sloja: svijetlosivo – bijeloga sloja pepela (MP1 003) koji je prekrivao tamnosmeđe – crni sloj zapečene zemlje (MP1 004) (sl. 4a). Ispod opisanih gorenih ostataka nalazilo se nekoliko kružno postavljenoga kamenja s tragovima gorenja (MP1 005).

Sloj crveno-smeđega tla (MP1 027) s izmiješanim rano i kasnoneolitičkim keramičkim ulomcima koji se nalazio ispod ognjišta, a koji je po sastavu sličan površinskome sterilnom sloju, prekrio je dva istražena ranoneolitička horizonta. Prvi, definiran kao **struktura 2,** sastojao se od nekoliko ukopa za stupove, jame, ognjišta te nakupine oblutaka položenih u ovalnu jamu (MP1 037–42) (sl. 4b), što ukazuje na intenzivnu aktivnost u ovome dijelu špilje. Rupe su vjerojatno služile za temeljenje okomitih stupova/greda koje su korištene za izgradnju privremenoga skloništa kojemu pripadaju i ostaci ognjišta, dok je nakupina oblutaka, namjenski položenih u jamu, vjerojatno imala funkciju temelja za glavni stup većih dimenzija. Primjerice, u ranoneolitičkome naselju na otvorenom Crno vrilo slične strukture s deponiranim kamenjem i ulomcima kućnoga lijepa definirane su kao temelji za vertikalne elemente zidne konstrukcije (Marijanović 2009a: 39, sl. 41–42). Slijedio je najraniji naseobinski sloj u Sondi 1 s nizom rupa za stupove s ostacima spaljenoga drveta u nekoliko zapuna, smještenih uglavnom uz špiljski zid (**struktura 3**). Također, istražene su i tri manje jame s nekoliko ulomaka karakteristične *impresso* keramike u zapunama (T. 3: 4). U ovome horizontu nisu zabilježeni tragovi „poda" ili ognjišta, ali su rupe od stupova vjerojatno imale istu funkciju kao i u prethodno opisanoj, mlađoj fazi. Antropogena stratigrafija, debljine 20–40 cm (sl. 5), nalazila se na debelome aluvijalnom sterilnom sloju koji je prekrivao kamen živac (sl. 6).

Najistaknutiji nalaz u Sondi 2 predstavlja jednostavna polukružna kamena struktura (MP2 008) s tragovima gorenja koju nalazi *impresso* keramike datiraju u rani neolitik (sl. 7).[2] Važno je napomenuti da se u strukturi nalaze i komadi okorine te stalagmita što ukazuje na iskorištavanje postojećih geoloških formi u špilji. Spaljeni sloj MP2 004, zabilježen između površinskih slojeva MP2 001–002 i kamene strukture, mogu se dovesti u vezu s ranoneolitičkom aktivnošću u

2 Prethodno spomenuti uzorak životinjske kosti, datiran između 5780. i 5640. god. pr. Kr., prikupljen je u izbačenome špiljskom sedimentu točno iznad opisane kamene strukture.

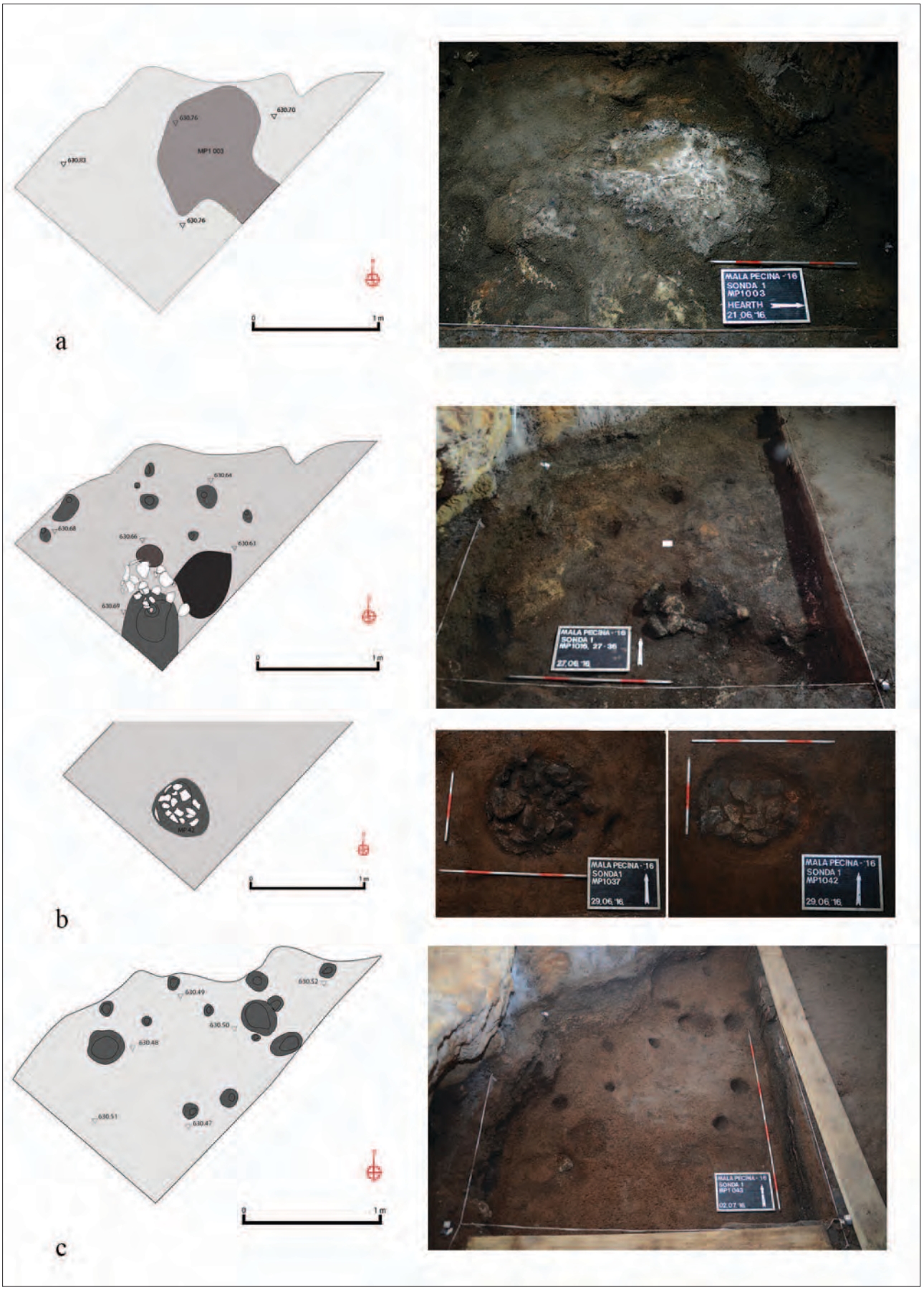


Fig. 4 Trench 1: a) structure 1; b) structure 2; c) structure 3 (photo: K. P. Trimmis, I. Drnić; plans: M. Mađerić, I. Drnić)
Sl. 4 Sonda 1: a) struktura 1; b) struktura 2; c) struktura 3 (foto: K. P. Trimmis, I. Drnić; nacrti: M. Mađerić, I. Drnić)

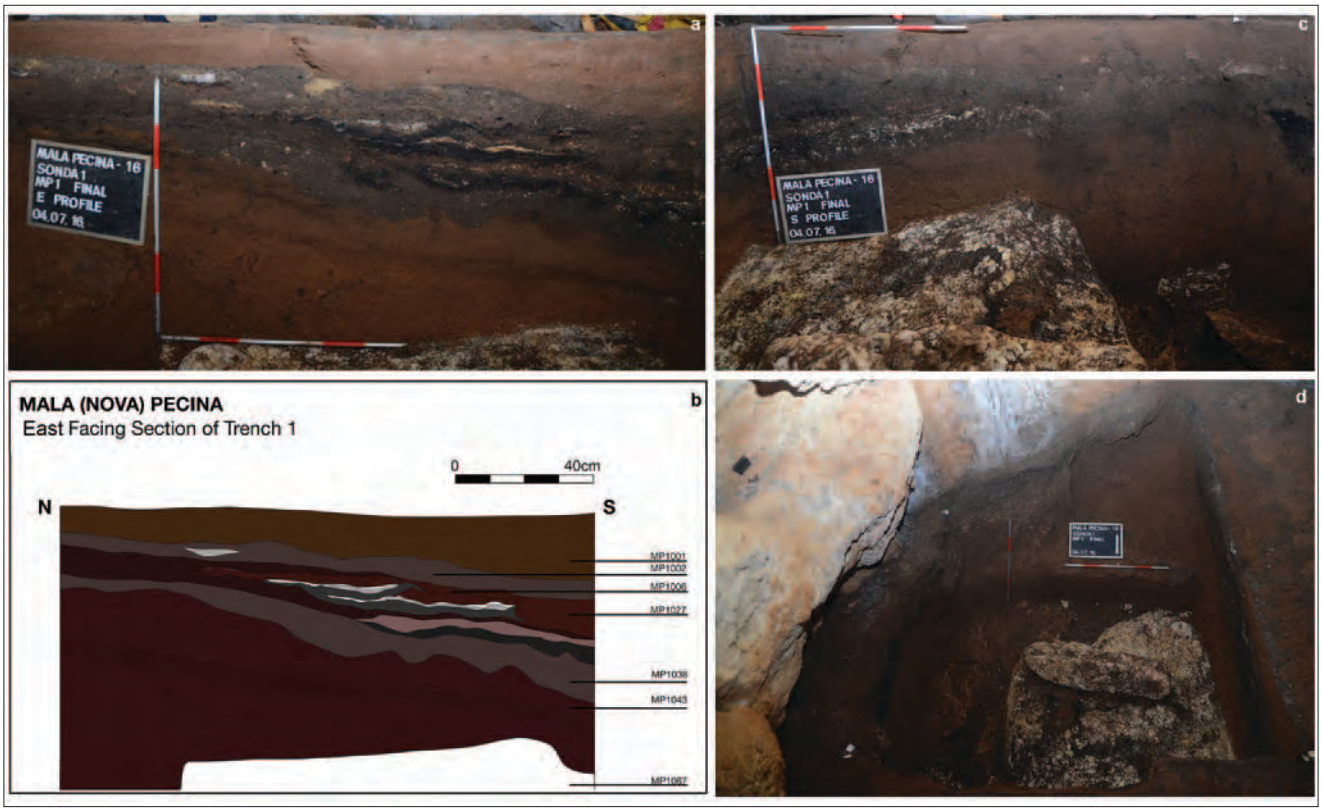


Fig. 5 a–b) Eastern profile in Trench 1 (photo/drawing: K. P. Trimmis); c) southern profile in Trench 1 (photo: K. P. Trimmis); d) trench 1 – final situation (photo: I. Drnić)

Sl. 5 a–b) Istočni profil u Sondi 1 (foto/nacrt: K. P. Trimmis); c) južni profil u Sondi 1 (foto: K. P. Trimmis); d) Sonda 1 – završna situacija (foto: I. Drnić)

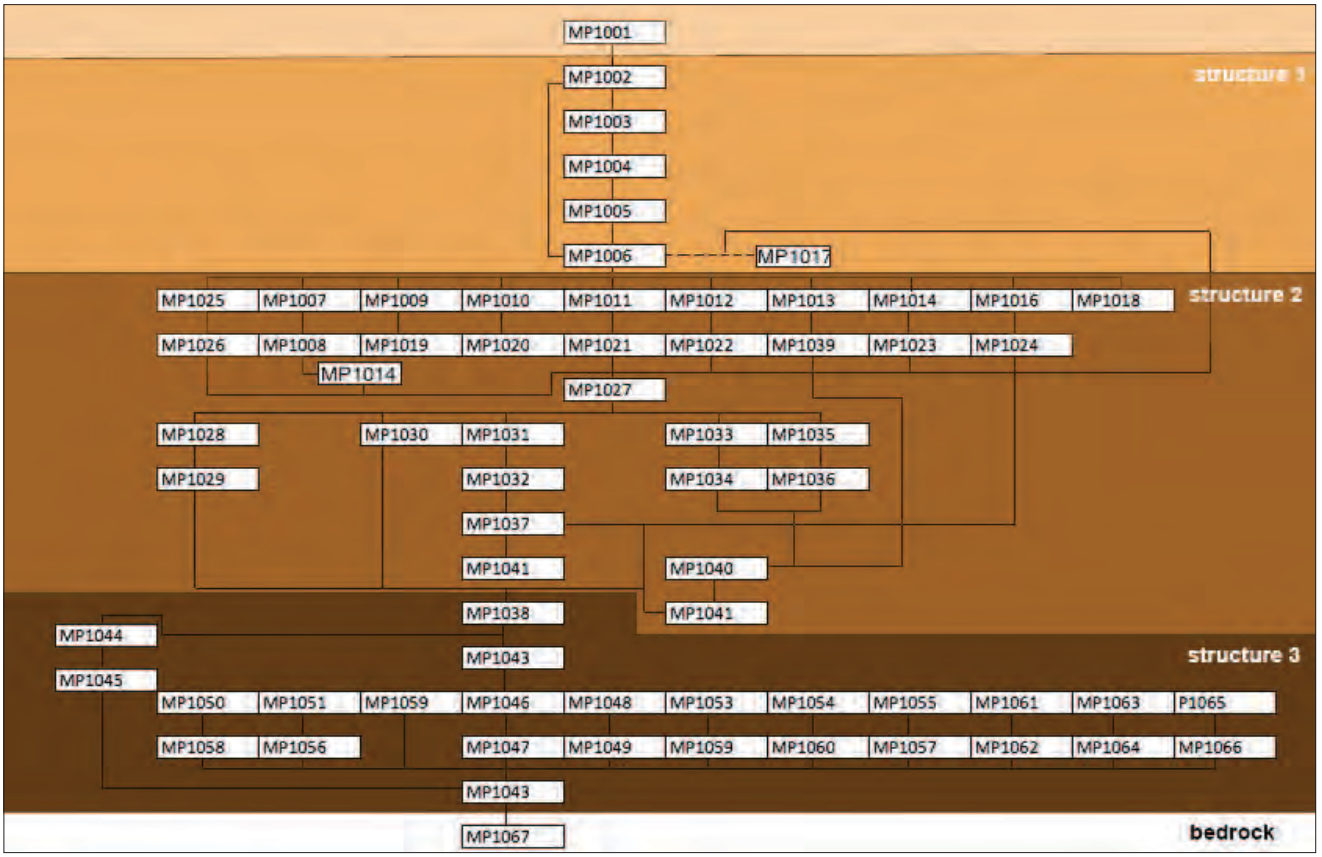


Fig. 6 Stratigraphy of Trench 1 – harris matrix (K. P. Trimmis, I. Drnić))

Sl. 6 Stratigrafija Sonde 1 – Harrisova matrica (K. P. Trimmis, I. Drnić)

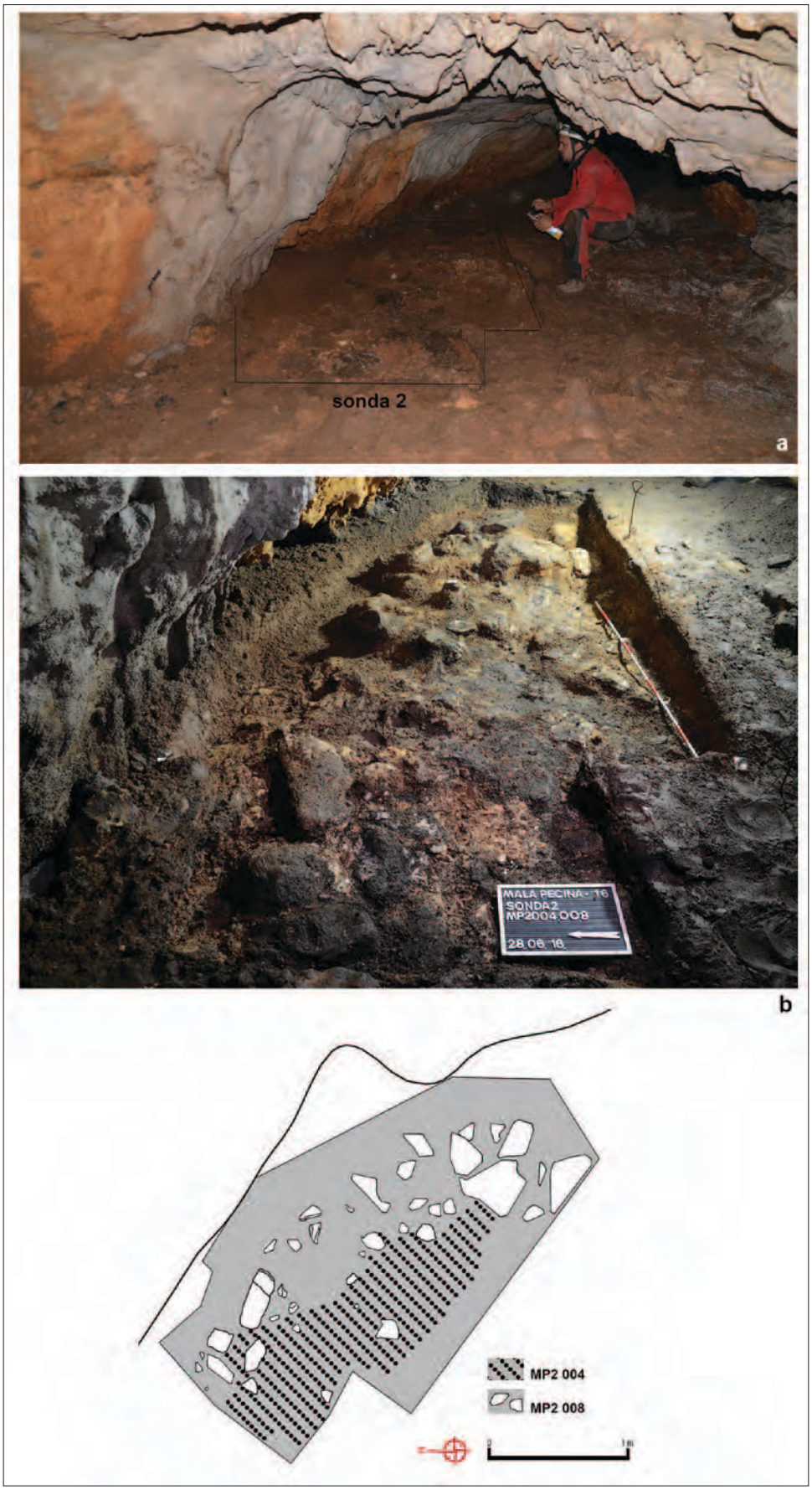


Fig. 7 a) Position of Trench 2 (photo: I. Drnić); b) stone structure in Trench 2 (photo: K. P. Trimmis; drawing: M. Mađerić, I. Drnić)

Sl. 7 a) Pozicija Sonde 2 (foto: I. Drnić); b) kamena struktura u Sondi 2 (foto: K. P. Trimmis; nacrt: M. Mađerić, I. Drnić)

structure includes crust and stalagmites that point to the exploitation of pre-existing geological features in the cave. Burnt layer MP2 004, recorded between layers MP2 001–002 and the stone structure, represents an event which could be related to the EN activity in the area. The thin layers above the stone structure (MP2 001–002) produced the largest volume of pottery compared to the other two trenches, but, interestingly, almost negligible faunal and botanical assemblages! A sterile cave sediment (MP2 010) was excavated under the stone structure.

ovome dijelu špilje. U tankim površinskim slojevima (MP2 001–002) prikupljena je znatno veća količina keramičkih ulomaka u odnosu na Sonde 1 i 3, ali, zanimljivo, gotovo zanemariv broj životinjskih kostiju i botaničkih uzoraka! Ispod kamene strukture nalazio se sterilni špiljski sediment (MP2 010).

Moguće je da prva dva tanka sloja u Sondi 3 pripadaju razdoblju ranoga neolitika, iako grafiti na zidu iznad sonde potvrđuju i aktivnost u relativno bliskoj prošlosti, zbog čega je teže interpretirati površinske slojeve koji su mogli

Fig. 8 Trench 3 (photo: K. P. Trimmis)
Sl. 8 Sonda 3 (foto: K. P. Trimmis)

In Trench 3, there is a possible thin Neolithic occupational phase in the first two layers. However, the graffiti on the cave wall above the trench points to possible recent use. This makes it difficult to interpret the top layers, for they could have been disturbed by recent activities. One feature, a hearth (MP3 008–009), stands out and attests to the Early Neolithic occupation (Fig. 8a). Context MP3 008 was probably a compressed ash layer and did not produce many finds. However, context MP3 009, with a lot of burnt wood, produced a large amount of animal bones, a piece of flint,

biti oštećeni tim recentim procesima. Ipak, ističe se jedna struktura – ognjište (MP3 008–009) (sl. 8a) koja potvrđuje ranoneolitičku prisutnost u ovome dijelu objekta. Sloj MP3 008 vjerojatno predstavlja sloj komprimiranoga pepela s malo nalaza, dok je u sloju MP3 009 s dosta spaljenoga drveta pronađena veća količina životinjskih kostiju, ulomak cijepane alatke od kremena i jedanaest ulomaka keramičkih posuda od kojih su tri ukrašena *impresso* ukrasom (T. 9: 2–4). Druga zanimljiva struktura u Sondi 3 sloj je kamenja (MP3 012–013) polukružnog ili kružnog oblika, pri čemu, nažalost,

and 11 sherds of pottery, of which 3 can easily be identified as impressed ware (Pl. 9: 2–4). The other interesting feature of Trench 3 is a layer of stones (MP3 012–013) that seems to form some kind of structure, possibly semi-circular or circular in shape, but, unfortunately, the size of Trench 3 (only 1.5 m^2) does not allow for definite conclusions. Interestingly, a pebble with traces of a red color that could be pigment was unearthed at the center of the feature; after the analyses, it could provide additional data for the interpretation of the possible stone structure.

The pottery assemblage

The ceramic assemblage from the 2016 excavation has 410 pottery sherds from all three trenches: 142 sherds have been collected from Trench 1, 220 from Trench 2, and 48 from Trench 3. In the secondary analysis, 165 sherds have been processed with a minimum number of 48 vessels; 68 sherds have been collected from the Late Neolithic layer (structure 1 and the layer between LN and EN in Trench 1 – MP1 027), but only a few of them are diagnostic. The remaining 342 sherds represent Early Neolithic pottery styles.

Open bowl-style vessels that can be identified as pottery for food production and consumption dominate the small LN assemblage. There are equal numbers of coarse and fine ware pottery and there is an absence of storing jars, pithoid vessels or cooking pots. Open vessels are also dominant in the EN assemblage but not exclusively. Based on the minimum number of vessels (MNV) from the EN strata, six closed pots – storage jars – can be identified. All of them are from Trench 2, from the interior of the (semi) circular structure. Again, no cooking vessels have been identified. Several ring-like bottoms have been found in the EN layers in Trench 2. This constructional element is not very frequent in EN ceramic assemblages, but it is known from several, mostly north Dalmatian sites like Crno Vrilo, Pokrovnik, and Škarin Samograd (Müller 1994: Pl. 3: 15; 34: 7–8; 39: 12, 15–17; Marijanović 2009a: Pl. 24: 2–4).

One fragment of a bowl with slightly everted rim is decorated with a group of diagonal incisions (Pl. 2: 8), while a fragment of the body has a pattern with horizontal and vertical lines (Pl. 2: 5). Two sherds (a slightly everted rim and a fragment of a body) have a black burnished surface with horizontal, vertical and diagonal incisions (possible triangles!) with traces of white incrustation (Pl. 2: 6–7). This is the typical decoration of the Late Neolithic Hvar culture, with similar materials in several cave sites in the eastern Adriatic hinterland like Hateljska Pećina, Ravlića Pećina and Zemunica (Marijanović 1981; 2000: 80; Šošić-Klinđić et al. 2015: 6, 17, 20, Fig. 13: 2–3).[3] The connection of Mala Pećina with the hinterland has also been confirmed by the find of a piece of conical neck of the pot from the hearth in Trench 1 (MP1 003) with burnished surface and thickened rim decorated with vertical incisions (Pl. 2: 4). The described shape and decoration are characteristic of the pots of the IIc sub-phase from the Ravlića Pećina site in western Herzegovina, which

3 Black burnished pottery decorated with incisions and white incrustation is also known from the middle Neolithic Danilo culture (Horvat, Vujević 2017: 54, Pl. 9: 4; 10: 2).

veličina Sonde 3 od samo 1,5 m^2 ne dozvoljava konačne zaključke. Zanimljivo, u sredini strukture pronađen je oblutak s tragovima crvene boje koja bi mogla predstavljati ostatke pigmenta, a nakon provedene analize mogao bi podastrijeti dodatne podatke za interpretaciju moguće kamene strukture.

Keramički nalazi

U istraživanjima iz 2016. godine u Sondama 1–3 prikupljeno je ukupno 410 ulomaka keramičkih posuda: 142 ulomka u Sondi 1, 220 ulomaka u Sondi 2 i 48 ulomaka u Sondi 3. U sekundarnoj analizi obrađeno je 165 ulomaka s minimalnim brojem od 48 posuda. Iz kasnoneolitičkoga sloja potječe 68 ulomaka (struktura 1 i sloj između strukture 1 i 2 u Sondi 1 – MP1 027), od čega je samo nekoliko dijagnostičkih. Ostala 342 ulomka pripadaju ranoneolitičkim posudama.

Otvorene posude – zdjele, koje se mogu interpretirati kao posuđe korišteno u pripremi i konzumaciji hrane, dominiraju u maloj skupini kasnoneolitičke keramike. Podjednako su zastupljeni ulomci grube i fine keramike, a zamjetan je nedostatak posuda za skladištenje i lonaca za kuhanje. Otvorene posude su najbrojnije i među ranoneolitičkim posuđem. Na osnovu minimalnoga broja posuda identificirano je šest zatvorenih posuda korištenih za pohranu. Sve potječu iz unutarnjega dijela (polu)kružne strukture Sonde 2. Kao i u slučaju kasnoneolitičkih keramičkih nalaza, među ranoneolitičkim ulomcima također nisu zabilježene posude za kuhanje. U ranoneolitičkom sloju u Sondi 2 pronađeno je i nekoliko prstenastih dna koja nisu brojna u ranoneolitičkoj keramografiji, ali su poznata s nekoliko nalazišta, uglavnom s prostora sjeverne Dalmacije, kao što su Crno vrilo, Pokrovnik i Škarin samograd (Müller 1994: T. 3: 15; 34: 7–8; 39: 12, 15–17; Marijanović 2009a: T. 24: 2–4).

Jedan ulomak zdjele s blago izvučenim rubom ukrašen je skupinom dijagonalno urezanih linija (T. 2: 8), dok se na jednom ulomku trbuha nalazi uzorak s okomitim i vodoravnim linijama (T. 2: 5). Na dva ulomka (blago izvučeni rub i ulomak tijela) crne, uglačane površine nalaze se vodoravne, okomite i dijagonalno urezane linije (možda i trokuti!) s tragovima bijele inkrustacije (T. 2: 6–7), što je karakterističan ukras kasnoneolitičke hvarske kulture. Sličan materijal zabilježen je na nekoliko špiljskih lokaliteta u istočnojadranskome zaleđu kao što su Hateljska pećina, Ravlića pećina, Zemunica (Marijanović 1981; 2000: 80; Šošić-Klinđić et al. 2015: 6, 17, 20, sl. 13: 2–3).[3] Povezanost Male pećine s unutrašnjošću potvrđuje nalaz ulomka stožastoga vrata lonca, pronađenoga uz ognjište u Sondi 1 (MP1 003), uglačane površine i zadebljanoga ruba ukrašenoga okomitim urezima (T. 2: 4). Opisani oblik i ukras karakterističan je za lonce IIc podfaze iz Ravlića pećine u zapadnoj Hercegovini koji pripada kasnoj fazi hvarske kulture (Marijanović 1981: 33, T. 28: 4–5). S obzirom na to da je u iskopavanju u Maloj pećini iz 2016. godine pronađen manji broj kasnoneolitičkih dijagnostičkih ulomaka, važno je napomenuti da su u površinskome pregledu

3 Keramika crne, glačane površine ukrašene urezanim motivima i bijelom inkrustacijom zabilježena je i u srednjoneolitičkoj danilskoj kulturi (Horvat, Vujević 2017: 54, T. 9: 4; 10: 2).

belongs to the late Hvar culture horizon (Marijanović 1981: 33, Pl. 28: 4–5). Considering that only a small number of diagnostic LN sherds were gathered in the 2016 excavation in Mala Pećina, it is important to mention that at least three sherds collected by D. Kliškić in the 1999 and 2003 surveys could be attributed to the Hvar culture (Kliškić 2004: 100–104, 122–123; Pl. 1: 7–9), especially the piece with the "outlined" decoration combining incision, burnishing and red painting, characteristic for the classic phase of the Hvar culture (Forenbaher, Kaiser 2008: 69).

iz 1999. i 2003. godine, koji je proveo D. Kliškić, prikupljena najmanje tri ulomka koji se mogu pripisati hvarskoj kulturi (Kliškić 2004: 100–104, 122–123; T. 1: 7–9). Pri tome se ističe ulomak s tzv. „obrubljenim" ukrasom koji se sastoji od kombinacije urezivanja, glačanja i crvenoga slikanja koji je karakterističan za klasičnu fazu hvarske kulture (Forenbaher, Kaiser 2008: 69).

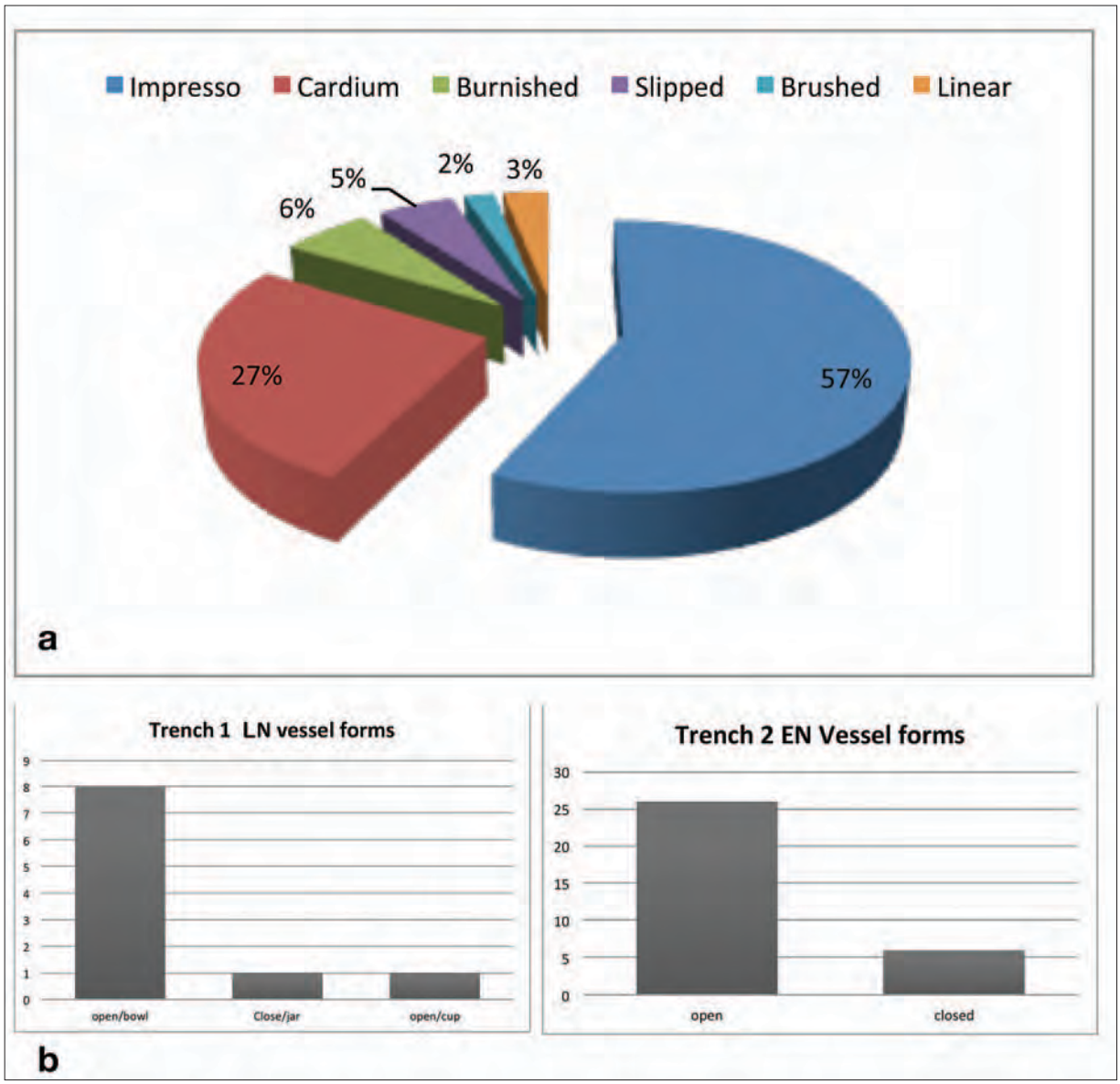


Fig. 9 a) Statistics for decorated pottery from Mala Pećina; b) statistics for typology of the pottery from Mala Pećina (made by: K. P. Trimmis)

Sl. 9 a) Statistika za ukrašenu keramiku iz Male pećine; b) statistika za tipologiju keramike iz Male pećine (izradio: K. P. Trimmis)

The majority of the EN pottery is decorated with different motifs of impressed decoration (57%). If we include the Cardium pottery (27%) in the impressed styles, we get 84% as the total share of impressed pottery in the early Neolithic ceramic assemblage (Fig. 9; Pl. 1: 3–4, 7; 3: 1–2, 5; 4: 3–5; 5: 1–3; 6: 6–8; 7: 1–3, 5–6; 8: 2–5; 9). Most of these

Većina ranoneolitičke keramike ukrašena je različitim *impresso* motivima (57%), a kada se tome broju dodaju i ulomci ukrašeni tzv. cardium ukrasom (27%), dolazi se do zaključka da čak 84% ulomaka ranoneolitičke keramičke građe pripada *impresso* keramici (sl. 9; T. 1: 3–4, 7; 3: 1–2, 5; 4: 3–5; 5: 1–3; 6: 6–8; 7: 1–3, 5–6; 8: 2–5; 9). Većina navedenih ukrasa pripada tradicionalano definiranom *impresso* stilu A za kojega se smatralo da je kronološki raniji od *impresso* stila B, iako novija istraživanja ukazuju da predložena stil-

decorations fit with the traditionally defined impressed A style, which was usually interpreted as coming earlier than the Impressed B style, but recent research has shown that the mentioned stylistic division has no firm chronological foundation (Forenbaher et al. 2013: 603). A few sherds from Mala Pećina could be attributed to the group of EN monochrome pottery with burnished surface (Pl. 1: 5; 3: 6; 5: 4), known from the several EN cave sites in the eastern Adriatic hinterland like Hateljska Pećina and Škarin Samograd (Batović 1979: 500, 505; Marijanović 2000: 73). In Mala Pećina a barbotine-style sherd was also unearthed in the EN context from Trench 2 (Pl. 7: 7), which is quite interesting because barbotine pottery is generally absent from EN coastal sites, but is quite frequent in ceramic production of the continental communities within the Starčevo culture.

ska podjela nema čvrstu kronološku osnovu (Forenbaher et al. 2013: 603). Nekoliko ulomaka iz Male pećine pripada u skupinu monokromne keramike glačane površine (T. 1: 5; 3: 6; 5: 4) koja je poznata s nekoliko ranoneolitičkih špiljskih lokaliteta na prostoru istočnojadranskoga zaleđa kao što su Hateljska pećina i Škarin Samograd (Batović 1979: 500, 505; Marijanović 2000: 73). Iz Male pećine potječe i ulomak keramičke posude ukrašen barbotinom, pronađen u ranoneolitičkom sloju u Sondi 2 (T. 7: 7). To je vrlo zanimljiv podatak s obzirom na to da je barbotinski ukras uglavnom nepoznat na obalnim ranoneolitičkim nalazištima, ali je čest u ranoneolitičkoj keramografiji kontinentalnih zajednica u okvirima starčevačke kulture.

Raznolikost motiva i stilova zabilježenih na ranoneolitičkoj keramici iz Male pećine mogla bi predstavljati dokaz

Fig. 10 Cross-sections of the pottery from Trench 2 (photo: K. P. Trimmis)
Sl. 10 Presjeci keramičkih ulomaka iz Sonde 2 (foto: K. P. Trimmis)

The variety of EN decorative motifs and styles in Mala Pećina could be interpreted as evidence of local people's movement from the hinterland to the Adriatic coast and vice versa. On one hand, there is a clear correlation with the pottery assemblages from Ravlića cave and Hateljska cave dominated by the impressed decoration made with various tools or fingers/nails, but on the other hand, relatively large numbers of cardium impressions or imitated shells could indicate stronger relations with the coastal communities. Additional evidence of the variety of the pottery assemblage from Mala Pećina is the different recorded types of tempering from the same contexts. For example, sherds of open bowls from MP2 02/05 contexts[4] with similar impressed decoration have completely different tempering with different materials used, such as grog, limestone, and organic material (Fig. 10).

The absence of cooking vessels or large storage jars, and the presence of small consumption pottery and open vessels in equal measure, indicates that the cave was not used as a long term dwelling but rather as a temporary shelter, either for groups that were moving through the mountains or for groups that visited the cave for short term activities. Also, certain facts, like the morphology of the cave with three chambers and low passages, and the presence of the stone structure in the most inhospitable position in the cave with traces of fire and the highest number of EN pottery, could point to ritual activities taking place in Mala Pećina in the EN horizon. Of course, to fully corroborate these assumptions, further investigation is needed!

The faunal assemblage

Mala Pećina has a modest and highly fragmented assemblage of animal remains. Because of the limited size, the isolated data collected from the assemblage has limited interpretative value in its own right, but can still make a valuable contribution to the limited corpus of published faunal material from the region. The animal bones from Mala Pećina were retrieved primarily by hand. All the deposits were 100% sieved through a 10mm mesh, which augmented the faunal assemblage and promoted an excellent level of recovery. The assemblage was recorded in the Cardiff University BioArchaeology (CUBA) laboratory, using the in-house reference collection and reference manuals. The recording was undertaken using the zoning method outlined in Serjeantson (1996), with fragments of over 50% of a zone being recorded. Sheep and goats were not differentiated and were recorded as "caprine" since no bones retained the landmarks which would allow for further distinction. When fragments could not be identified by species, they were classified as unidentified mammals and assigned a size category (rabbit-size, sheep-size, cattle-size). All the elements were classed as identifiable and recorded whenever possible. Those outside Serjeantson's (1996) scheme were recorded when the fragment was at least 2 cm long.

This produced a Number of Identifiable Specimens (NISP) for all taxa present and a fragment count for unidentified specimens. The Minimum Numbers of Elements (MNE) was

4 Context MP2 005 is the extension of context MP2 002 to the south.

o kretanjima ljudi iz unutrašnjosti prema jadranskoj obali i obrnuto. S jedne strane postoji jasna poveznica s keramičkim nalazima iz Ravlića pećine i Hateljske pećine u kojima dominiraju *impresso* motivi izvedeni različitim alatkama ili prstima/noktima. S druge strane, relativno veliki broj ulomaka ukrašenih utiskivanjem školjki, ali i imitacijom toga motiva, mogao bi ukazivati na snažnije veze s obalnim zajednicama. Dodatan dokaz raznolikosti keramičkoga materijala iz Male pećine različite su primjese dodavane glinenoj smjesi koje su zabilježene u strukturi posuda iz istih slojeva. Primjerice, ulomci otvorenih zdjela ukrašeni sličnim *impresso* ukrasom iz sloja MP2 02/05[4] imaju potpuno različite primjese kao što su grog, vapnenac i organski materijal (sl. 10).

Nedostatak posuda za kuhanje, kao i većih posuda za skladištenje, te prisustvo otvorenih keramičkih oblika, uključujući i manje posude korištene u konzumaciji jela/pića, ukazuje da objekt nije korišten kao dugotrajna nastamba, nego kao privremeno utočište od strane skupina koje su se kretale okolnim planinama, odnosno onih koje su posjećivale špilju u sklopu kratkotrajnih aktivnosti. Također, određeni činjenice kao što je morfologija špilje s tri dvorane i uskim prolazima, prisutnost kamene strukture u najnegostoljubivijem dijelu objekta s tragovima gorenja i najvećom količinom ranoneolitičke keramike, mogle bi ukazivati na moguće ritualne aktivnosti koje su se mogle odvijati u ranoneolitičkome horizontu Male pećine. Naravno, potrebna su dodatna istraživanja kako bi se jasno potvrdile ove pretpostavke!

Koštani materijal

U istraživanju Male pećine prikupljeni su skromi i vrlo fragmentirani nalazi životinjskih ostataka. Zbog ograničenoga obima, prikupljeni nalazi imaju ograničenu interpretativnu vrijednost za ovaj lokalitet, ali još uvijek mogu dati značajan doprinos ograničenome broju objavljenih zooarheoloških nalaza iz regije. Životinjske kosti prikupljene su ručno. Sav sediment prosijavan je kroz sito veličine oka 10 mm, što je povećalo količinu i razinu sačuvanosti prikupljenih životinjskih kostiju. Uzorak je analiziran u laboratoriju BioArchaeology (CUBA) Sveučilišta u Cardiffu, pri čemu je korištena interna referentna zbirka i priručnici. Uzorak je pregledan koristeći tzv. *zoning method* prema Serjeantson (1996), a pregledano je više od 50% ulomaka. Zbog nedostatka razlikovnih elemenata, ovce i koze označavane su kao "kapridi". U slučaju nemogućnosti taksonomske determinacije takvi ulomci klasificirani su kao neodredivi sisavci koji su podijeljeni u kategorije prema veličini (veličina zeca, veličina ovce, veličina stoke). Svi su elementi klasificirani kao prepoznatljivi i zabilježeni kada god je to bilo moguće. Oni koji nisu bili unutar sustava Serjeantson (1996) analizirani su kada je fragment bio duži od najmanje 2 cm.

Za sve taksone određen je najmanji broj odredivih uzoraka (NISP), dok su svi neodredivi fragmenti izbrojani. Najmanji broj anatomskih elemenata (MNE) određen je za pojedinačne kontekste, a u slučaju Sonde 1 proširen je na pojedinačne strukture koje se sastoje od više stratigrafskih jedinica. Zbog male veličine uzoraka MNE podaci

4 Kontekst MP2 005 predstavlja nastavak konteksta MP2 002 prema jugu.

calculated for individual contexts and, in the case of Trench 1, these were expanded for features comprising multiple contexts. The sample size is very small and therefore MNE data have little interpretative value alone and are not presented here. These data were used for calculating the Minimum Number of Individuals (MNI). This calculation took account of element, zone, and side, but no pair matching was undertaken. Fusion was recorded as either fused, fusing or unfused. No dimorphic characteristics useful for sex determination were observed in the assemblage. For all the recorded elements, including those classified as unidentified mammals, all the examples of gnawing, butchery, and burning were recorded. Butchery marks were recorded as 'chop' or 'cut' marks and the location and orientation was also noted. Burning was recorded as three ordinal categories – slight burning, black charring, and white calcination – according to Shipman et. al (1984) to determine the variation in burning temperatures. Weathering (following Behrensmeyer 1978) and calcareous concretions (following Madgwick 2011) were recorded in an attempt to access preservation and other taphonomic processes within contexts. These indices also determine if the skeletal elements were left exposed in the cave environment or rapidly buried. Aging using dental wear was recorded when possible on the main domestic mammals when applicable according to Grant (1982). However, again because of the fragmentary nature of the assemblage, there was not enough fusion data available within the samples to approximate their age based on the skeletal remains. In total, 279 fragments were analysed in detail (Fig. 11). Of the 279 fragments, only 118 were recorded as species, an additional 63 were recorded as unidentified mammals of a specific size class, and 98 fragments were left unidentified because of their size and the fragmentary nature of the assemblage. The assemblage comprises seven species of mammal and two avian species.

Material considered modern or intrusive have been excluded from the analysis. These specimens consist of the various passerine-size bones, all showing evidence of digestive corrosion, as well as the rodent bones found in what is considered to be a burrow in Trench 3. These specimens were recorded as intrusive on the basis of their taphonomy, the taxa they represent, and their depositional context. Weathering and calcareous concretions were found to be most common and extreme in the top layers of the trenches, with some deep deposits showing a similar level to that of the topmost layers. Fig. 12a displays a rib covered in calcareous concretions which was extracted from the topmost layer of Trench 1. There was a drastic decrease in both weathering and calcareous concretions in what were perceived to be anthropogenic contexts. The proportion of burnt bones varies across the trenches and features. Overall, 57% of the assemblage is burnt. Fig. 12b breaks down the burnt material by trench and stage of burning (1=slight burning; 2=charring; 3=calcination). Trench 1, with 2 hearths, had the most burnt material, Trench 3 had some, and Trench 2 had no burnt material.

Only 10 fragments in the assemblage displayed traces of butchery. These are listed in Tab. 1. This may radically unimaju malu interpretativnu vrijednost, pa stoga nisu ovdje predstavljeni. Ovi podaci korišteni su za izračunavanje najmanjega broja jedinki (MNI) pri čemu je korišten najbrojniji element i orijentacija elementa, ali ne i spajanje strana (*pair matching*). Sraštanje je bilježeno kao srašteno, sraštava i nesraslo. U materijalu nisu uočeni elementi za razlikovanje spola kod životinja. Za sve analizirane elemente, uključujući i neidentificirane sisavce, bilježeni su tragovi griženja, mesarenja i gorenja. Tragovi mesarenja bilježeni su kao sječenje i rezanje, kao i njihovo mjesto i orijentacija. Gorenje je bilježeno prema Shipman et al. (1984) kroz tri faze kako bi se razlikovala temperatura gorenja – lagano gorenje, crno pougljenjivanje i bijela kalcinacija. Trošenje materijala bilježeno je prema Behrenmeyer (1978), dok su kalcitne nakupine bilježene prema Madgwick (2011) kako bi se dobili podaci za tafonomske procese i očuvanost unutar pojedinih konteksta. To uključuje i podatak jesu li životinjske kosti ostale nezaštićene u špilji ili su brzo ukopane. Dob je određivana, kada je to bilo moguće, prema dentalnim nalazima na glavnim sisavcima prema Grantu (1982). Ipak, zbog fragmentiranosti nalaza, približnu dob nije bilo moguće odrediti prema kosturnim elementima. Ukupno je analizirano 279 ulomaka (sl. 11). Od 279 ulomaka, samo je za 118

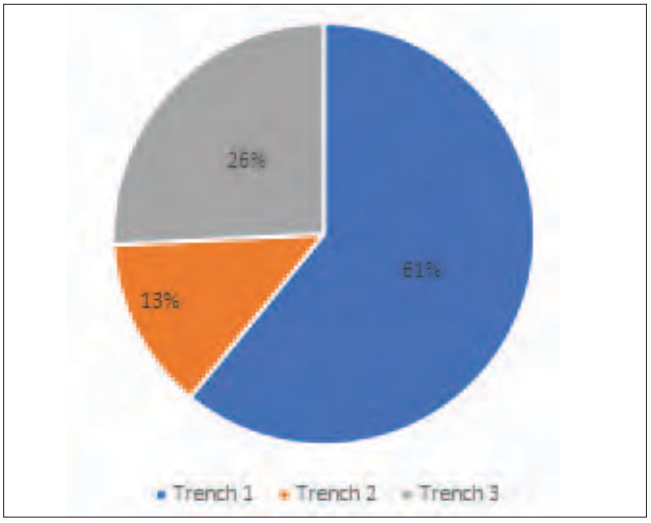


Fig. 11 Proportion of identified specimens by trench. The total number of specimens is 279 (made by: A. Hale, R. Madgwick)
Sl. 11 Udio identificiranih primjeraka po sondama. Ukupan broj primjeraka je 279 (izradili: A. Hale, R. Madgwick)

određena vrsta, dok su 63 ulomka određena kao sisavci prema kategoriji veličine. Neodredivih ulomaka je 98. Ukupno je određeno sedam vrsta sisavaca i dvije vrste ptica.

Materijal za koji se pretpostavlja recentno porijeklo ili mogućnost da predstavlja intruzije, poput kostiju veličine vrapčarki koje pokazuju tragove probavljanja, kao i kosti glodavaca pronađene u jazbini u Sondi 3, isključen je iz analize. Prema taksonomskom određenju, tafonomiji i depozicijskom kontekstu, ove su vrste određene kao intruzija. Trošenje i pojava kalcitnih nakupina najizraženije su u gornjim slojevima sondi, ali su slične pojave vidljive i u dubljim slojevima. Na sl. 12a je rebro s površine Sonde 1 prekriveno kalcitnom konkrecijom. U slojevima za koje se pretpostavlja da su antropogenoga porijekla značajan je porast u troše-

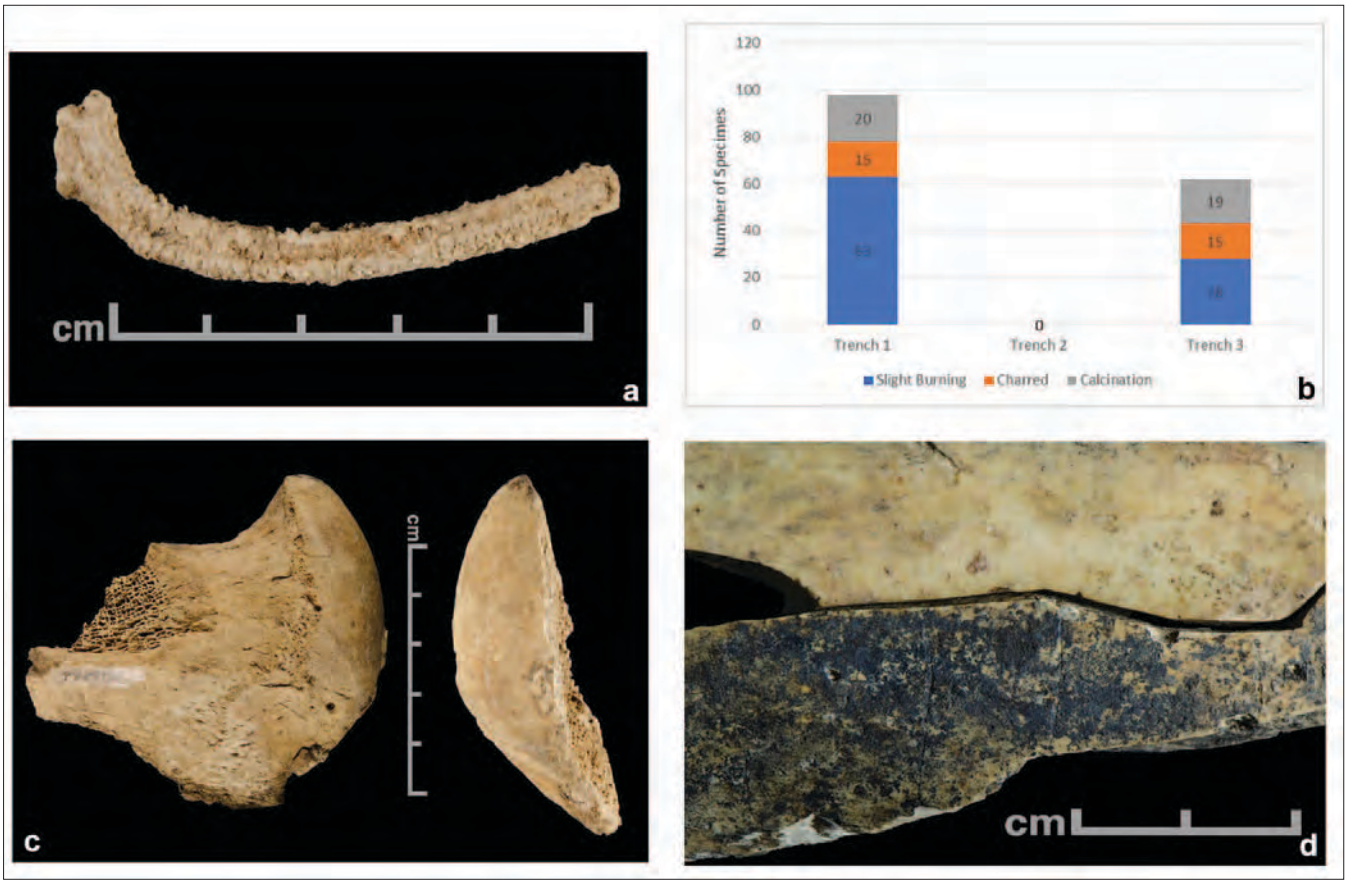


Fig. 12 a) Calcareous concretions on a medium mammal rib; b) number of burnt specimens from each trench; c) cut marks on the medial side of a cattle tibia; d) axially chopped cattle humerus (photo: A. Hale)

Sl. 12 a) Kalcitna konkrecija na medijalnom rebru sisavca; b) broj spaljenih primjeraka po sondama; c) tragovi sječenja na medijalnoj strani tibije goveda; d) aksijalno rasječen humerus goveda (foto: A. Hale)

derestimate the presence of butchery evidence, as the relatively common occurrence of weathering and calcareous concretions means that fine knife cuts are often overprinted. Fig. 12c–d show the butchery evidence from the cattle tibia from context MP1 005 and the cattle humerus from context M3 009 as described in Tab. 1.

Domestic species dominated the assemblage. Cattle, sheep/goat, and dog are the main taxa represented, with wild species being wild boar, passerines, and rodents (Tab. 2). Since the assemblage is small, context and feature-specific MNI values are invariable for all the taxa. There are only two exceptions to this – the Trench 1 contexts MP1 002, with an MNI of 2 for caprine, and MP1 004, with an MNI of 2 for cattle. The MNI figures for each chronological phase are presented in Tab. 2. Tab. 3 pools the MNI totals per phase, but no discernible differences can be observed when separated by features.

Tab. 3 provides a breakdown of the basic anatomical representation as found in the assemblage sorted by element group. Fore limbs and hind limbs represent the majority of the assemblage, with extremities also representing a large quantity of the cattle, sheep/goat, and wild boar remains. The passerine and rodent bones most likely indicate natural species in the cave environment or an intrusive species in the archaeological strata. Dental attrition could be assessed

nju i kalcitnim nakupinama. Omjer gorenih kostiju varira u sondama i stratigrafskim jedinicama. Ukupno je 57% kostiju izgoreno. Sl. 12b prikazuje izgoreni materijal po sondama, kao i stupanj gorenja (1= nagorenost; 2= pougljenjivanje; 3= kalcinacija). Najviše izgorenoga materijala zabilježeno je u Sondi 1 u kojoj su istražena dva ognjišta, a slijedi Sonda 3. U Sondi 2 nisu pronađene kosti s tragovima gorenja.

Tragovi mesarenja vidljivi su na samo deset ulomaka koji su prikazani u tab. 1. Relativno česta pojava trošenja i kalcitnih nakupina mogli bi umanjiti vidljivost ili prekriti tragove sječenja i rezanja. Sl. 12 c–d pokazuju tragove mesarenja na tibiji od stoke iz MP1 005 i humeru od stoke iz MP3 009, kao što je navedeno u tab. 1.

Domesticirane vrste najzastupljenije su među koštanim nalazima. Stoka, ovikapridi i pas su najzastupljenije vrste, uz divlje vrste poput divlje svinje, vrapčarki i glodavaca (tab. 2). Zbog maloga uzorka kostiju, konteksta i specifičnog konteksta, MNI je nepromjenjiv za sve taksome. Dvije su iznimke, MP1 002 u Sondi 1 s 2 MNI za kapride i MP1 004 s 2 MNI za stoku. U tabl. 2 vidljivi su MNI podaci za svaku kronološku fazu. U tab. 3 skupljeni su ukupni MNI, ali su uočljive razlike kada se razdvoje prema stratigrafskim jedinicama.

Tab. 3 donosi podatke o broju kosturnih elemenata prema dijelovima kostura kod različitih vrsta u uzorku. Najzastupljeniji su prednji i stražnji udovi, a slijede ekstremiteti

Trench / sonda	Context /stratigrafska jedinica	Species / vrsta	Element / element	Notes / napomene
1	MP1 002	medium mammal / sisavac srednje veličine	rib /rebro	cut / tragovi rezanja
			rib / rebro	cut / tragovi rezanja
		sheep/goat / ovca/koza	vertebral body / tijelo kralješka	cut / tragovi rezanja
		sheep/goat / ovca/koza	spinous process – thoracic vertebra / trnasti nastavak – prsni kralježak	chopped / isječeno
		sheep/goat / ovca/koza	metacarpal / metakarpalna kost	cut / tragovi rezanja
	MP1 005	cattle / stoka	spinous process – lumbar vertebra / trnasti nastavak – lumbalni kralježak	cut – sporadic and varying along the medial shaft / tragovi rezanja – sporadično niz tijelo kosti
		cattle / stoka	tibia / goljenična kost	
		cattle / stoka		
2	MP2 001	medium mammal / sisavac srednje veličine	rib / rebro	cut / tragovi rezanja
3	MP3 001	small mammal / sisavac male veličine	rib / rebro	cut / tragovi rezanja
	MP3 009	cattle / stoka	humerus / nadlaktična kost	chopped – lenghtwise through the head and down the shaft / isječeno – dužinom kroz glavu i tijelo kosti

Tab. 1 List of butchered fragments by context (izradili: A. Hale, R. Madgwick)
Tab. 1 Popis mesarenih ulomaka po Sondama (made by: A. Hale, R. Madgwick)

	MNI Cattle / MNI stoke	MNI Caprine / MNI ovce/koze	MNI Dog / MNI psa	MNI Wild Boar / MNI divlje svinje	MNI Passerine / MNI vrapčarki	MNI Rodent / MNI glodavaca
Mixed Modern/ Neolithic / Miješani moderni/neolitik	1	1	0	1	3	1
Early Neolithic / Rani neolitik	1	1	1	1	1	0
Late Neolithic / Kasni neolitik	2	2	0	0	0	0
Mixed Neolithic / Miješano neolitik	1	2	1	1	1	0
MNI Total / MNI ukupno	5	6	2	3	4	1

Tab. 2 MNI totals per chronological phase, ignoring trench and feature distinctions
Tab. 2 Minimalan broj jedinki (MNI) prema kronološkim fazama, bez razlika između sondi i struktura

for a small number of specimens. These were too few for assertions to be made with regard to husbandry regimes, but those that were recorded are listed in Tab. 4.

Because of the small size of the assemblage, the discussion focuses on more detailed trench descriptions and tentative reconstructions of social practices based on the faunal signature.

stoke, ovikaprida i divlje svinje. Vrapčarke i glodavci vjerojatno su ustaljene vrste u špiljskoj okolini, dok su u arheološkome kontekstu intruzivne vrste. Trošenje zuba vidljivo je na malome broju jedinki. Premalo je dokaza za tvrdnju o uzgoju, ali registrirani podaci predstavljeni su u tab. 4.

Zbog maloga uzorka, rasprava je fokusirana na detaljan opis sondi i preliminarne rekonstrukcije socijalne prakse temeljene na faunalnim ostacima.

	Cattle / stoka	Caprine / ovca/koza	Dog / pas	Wild Boar / divlja svinja	Passerine / vrapčarke	Rodent / glodavci
Skull / lubanja	5	4	2	0	0	1
Teeth / zubi	2	5	9	1	0	5
Fore Limb / prednji udovi	6	19	2	1	4	0
Hind Limb / stražnji udovi	6	9	2	2	4	0
Axial / trup	1	8	5	0	0	0
Extremities / ekstremiteti	8	5	0	2	0	0
TAXON TOTAL / UKUPNO TAKSON	28	50	20	6	8	6

Tab. 3 Taxonomic and anatomical representation by NISP (izradili: A. Hale, R. Madgwick)

Tab. 3 Taksonomski i anatomski prikaz prema najmanjem broju odredivih uzoraka (NISP) (made by: A. Hale, R. Madgwick)

Context / kontekst	Taxon / takson	Side / strana	Tooth / zub	Wear Stage / stupanj istrošenosti	Notes / napomena
MP1002	Caprine	L	M3	f/g	Broken before third cusp / razbijen prije trećega očnjaka
MP3009	Caprine	R	M3	g	
MP2001	Caprine	L	D4	g	Part of mandible / dio donje čeljusti
MP2001	Caprine	L	M1	g	Part of mandible / dio donje čeljusti
MP2001	Caprine	L	M2	g	Part of mandible / dio donje čeljusti
MP1004	Bos	L	M3	-	Shattered wear face / razbijena lica

Tab. 4 Teeth from the assemblage and wear stages according to Grant (1982) when applicable (izradili: A. Hale, R. Madgwick)

Tab. 4 Zubi iz koštanoga materijala i stupnjevi istrošenosti prema Grant (1982) kada je moguće (made by: A. Hale, R. Madgwick)

Trench 1

From a zooarchaeological perspective, the main feature of this trench, consisting of contexts MP1 003–005, is that of a hearth (**structure 1**). Bones include cattle elements from the hind limbs, ribs and the spinous process of a lumbar vertebra. The sheep/goat bones are comprised only of forelimb elements. All of these bones are burnt and were likely cooked over the fire, with several being discarded in the hearth and therefore showing evidence of calcination. This context was likely used as a short-term shelter for an individual not familiar with butchering animals, as demonstrated by the sporadic cuts along the medial shaft of the tibia featured in Fig. 12c. The trench also comprised an older structure consisting of post holes and a hearth (**structure 2**). This structure yielded very few bones despite it clearly being an occupation layer. The absence of bones within this structure may indicate a domestic structure, which would

Sonda 1

Najznačajnija struktura, iz zooarheološke perspektive, u Sondi 1 je ognjište koje se sastoji od stratigrafskih jedinica MP1 003–1005 (**struktura 1**). Osteološka skupina nalaza uključuje prednje udove, rebra i trnasti nastavak lumbalnoga kralješka. Kosti ovaca/koza sastoje se samo od gornjih udova. Sve kosti iz ove skupine nalaza izgorene su, vjerojatno zbog pripremanja na vatri, a nekoliko ih je bilo odbačeno u ognjište te stoga pokazuju tragove kalcinacije. Ovaj istraženi horizont vrlo je vjerojatno korišten kao kratkotrajno sklonište za pojedinca koji nije vješt u mesarenju, što je vidljivo prema sporadičnim rezovima uzduž medijalnoga reza (*shaft*) tibije prikazane na sl. 12c. U Sondi 1 zabilježena je i starija struktura s rupama od stupova i ognjištem (**struktura 2**) u kojoj se nalazilo vrlo malo kostiju unatoč jasnim dokazima da se radi o naseobinskome sloju. Odustnost kostiju može ukazivati na boravišni kontekst koji

have been kept clean with the periodic removal and disposal of debris.

In contexts outside of the described structures, the quantity of data is mixed, depending on location and depth. Context MP1 027 had pottery dating from the Early and Neolithic. This context consisted of 59% sheep/goat bones and 25% cattle bones (N=10). Deeper, in the clear EN context MP1 038, there was a grouping of burnt, mostly unfused, sheep/goat bones in a concentrated area (N=9), likely indicating that this small deposition was not natural, especially as there was no sign of burning in the context. Finally, in context MP1 043, there were two bones, a part of a sheep/goat mandible and a fused canid metacarpal.

Trench 2

Trench 2 has little zooarchaeological significance. The burnt contexts produced no *in situ* burnt bones. The majority of the bones that were excavated shows no evidence of anthropogenic modification and may be intrusive. The only exception was that of a medium mammal rib with a cut mark, found in the top layer of the trench.

Trench 3

Trench 3 has by far the most cattle bones when compared to the other trenches. The cattle bones (N=12, 17% of trench NISP), most likely all from the same animal based on fusion evidence, were recovered along with 3 sheep/goat specimens and a wild boar metatarsal. There is another hearth in this trench, and, again, there are burnt bones throughout the trench. The only bone associated with the hearth which was not burnt was that of a cattle humerus which was chopped through the still fusing head. This could have resulted from a single consumption event.

Cave taphonomy is complex, and confidently identifying intrusive material can be a difficult task. It is also difficult to establish anthropogenically accumulated faunal remains with certainty in some instances. Some taxa are easy to distinguish as intrusive or natural to the environment. The passerine bones show evidence of digestive processes and were most likely deposited by larger animals, while the rodent bones show clear signs of being modern and intrusive, having burrowed through Trench 3. Overall, however, the assemblage from Mala Pećina is dominated by domestic mammals, sheep/goat and cattle in particular, both of which show clear evidence of butchery. This is consistent with what would be expected for the Neolithic diet in this region (Orton 2012). Trench 1 is the only trench within the assemblage to contain foetal bones. There are 7 in total within the trench – 3 cattle and 4 caprine. These few foetal bones, some of which are burnt, suggest animals were bred in the vicinity of the cave, though the lack of animal dung and cramped nature of the cave indicate it was not used for the long-term keeping of animals, but for short-term occupation, as evidenced by the stratigraphy of the trenches, as well as the low mNI of the contexts.

Archaeobotanical data

During the 2016 excavation at Mala Pećina archaeobota-

je mogao biti periodično čišćen. U ostalim slojevima u Sondi 1, izvan opisanih struktura, količina kostiju varira ovisno o položaju i dubini. Stratigrafska jedinica MP1 027, koja sadrži keramičke nalaze iz ranoga i kasnog neolitika, sadrži 59% kostiju ovikaprida i 25% kostiju stoke (N=10). Dublje, u jasnome ranoneolitičkom sloju MP1 038 zabilježena je skupina gorenih, uglavnom nesraštenih kostiju ovce/koze (N=9), što ukazuje da ovaj mali skup nalaza nije prirodno deponiran, a tome u prilog idu i izgorene kosti, osobito kada se uzme u obzir da u ostatku sloja nema tragova gorenja. Konačno, u MP1 043 nađene su dvije kosti – dio donje čeljusti ovce/koze i sraštena falanga kanida.

Sonda 2

Sonda 2 ima nizak zooarheološki značaj. Slojevi u kojima je zabilježeno gorenje nemaju *in situ* gorene kosti. Većina kostiju ne pokazuje antropogene promjene i mogle bi biti intruzivne. Jedina iznimka je srednje rebro sisavca s tragovima rezanja pronađeno u površinskome sloju sonde.

Sonda 3

U Sondi 3 zabilježen je najveći broj kostiju goveda u usporedbi s ostale dvije sonde. Sudeći po sraštanjima, pronađene kosti goveda (N=12, 17% od NISP u Sondi 3) vjerojatno pripadaju jednoj životinji. U sondi su još pronađene tri metatarzalne kosti ovce/koze i divlje svinje. U sondi je pronađeno još jedno ognjište kao i izgorene kosti. Jedina kost povezana s ognjištem koja nije bila izgorena goveđi je humer koji je bio presječen kroz još ne sasvim srašteni spoj glave humera. Moguće je da je ovdje riječ o jednoj epizodi konzumacije.

Špiljska tafonomija je kompleksna, pa dokazivanje intruzivnih vrsta može biti zahtjevan zadatak. Također, u pojednim slučajevima teško je sa sigurnošću ustvrditi antropogeno akumulirane životinjske ostatke. Neke taksone lako je odrediti kao intruzivne ili uobičajne za takav okoliš. Kosti vrapčarki ukazuju na probavne procese i vrlo vjerojatno su odbačene od strane većih životinja, dok kosti glodavaca izgledaju svježe i pronađene su u jazbini u Sondi 3. Ukupno gledajući, među koštanim materijalom iz Male pećine najzastupljenije su domaće životinje, posebno ovce/koze i govedo, koji pokazuju jasne znakove mesarenja, što potvrđuju dosadašnji podaci o neolitičkoj prehrani na ovome području (Orton 2012). Samo su u Sondi 1 pronađene fetalne kosti. Ukupno ih je sedam: tri goveđe i četiri kaprida. Ovih nekoliko fetalnih kostiju, od kojih neke pokazuju znakove gorenja, ukazuju da je riječ o životinjama uzgojenim u okolici špilje iako nedostatak životinjskoga izmeta i skučeni špiljski prostor ukazuju da špilja nije korištena za dugotrajno čuvanje životinja već je prostor korišten u kraćim intervalima, što je vidljivo u stratigrafiji sondi, kao i niskom minimalnom broju jedinki (mNI) u istraženim stratigrafskim jedinicama.

Arheobotanički podatci

Tijekom istraživanja Male pećine 2016. godine arheobotanički uzorci prikupljeni su u sve tri sonde. Do sada je analizirano 49 uzoraka: 38 iz Sonde 1, četiri iz Sonde 2

nical samples were collected from the three trenches. Only 49 samples have so far been processed; 38 from Trench 1, four from Trench 2, and seven from Trench 3. A range of context types were sampled, including pits, post-holes, hearths, and general occupation layers (see text above). The samples were processed through bucket flotation using a 0.25 mm and 1 mm mesh to collect the flot. The flots were scanned under a low power stereomicroscope (x10–x30 magnifications) and the charred plant macrofossils were removed for further assessment. Charred plant macrofossils were identified and recorded using reference literature (Cappers et al. 2006; Jacomet 2006) and a modern reference collection where necessary.

Only 19 samples contained archaeobotanical remains. Seed density was very low, with only 112 seed items being identified (excluding unidentified plant fragments). The results are presented in Tab. 5. Preservation was poor, with many of the seeds being either fragmented or severely puffed and distorted. The samples were dominated by cereal grains, representing 72% of the assemblage (not including cerealia indet fragments), and included eight emmer (*Triticum dicoccum*) (Fig. 13a), seven barley (*Hordeum vulgare*), and four einkorn (*Triticum monococcum*) grains. Two grains from Trench 2 were slightly smaller and narrower than the einkorn grains, with a flat ventral surface and pointed apex, possibly indicating the presence of 2-grained einkorn (Kroll 1992). Four glume wheat glume bases from Trench 2 were also identified, along with one poorly preserved lentil (*Lens sp.*).

A small number of wild fruit species was identified, including six seeds of raspberry (*Rubus ideaus*) (Fig. 13b) from all three Trenches and one cornelian cherry (*Cornus mas*) from Trench 1 and some possible fragments from Trench 3. Only four wild or possibly weed seeds were identified from Trench 1. These included singular finds of the common cereal crop weed fathen (*Chenopodium* cf. *album*) and knotweed (*Polygonum* sp.).

Preliminary interpretations

The first domestic crops and animals, originating from south-west Asia, spread by sea along the coast, reaching Dalmatia ca. 6000 cal BC (Chapman, Müller 1990; Forenbaher, Miracle 2005; Forenbaher et al. 2013). These domestic crops are understood to consist of the eight 'founder crops': einkorn (*Triticum monococcum*), emmer (*Triticum dicoccum*), barley (*Hordeum vulgare*), pea (*Pisum sativum*), lentil (*Lens culinaris*), chickpea (*Cicer arietinum*), bitter vetch (*Vicia ervilia*), and flax (*Linum usitatissimum*) (Zohary et al. 2012). At Mala Pećina, Early Neolithic contexts, such as MP3 009, indicate the presence of at least one of the founder crops, pointing to the presence of early farming communities in the region.

Overall, the presence of emmer, einkorn and barley as well as wild fruits at the cave site signals that the occupants brought crops to the cave and exploited the local environment for wild foods to supplement their diet. The presence of four of the eight founder crops within the Mala Pećina assemblage is similar to other Early and Late Neolithic sites in the region (Reed 2015).

i sedam iz Sonde 3. Uzorci su uzimani iz različitih konteksta: jama, rupa od stupova, ognjišta i hodnih površina (vidjeti prethodni dio teksta). Uzorci su prosijavani kroz sito oka veličine 0,25 mm i 1 mm, a pregledavani su stereo lupom (povećanje 10x–30x). Karbonizirani biljni makrofosili izdvojeni su za analizu, a pri taksonomskoj determinaciji korištena je referentna literatura (Cappers et al. 2006; Jacomet 2006), a po potrebi i recentna referentna zbirka.

Samo 19 uzoraka sadržavalo je arheobotanički materijal, od kojih je 112 sjemenki taksonomski određeno (nisu uključeni neodredivi biljni fragmenti). Rezultati su predstavljeni u tab. 5. Većina biljnoga materijala je fragmentirana ili deformirana, pa je ukupna očuvanost materijala vrlo niska. Najzastupljenije su žitarice koje čine 72% ukupnoga materijala (neodredivi fragmenti žitarica nisu ubrojeni), među kojima je zabilježeno osam zrna dvozrnoga pira (*Triticum dicoccum*) (sl. 13a), sedam sjemenki ječma (*Hordeum vulgare*) i četiri jednozrnoga pira (*Triticum monococcum*). Dva zrna iz Sonde 2 neznatno su manja i uža od jednozrnoga pira s ravnom ventralnom površinom i istaknutim vrhom, što bi moglo indicirati prisutnost dvozrnoga pira (Kroll 1992). U istoj sondi pronađene su i četiri pšenične pljeve, zajedno s loše očuvanom lećom (*Lens* sp.).

Pronađeni su malobrojni samonikli plodovi. U sve tri sonde pronađeno je šest sjemenki kupina (*Rubus ideaus*) (sl. 13b), dok je jedan drijen (*Cornus mas*) pronađen u Sondi 1 i moguće u Sondi 3. U Sondi 1 pronađene su moguće četiri sjemenke korova, što uključuje čestu pratilju usjeva – bijelu lobodu (*Chenopodium cf. album*) i dvornik (*Polygonum sp.*).

Preliminarna interpretacija

Prve domesticirane biljne kulture i životinje, porijeklom iz jugozapadne Azije, širile su se uz more da bi dosegle Dalmaciju oko 6000 godine pr. Kr. (Chapman, Müller 1990; Forenbaher, Miracle 2005; Forenbaher et al. 2013). Prvi val domesticiranja biljaka uključuje osam prvih vrsta (eng. *'founder crops'*): jednozrni pir (*Triticum monococcum*), dvozrni pir (*Triticum dicoccum*), ječam (*Hordeum vulgare*), grašak (*Pisum sativum*), leća (*Lens culinaris*), slanutak (*Cicer arietinum*), lećasta grahorica (*Vicia ervilia*) i lan (*Linum usitatissimum*) (Zohary et al. 2012). U Maloj pećini pronađena je barem jedna od prvih kultiviranih vrsta u ranoneolitičkim slojevima, poput MP3 009, što ukazuje na ranu pojavu poljodjelskih zajednica na ovome području.

Prisutnost dvozrnoga pira, jednozrnoga pira, ječma, ali i samoniklh plodova na lokalitetu ukazuje da su posjetitelji donosili usjeve u špilju, ali i na činjenicu da su iskorištavali lokalni okoliš kako bi nadopunili prehranu samoniklim biljem. S obzirom na to da su u uzorku iz Male pećine prisutne četiri od osam prvih domesticiranih vrsta, uočljiva je sličnost s istovremenim lokalitetima u regiji (Reed 2015).

Biljni makrofosili ostali su sačuvani karboniziranjem koje je rezultat slučajnoga ili namjernog izlaganja biljnoga materijala visokoj temperatura što može uključivati kuhanje, paljenja smeća ili ogrjeva (usp. Hillman 1984; Miller, Smart 1984; Van der Veen 2007). Stoga karbonizirani biljni ostaci znatno odstupaju od primjeraka koji su češće bili u doticaju s vatrom i ostali neoštećeni u precesu gorenja (usp. Hillman

The form of preservation of the archaeobotanical remains at Mala Pećina was carbonisation or charring, which results from organic material being exposed to heat, either accidentally or deliberately, such as cooking, burning rubbish or fuel (e.g. Hillman 1984; Miller, Smart 1984; Van der Veen 2007). Thus, carbonised plant remains will be heavily biased towards items that come into contact with fire more frequently and survive the charring process (e.g. Hillman 1981; Jones 1981; Boardman, Jones 1990). The mode of deposition may also be inferred from the low density of remains and their poor preservation, possibly indicating that these plant remains resulted from different charring events conducted in the area that were then deposited over time within different contexts. Thus, these finds could be the remains of some of the foods consumed in the cave that

1981; Jones 1981; Boardman, Jones 1990). Loša očuvanost i nizak broj sačuvanih biljnih makrofosila mogu ukazivati na pougljenjivanje sjemenki u više navrata na istome prostoru. S druge strane, možda su neke pougljenjene sjemenke slučajno karbonizirane tijekom aktivnosti u špilji, a zatim raspršene nakon pougljenjivanja. Mala zastupljenost pljeve sugerirala bi da je prisutna samo zadnja faza obrade žitarica, što se može dovesti u vezu s procesom pripremanja hrane.

Prema distribuciji nalaza u sondama, Sonda 2 sadrži najviše taksonomski određenih biljnih ostataka, iako, iznenađujuće, bez značajnih zooarheoloških ostataka. Bitno je istaknuti da su u MP2 005 pronađeni miješani nalazi, što bi moglo indicirati izmiješanost i intruzivnost biljnih ostataka. Nizak broj očuvanih biljnih makrofosila utječe na spacijalnu distribuciju biljnoga materijala, što opet utječe na interpre-

				Crops / usjevi									Wild and weed species / divlje biljke i korovi							
Trench / sonda	Context / kontekst	**Sample no.**	**Flotation no.**	***Hordeum vulgare***	***Triticum dicoccum***	***Triticum monococcum***	***Triticum dicoccum/monococcum***	**cf. *Triticum monococcum* 2-grained**	***Triticum* sp.**	***Triticum* sp. *glume base***	***Cerealia***	***Lens* sp.**	***Rubus ideaus***	***Cornus mas***	**cf. *Cornus mas frag***	**Chenopodium cf. *album***	**cf. *Dasypyrum* sp.**	***Polygonum* sp.**	**cf. *Trifolium* sp.**	**Indeterminate**
1	MP1004	1010	12																1	2
1	MP1006	1012	13																	1
1	MP1007	1017	16													1				
1	MP1007	1017	17															1		1
1	MP1010	1015	15																	8
1	MP1027	1036	31	1							2		1							
1	MP1038	1047	34																	2
1	MP1039	1035	32		1															
1	MP1050	1055	42		1	2			2		8			1					1	4
1	MP1050	1055	44		2						2									4
2	MP2003		21	1	1				2		22									
2	MP2003		22					2	2											8
2	MP2004	2007	23								3									9
2	MP2005	2010	24	5		2			5	4	15	1	3							
3	MP3008	3011	48										2							
3	MP3009	3014	43		1						2									7
3	MP3009	3014	45		1						3				2		1			6
3	MP3009	3015	50		1		1				2									1
3	MP3010	3027	46								2									2

Tab. 5 Summary of the archaeobotanical remains from Mala Pećina (izradili: A. Hale, R. Madgwick)
Tab. 5 Sažetak arheobotaničkih ostataka iz Male pećine (made by: A. Hale, R. Madgwick)

were accidentally burnt during preparation activities and dispersed after charring. The limited chaff evidence would suggest that only final-stage crop processing activities occurred in relation to cooking preparation.

Looking at the distribution of plant remains between the trenches, Trench 2 contains the greatest number of identified crop remains. What is surprising though is that no significant zooarchaeological evidence was recovered from this trench. It is also important to note that MP2 005 was identified during the excavation as having mixed finds and may indicate disturbance and intrusive plant remains. Thus at present, the low numbers of found remains make it difficult to determine whether there are any significant patterns in the distribution of the plant remains on the site and what this may mean for the interpretation of the diet and subsistence in the cave. What we can say is that the occupants of the cave brought cereal crops and wild foods to the site.

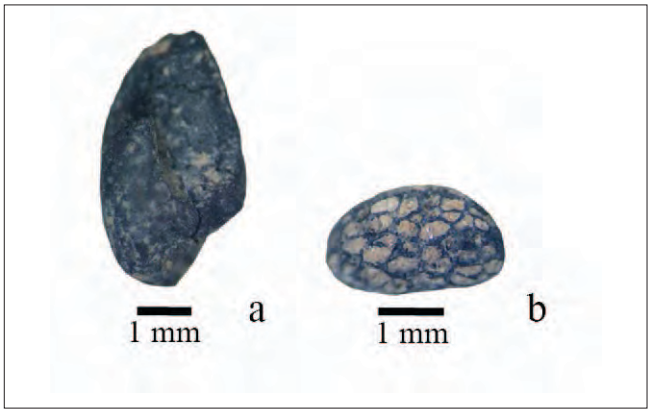


Fig. 13 Carbonised plant remains of: a) an einkorn grain (*Triticum dicoccum*); b) a raspberry seed (*Rubus idaeus*). Scale = 1 mm (photo: K. Reed)

*Sl. 13 Karbonizirani ostaci biljaka: a) dvozrnoga pira (*Triticum dicoccum*); b) kupine (*Rubus idaeus*). Mjerilo = 1 mm (foto: K. Reed)*

Lithics

A technological and typological analysis, a macroscopic analysis of raw materials, and a descriptive statistics of lithic assemblage from Mala Pećina were undertaken. Tool types are defined according to the typology of Debénath, Dibble (1994). Technological categories are defined according to Inizan et al. (1999) and include two categories: flakes and blades. Blades are flakes made by a special manufacturing process, and their length is at least twice the width. An additional criterion for blades is parallel edges. Flakes and blades were determined according to the characteristic features of ventral and dorsal faces (Patterson 1983). The presence of a cortex was determined for each piece and assigned to one of two categories: present and not present. The butt type was determined for complete artefacts and those with the preserved proximal part. The butt-type categories are determined according to Inizan et al. (1999) as plain, dihedral and punctiform. The categories of the fragmentation level are: complete, proximal medial, and distal medial. Length, width, thickness and weight were measured for each piece during the analysis (Debénath, Dibble 1994: 17). Artefacts with retouch were subjected to the typological analysis and divided into the following categories: piece with retouch and point. Position and side of retouch, sickle gloss, and edge damage were noted. The methodology described by Antonović (2003) was used for polished tools. Raw material was determined using the magnification of 10x.

A total of 11 lithic artefacts (five flakes and six blades) were unearthed in the early Neolithic sequence of Mala Pećina (Tab. 6). The total weight of the lithic assemblage is 25. 07g. Four flakes and three blades were fully preserved. According to Villa and Courtin (1983: 267), flakes have a better chance of being preserved since their average thickness is usually greater (as seen in this assemblage), so they are more resistant to actions such as bioturbation, cryoturbations, trampling etc. As for the rest of the assemblage, there are two medial parts of blades and one blade with preserved medial and distal part. There was also the proximal and medial part of one flake. Only two blades have some nodular

taciju prehrane i strategiju preživljavanja u špilji. Sigurno je da su pojedinci koji su boravili u špilji donosili sa sobom žitarice i samoniklo bilje.

Litika

Na kamenoj građi iz Male pećine provedena je tehnološka i tipološka analiza, makroskopska analiza sirovinskoga materijala te deskriptivna statistika. Tipološke kategorije određene su prema Debénath i Dibble (1994). Tehnološke kategorije određene su prema Inizan et al. (1999) i uključuju dvije kategorije: odbojke i sječiva. Sječiva su odbojci dobiveni posebnim proizvodnim postupkom čija je dužina barem dva puta veća od širine (http://struna.ihjj.hr/naziv/sjecivo/28823/#naziv). Dodatni kriterij za sječiva su paralelni rubovi. Odbojci i sječiva određeni su prema karakterističnim značajkama ventralne i dorzalne strane (Patterson 1983). Za svaki komad bilježena je okorina u dvije kategorije: prisutna i nije prisutna. Plohak je bilježen na cjelovitim artefaktima i onima sa sačuvanim proksimalnim dijelom. Kategorije plohka određene su prema Inizan et al. (1999) kao glatki, dvopovršinski i točkasti plohak. Kategorije fragmentiranosti su: cjelovito, proksimalno medijalno i distalno medijalno. Svakom komadu izmjerena je dužina, širina, debljina i težina (Debénath, Dibble 1994: 17). Artefakti s obradom uvršteni su u tipološku analizu koja je sadržavala kategorije: komadić s obradom i šiljak. Bilježene su i pozicija i strana obrade, sjaj srpa i rubna oštećenja. Za polirano oruđe korištena je metodologija prema Antonović (2003). Sirovinski materijal određen je pod povećanjem od 10x.

U ranoneolitičkim slojevima Male pećine pronađeno je ukupno jedanaest litičkih artefakata (pet odbojaka i šest sječiva) (tab. 6). Ukupna težina litičkih nalaza je 25,07 g. Četiri odbojka i tri sječiva cjelovito su sačuvana. Prema Villa i Corutin (1983: 267) odbojci imaju veći izgled za očuvanost zbog veće debljine (to je vidljivo i na materijalu iz Male pećine) te su zato i otporniji na bioturbacije, krioturbacije, gaženje itd. Od ostalih litičkih nalaza pronađena su dva medijalna dijela sječiva, a jedno sječivo ima sačuvani medijalni i distalni dio.

Lithic type / tip litike	Average length / prosječna duljina (mm)	Average width / prosječna širina (mm)	Average thickens / prosječna debljina (mm)
Flakes / odbojak	28.65	18.28	4.53
Blades / sječivo	33.11	14.55	3.35

Tab. 6 Average length, width, and thickness of lithic artefact types from Mala Pećina (izradili: A. Hale, R. Madgwick)
Tab. 6 Prosječna dužina, širina i debljina litičkih izrađevina iz Male pećine (made by: A. Hale, R. Madgwick)

Fig. 14 Lithic assemblage from Trench 1 (1–5) and Trench 3 (6) (photo: I. Drnić)
Sl. 14 Litički nalazi iz Sonde 1 (1–5) i Sonde 3 (6) (foto: I. Drnić)

cortex.

A total of 5 artefacts have a preserved butt. Of these, one flake and one blade have a plain butt, two flakes have a punctiform butt, and one flake has a dihedral butt. The dihedral butt points to the trimming of the core platform, but no cores were unearthed at the site. Plain butt is seen on artefacts produced without core platform preparation (Vukosavljević 2012). Two blades have a triangular cross section and four have a trapezoid one. Four artefacts (two flakes and two blades) display marginal retouch (one has abrupt retouch and three have alternating retouch). This type of retouch results from natural processes or from the use of artefacts (Bordes 1961). Nine artefacts (81%) show visible edge damage, resulting from taphonomic processes. Sickle gloss is seen on three blades.

A total of four tools (all made on blades) are present in the assemblage: two pieces with retouch (Fig. 15a: 4–5), one trapezoidal point (Fig. 15a: 2), and one trapeze (Fig. 15a: 1). On three of these pieces, retouch is present on side edges produced either by direct retouch (in two cases) or indirect retouch (in one case). One interesting tool found at the site is a polished chisel (a combination of type 2 and 4 according to the typology of Antonović, 2003: 55) with a blade length of 18.5 mm (Fig. 15b).

Based on the macroscopic analysis of ram material, Proksimalni i medijalni dio odbojka su također sačuvani. Samo dva sječiva imaju mali udio nodularne okorine.

Plohak je sačuvan na ukupno pet izrađevina od kojih jedan odbojak i jedno sječivo imaju glatki plohak, dva odbojka imaju točkasti plohak, dok je dvopovršinski plohak vidljiv na jednome odbojku. Dvopovršinski plohak upućuje na pripremu udarne plohe jezgre, no do sada jezgre nisu otkrivene na lokalitetu. Glatki plohak vidljiv je na izrađevinama izrađenim od jezgara bez pripreme udarne plohe (Vukosavljević 2012). Dva sječiva imaju trokutast, a četiri trapezoidan presjek. Četiri izrađevine (dva odbojka i dva sječiva) imaju sitnu obradu (u jednome je slučaju riječ o strmoj obradi, dok tri imaju naizmjeničnu obradu). Ovakav tip obrade čest je rezultat prirodnih procesa ili korištenja oruđa (Bordes 1961). Devet izrađevina (81%) ima vidljiva rubna oštećenja koja su rezultat tafonomskih procesa. Sjaj srpa vidljiv je na tri sječiva.

Među litičkim nalazima prisutna su četiri oruđa (izrađena na sječivima), dva komadića s obradom (sl. 15a: 4–5), jedan trapezoidni šiljak (sl. 15a: 2) i jedan trapez (sl. 15a:1). U tri slučaja riječ je o izravnoj obradi, a u jednome slučaju o neizravnoj. Među materijalom ističe se glačano dlijeto (kombinacija tipa 2 i 4 prema Antonović 2003: 55) s dužinom sječiva od 18,5 mm (sl. 15b).

Sirovinski materijal za sve izrađevine, osim dlijeta, makroskopski gledano tercijarni je numulitni rožnjak s va-

Fig. 15a Lithic assemblage from Trench 2 (photo: I. Drnić)
Sl. 15a Litički nalazi iz Sonde 2 (foto: I. Drnić)

all artefacts, except the chisel, are produced of tertiary nummulite flint that varies in colour from milky-white to yellowish light-brown and displays light spots in places. Several nummulitid foraminiferans can be observed on artefacts. The closest sources of this raw material are found in the Split-Kaštela area, more precisely on the southern slopes of the Vlaška hill, Seget Donji, Opor, Kozjak, Mosor, the Marjan peninsula, Čiovo, and Baška Voda (Vukosavljević et al. 2011). The raw material from which the polished chisel was produced could not be determined macroscopically, and a more detailed petrographic analysis is needed to address this question.

The lithic material discussed here comes from the early Neolithic layers of the site, except for the pieces (Fig. 14: 1) (Late Neolithic) and find (Fig. 14: 3) (MP 1 027 with mixed Late and Early Neolithic ceramic material). Analyses of lithics from this time period in Dalmatia are still relatively rare, and the small quantity of artefacts found at this site limits the possible comparisons and larger conclusions. However, analogies can be drawn between the material from Mala Pećina and other contemporary sites in Dalmatia. Early Neolithic sites with similar lithic blade material include Smiličić (Spataro 2002: 73), Pokrovnik (Müller 1994), Markova Pećina on the island of Hvar (Čečuk 1974: 234–235), Vela Gromača near Kavran in Istria (Bačić 1973: 13), Vela Spila on the island of Korčula (Čečuk, Radić 2005: 71), Gudnja cave on the Pelješac peninsula (Marijanović 2005: 30), Spila Nakovana on Pelješac (Forenbaher, Perhoč 2015), Odmut cave (Marković 1985: 38), Hateljska cave in the Dalmatian hinterland (Marijanović 2000), Crno Vrilo (Korona 2009) and Polje Niže Vrcelja (Horvat 2015).

In general, the Mala Pećina assemblage contains a small number of tools – pieces with retouch, trapeze, and a point. The sickle gloss seen on three blades is also of some inte-

Fig. 15b Polished chisel from Trench 2 (photo: I. Drnić)
Sl. 15b Glačano dlijeto iz Sonde 2 (foto: I. Drnić)

rijetetima od mliječno-bijele do žućkasno svijetlo-smeđe boje s istaknutim svijetlim točkama. Nekoliko numulitnih foraminífera vidljivo je na površini izrađevina. Najbliži izvor ovakvoga sirovinskog materijala može biti pronađen u okolici Splita i Kaštela, na južnim obroncima brda Vlaška, Segetu Donjem, Oporu, Kozjaku, Mosoru, poluotoku Marjanu, Čiovu i Baškoj vodi (Vukosavljević et al. 2011). Sirovinski materijal dlijeta ne može biti određen makroskopski, već petrografskom analizom.

Analizirani litički materijal dolazi iz ranoneolitičkih slojeva, osim nalaza (sl. 14: 1) koji potječe iz kasnoneolitičkoge sloja te nalaza (sl. 14: 3) (MP1 027 s miješanim rano i kasnoneolitičkim keramičkim materijalom). Litičke analize iz

rest, as it points to the cutting of grasses (Semenov 1964). All three blades are smaller than 4 cm. According to Semenov (1964), blades with sickle gloss that are less than 6 cm in length are too small to be held in the hand, and were more likely a part of a sickle. However, this cannot be proved at this site. Interestingly, sickle gloss is also present on the stone point from the site. The fact that no cores, primary decortication flakes/blades, or retouch flakes were discovered at the site, and that a cortex is present only on two artefacts, could indicate that the artefacts were brought to the site and not produced *in situ*. Alternatively, the tool production could have been located on the site, but in the parts of the cave where no excavations took place, or in front of the cave, where natural light is available.

Dense point cloud photogrammetry based mapping methodology used in Mala Pećina research

A recent innovation in georeferenced mapping is the application of 3D dense point cloud photogrammetry based mapping. Advances in 3D modeling technology and the availability of inexpensive, user-friendly processing software have enabled archaeological fieldwork to be carried out at a significantly higher resolution and with far greater accuracy than previously possible. Structure from Motion technology (SfM) is central to these developments, democratizing the ability to produce precise, photo-realistic, scalable models of the world and everything in it, using only standard photographs (Prins 2016). 3D dense point cloud photogrammetry based mapping like Agisoft – the software that is mostly used for archaeological applications[5] – are based on an advanced algorithm which creates a 3D point cloud mesh of an object based on the photographs of the object that have been taken from different angles. In order for the PhotoScan software to align the photos and generate the point cloud mesh, photos must have a 60% overlay between them. SfM functions by sifting through a series of overlapping photos taken from a variety of angles and finding points between them that match. After turning the matched points into a point cloud, the software interpolates the geometry between the points and builds a model that is accurately scaled to itself. Once the software has generated the 3D model, a "texture" layer can be applied in order to re-create the feeling of the photograph. The real power of the 3D photoscans is the ability to georeference the 3D model based on just four ground control points with known coordinates. In a cave environment the ground control points can be located using either a Total Station or any other specialized cave techniques. Once the 3D model is georeferenced, the user can extract geotiffs, photogrammetric plans, cross-sections, or simply measure distances to scale on the actual 3D model.

In Mala Pećina, Agisoft and 3D dense point cloud photogrammetry based mapping photogrammetry have been used as one of the mapping and field recording techniques. Considering that Agisoft had not been used in ca-

5 For information about Agisoft PhotoScan visit http://www.agisoft.com.

ovoga razdoblja u Dalmaciji još su uvijek relativno rijetke, a mala količina pronađenih litičkih nalaza na ovome lokalitetu smanjuje mogućnost usporedbe i detaljnije zaključke. Ipak, neke analogije mogu se povući između Male pećine i istovremenih lokaliteta u Dalmaciji. Ranoneolitički lokaliteti koji se mogu usporediti s Malom pećinom su Smiličić (Spataro 2002: 73), Pokrovnik (Müller 1994), Markova pećina na Hvaru (Čečuk 1974: 234–235), Vela Gromača u blizini Kavrana u Istri (Bačić 1973: 13), Vela Spila na Korčuli (Čečuk, Radić 2005: 71), pećina Gudnja na Pelješcu (Marijanović 2005: 30), Spila Nakovana na Pelješcu (Forenbaher, Perhoč 2015), pećina Odmut (Marković 1985: 38), Hateljska pećina u dalmatinskome zaleđu (Marijanović 2000), Crno vrilo (Korona 2009) i Polje niže Vrcelja (Horvat 2015).

Ukupno gledajući, litička građa iz Male pećine sadrži mali broj oruđa: komadiće s obradom, trapez i trapezoidni šiljak. Sjaj srpa vidljiv je na tri sječiva, a upućuje na rezanje trava (Semenov 1964). Sva tri sječiva manja su od 4 cm. Prema Semenovu (1964), sječiva sa sjajom srpa manja od 6 cm premala su da bi se držala u ruci, već su vjerojatno bila dio srpa. Ipak, ovo ne može biti dokazano na ovome lokalitetu. Zanimljivo je kako je sjaj srpa vidljiv i na trapezoidnom šiljku. Nedostatak jezgara, prvotnih sječiva/odbojaka i odbojčića od obrade ili popravaka plohe, kao i činjenica da je okorina prisutna na samo dva artefakta, sugerira kako su izrađevine donesene na lokalitet, a ne proizvedene *in situ*. S druge strane, dokazi *in situ* proizvodnje možda se nalaze u neistraženome dijelu pećine ili u predšpiljskome prostoru s dostupnim danjim svjetlom.

Izrada nacrta Male pećine korištenjem fotogrametrijske metode generiranja oblaka točaka

Recentnu inovaciju u georeferenciranome mapiranju predstavlja primjena 3D izrade modela generiranjem oblaka točaka korištenjem niza fotografija (eng. dense point cloud photogrammetry). Napredak u tehnologiji 3D modeliranja, kao i dostupnost jeftinih, lako učljivih softvera, omogućilo je znatno kvalitetnije provođenje arheološkoga terenskog rada, sa znatno većom preciznošću nego što je to bilo prethodno moguće. *Structure from motion* (SfM) tehnologija ključna je za ovaj razvoj, demokratizirajući mogućnost izrade preciznoga, foto-realističnog, mjerljivog modela svijeta i svega u njemu uporabom standardnih fotografija (Prins 2016). Programi za 3D izradu modela generiranjem oblaka točaka iz niza fotografija, kao što je Agisoft softver koji se najčešće koristi u arheologiji,[5] zasnivaju se na naprednim algoritmima koji stvaraju 3D skup mreže točaka (*point cloud mesh*) objekta na osnovi fotografija koje su snimljene iz različitih kutova u odnosu na objekt. Da bi PhotoScan softver uskladio fotografije i stvorio *point cloud mesh* fotografije moraju imato 60% međusobnoga preklapanja. SfM tehnologija funkcionira na način da prolazi kroz niz preklopljenih fotografija, snimljenih iz različitih kutova, i pronalazeći među njima točke koje međusobo odgovaraju. Nakon što pretvori odgovarajuće točke u skup točki (*point cloud*), softver interpolira geometriju između točki i gradi model koji je

5 Za informacije o Agisoft PhotoScan vidjeti http://www.agisoft.com.

ve archaeology before, all the challenges faced by a cave photographer were limitations for our methodology – the lack of good light sources, the difficulty to illuminate large chambers, and so on. In Mala Pećina, Agisoft models were georeferenced using ground points that were located using Total Station.

In the 2010 survey, Toni Terzić, surveyor and member of the Society for the Research, Surveying and Filming of Karst Phenomena from Zagreb (DISKF Zagreb), set up a polygon routing (a series of fixed points with x, y and z coordinates in the MGI/ Balkans Zone 6 geographic system) from the top of the hill to the interior of the cave. The primary orientation (at the top of the hill) was based on the coordinates of a church tower and an antenna that were visible in the landscape. Terzić produced cave layouts through detailed georeferenced vector drawings made in AutoCAD. At the beginning of the 2016 excavations, it was established that the points (pegs driven into the ground) of the polygon routing were destroyed or unreachable. Using the detailed 2010 layout, it was possible to orientate the Total Station within the cave based on the details on the walls discernible from the 2010 vector drawing. After the Total Station was orientated for the first time, six orientation polygons were placed, covering all three chambers. The Total Station had to be mobile on a daily basis to cover three trenches in three chambers, and its possible placement was reduced to a minimum and sometimes required the user to be quite an acrobat.

u preciznome omjeru u odnosu na snimani objekt. Nakon stvaranja skupa točki (*point cloud*), softver generira teksturu kako bi se ponovno stvorio dojam fotografije. Stvarna snaga ove metode fotoskeniranja je mogućnost georeferenciranja 3D modela na osnovi samo četri stalne točke. U špilji stalne točke mogu biti postavljene uz pomoć totalne stanice ili neke druge tehnike koje se koriste u nacrtnoj dokumentaciji. Nakon što je 3D model georeferenciran, korisnik može izvući *geotiff* dokumente, fotogrametrijske planove, presjeke ili jednostavno izmjeriti udaljenosti u mjerilu koristeći 3D model.

U Maloj pećini Agisoft i fotogrametrija zasnovana na fotogametrijskoj metodi generiranja oblaka točaka korišteni su kao jedna od tehnika za izradu nacrtne dokumentacije i snimanje. S obzirom da Agisoft nije korišten u špiljskoj arheologiji u ovom obimu, svi izazovi s kojima se suočava snimatelj u špiljama predstavljali su otežavajuću okolnost za primjenjenu metodologiju; nedostatak dobrih izvora svjetlosti, nemogućnost da se osvijetle velike dvorane itd. Izrađeni modeli su georeferencirani pomoću fiksnih točaka postavljenih pomoću totalne stanice.

U pregledu objekta iz 2010. godine, Toni Terzić, geodet i član Društva za istraživanje i snimanje krških fenomena iz Zagreba, u svrhu mapiranja pećine, postavlja poligonski vlak (niz točaka u prostoru s x, y i z koordinatima u MGI/ Balkans Zone 6 geografskom sustavu) od vrha brda do ulaza u špilju i u njoj. Za prvu orijentaciju (na vrhu brda) Terzić je koristio koordinate tornja crkve i antene vidljivih u okolišu te je detaljnim georeferenciranim vektorskim crtežom u Au-

Fig. 16 Making of digital documentation in the 2016 excavation in Mala Pećina (photo: K. P. Trimmis)
Sl. 16 Izrada digitalne dokumentacije u istraživanju Male pećine 2016. godine (foto: K. P. Trimmis)

The digital documentation was composed of a combination of vector drawings and 3D photoscan models obtained by applying photogrammetric methods. The equipment used was: a Leica TS06 plus EDM/total station, two digital cameras – a Nikon D7000 and a Canon EOS 400D – and a laptop computer (Fig. 16).

Apart from documenting archaeological layers, cuts, fills and structures, the idea was to thoroughly document the cave chambers and entrance using georeferenced 3D models. The georeferenced points recorded by the Total Station were transferred to the laptop in .dxf and .idx formats,

toCADu izradio tlocrt objekta. Na samom početku istraživanja, 2016. godine, ustanovljeno je da su stalne točke (klinovi zabijeni u zemlju) poligonskoga vlaka uništene ili nedostupne. Zahvaljujući detaljnom tlocrtu iz 2010. godine, orijentirali smo totalnu stanicu unutar špilje po karakterističnim detaljima na zidu prepoznatim na vektorskome crtežu. Nakon što je totalna stanica prvi puta orijentirana, postavljeno je šest orijentacijskih poligona kojima su „pokrivene" sve tri špiljske komore. Tri sonde u tri komore zahtjevale su mobilnost totalne stanice na dnevnoj osnovi, a izbor mjesta za postavljanje bio je sveden na minimum i ponekad je zahtje-

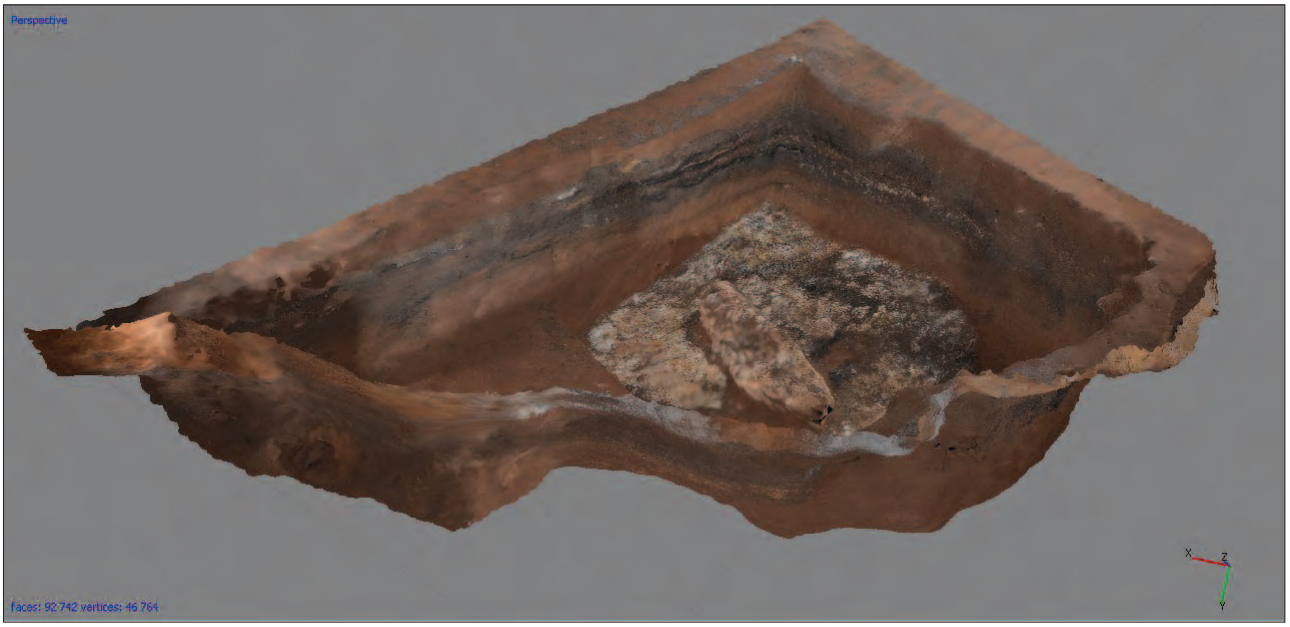


Fig. 17 Model of Trench 1 (made by: I. Drnić, M. Mađerić)
Sl. 17 Model Sonde 1 (izradili: I. Drnić, M. Mađerić)

and were connected (sometimes immediately) in AutoCAD to create a linear layout. Total Station was also used to document archaeological structures and stratigraphic relations and to record the xyz coordinates of the "target points" used to georeference the 3D photoscan models and generate orthophotos and photogrammetric documentation.

Another aspect of digital documentation included photogrammetric methods, i.e. taking photographs to produce and georeference 3D models (situations in trenches or chambers) (Fig. 17). When photographing, it was crucial to achieve at least a 60% overlap between two subsequent photographs. To make a successful model, it was also necessary to "close the dome of frames" around the documented situation. Because of specific light conditions within the cave (the lack of daylight), the photographing was especially difficult. Several photography modes were tested (secondary light sources on the frame, manual setting with different shutter speeds, using flashguns manually or in an automatic TTL mode), and it was determined that the given conditions could best be recorded by photographing with the automatic setting and flash (exclusively for 3D models!). Sets of photographs (up to 50 for trench situations and up to 300 for chambers) were transferred to the Agisoft PhotoScan, which then produced the 3D model through

vao iznimne sposobnosti operatera. Digitalna nacrtna dokumentacija sastojala se od kombinacije vektorskoga crteža i 3D modela dobivenoga fotogrametrijskom metodom. Od opreme korišteni su totalna stanica Leica TS06 plus, fotoaparat Nikon D7000 i Canon EOS 400D te prijenosno računalo (sl. 16).

Osim dokumentiranja arheoloških slojeva, ukopa, zapuna i struktura, namjera je bila temeljito dokumentirati sve komore i ulazni prostor georeferenciranim 3D modelom. Georeferencirane točke snimljene totalnom stanicom prebacivane su na prijenosno računalo u .dxf i .idx formatu i spajane (ponekad i na samomome lokalitetu) u AutoCADu u linijski crtež. Osim za bilježenje arheoloških struktura i stratigrafskih odnosa, totalna stanica je korištena i za bilježenje xyz koordinata tzv. fototočki koje služe za georeferenciranje ortofotografije i 3D modela.

Drugi vid digitalne nacrtne dokumentacije sastojao se od fotogrametrijske metode, odnosno fotografiranja za potrebe izrade 3D modela (situacije u sondi ili komore) i njihovo georeferenciranje (sl. 17). Pri fotografiranju je bilo nužno držati se pravila od barem 60% preklopa između dvije susjedne fotografije. Za uspješan model također je potrebno „zatvoriti kupolu kadara" oko objekta koji se želi dokumentirati. Zbog specifičnih uvjeta osvjetljenja u špilji (nedostatak dnevnoga svjetla), fotografiranje je bilo poseb-

several stages of the photographic and geographic dataset process. Georeferencing was achieved using the same software after the target points were transferred from the CAD software. The georeferenced model obtained in this manner contained all the relevant field data, and was used as the basis for exporting ortophotographs in the .GEOtiff format, and the vector grid (mesh). The final product was a composite document in the AutoCAD format, including the mesh, orthogonal photographs, and linear drawings, i.e. a photosketch placed on the relevant coordinates. Based on the composite, it was possible to compare the linear drawings to the model, add information to them, or additionally draw an archaeological structure or cave chamber in the cases when there was no time or people to use the total station. Although it is less detailed and visually attractive, a linear/vector drawing is still necessary because of its lesser software demands in comparison to 3D models.

It was possible to illuminate the trenches because of their small size, but making photogrammetric models of chambers was very demanding. Poor lighting caused discrepancies in the model, so the textures were not visually attractive. Nevertheless, the mesh turned out to be satisfactory and, when georeferenced, contained all the measurable data on the cave configuration. When imported into AutoCAD, it was used to draw cross-sections and measure all the spatial dimensions. Once improved, these models can be the basis for future 3D visualizations and reconstructions. (Fig. 18)

no zahtjevno. Isprobano je nekoliko načina fotografiranja (sa sekundarnim izvorima svjetla na kadar, manuala opcija, sa i bez fleša) da bi se ustanovilo da u datim uvjetima najbolje funkcionira fotografija dobivena na *automatic* opciji s flešom (isključivo za 3D model!). Skup tako dobivenih fotografija (do 50 za situacije u sondama i do 300 za komore) ubacivao bi se u Agisoft softver koji bi kroz nekoliko koraka izveo 3D model. Georeferenciranje se vršilo u istom softveru nakon prebacivanja koordinata fototočaka iz AutoCADa. Tako dobiveni georeferencirani model, osim što sam nosi sve relevantne terenske podatke, poslužio je kao baza za eksportiranje orto-fotografije u .GEOtiff formatu i vektorske mreže (*mesh*). Konačni proizvod bio je kompozitni dokument u AutoCAD formatu koji se sastoji od vektorske mreže, ortogonalne fotografije i linijskoga crteža, tj. fotoskice s relevantnim koordinatima. Na kompozitu je bilo moguće usporediti linijski crtež s modelom, dopuniti, popraviti ili u slučajevima nedostatka vremena ili ljudi potrebnih za snimanje totalnom stanicom, naknadno nacrtati arheološku strukturu ili špiljsku dvoranu. Iako manje detaljan i vizualno neatraktivan, linijski/vektorski crtež još je uvijek nužna stvar zbog manjih hardverskih zahtjeva naspram 3D modela.

Dok je sonde zbog manjih dimenzija bilo moguće dovoljno dobro osvijetliti za fotografiranje, pokušaj izrade fotogrametrijskoga modela komora bio je vrlo zahtjevan proces. Nedostatak svjetla uzrokovao je stvaranje smetnji na modelu, pa je isti teksturiran i nije vizualno atraktivan. Unatoč tome, sama vektorska mreža ispala je zadovoljavajuće i nakon georeferenciranja nosi sve mjerljive podatke o

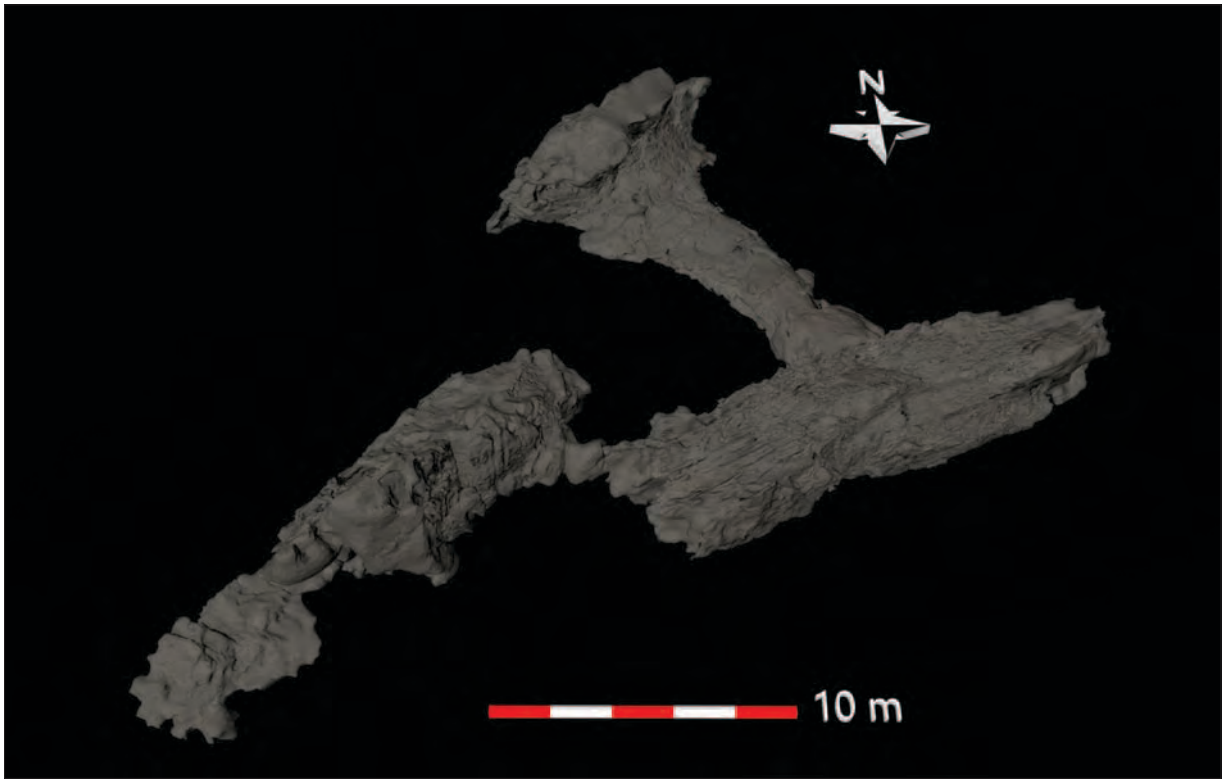


Fig. 18 3D model of Mala Pećina (made by: M. Mađerić)
Sl. 18 3D model Male Pećine (izradio: M. Mađerić)

Evaluating dense point cloud photogrammetry mapping in cave archaeological research

The pilot application of 3D photoscan-based photogrammetry using Agisoft software in combination with EDM has proven valuable because of the speed and accuracy of data recording. In the difficult conditions of a subterranean research, completely paperless recording minimized errors and the recording team's workload. However, working with dense point cloud photogrammetry in caves creates the very difficult technical challenge of lighting properly and consistently any area that is recorded. In Mala Pećina, working with portable battery-based LED lights, we failed to produce consistent textures for the PhotoScan. Although the recording was conducted properly, the presentations of the 3D models are not of the highest quality. This is not a PhotoScan or methodological problem, though. Is a technical issue that can be tackled using different lighting techniques and/or more advanced equipment. Having in mind all the issues of mapping in a cave environment, photoscans can be adapted to work as cave mapping/recording software while also being used during the excavation for trenches and the recording/documentation of features. The speed, accuracy and efficiency of dense point cloud photogrammetry provide the tool which could minimize the large error margin of cave archaeology mapping and bring it to the levels of open field archaeology.

DISCUSSION AND CONCLUDING REMARKS

Mala (Nova) Pećina excavation presented two distinct phases of occupation in the cave; a later one, with the Late Neolithic Hvar Culture remains found only in Trench 1, and an earlier one from the Early Neolithic Impressed Ware Culture, found in all three trenches. A similar chronological sequence in the Neolithic period is attested by several cave sites in the Adriatic hinterland like Hateljska Pećina, Ravlića Pećina, and Zelena Pećina (Benac 1957; Marijanović 1981; 2000; for absolute dating see Vander Linden, Pandžić, Orton 2014: 18–19), but also by some coastal and island sites, as shown by the recent excavations in Grapčeva Špilja (Forenbaher, Kaiser 2008).

In Mala Pećina, there is a clear differentiation between the occupation areas and the spatial arrangements inside the cave from the Early to the Late Neolithic. The micro-morphological analyses of the layers from the three trenches will definitely contribute to a better understanding of this problem once complete. However, at this point we can still discuss the position – awkward to the modern visitor – of the EN structure in Trench 2 at the end of the low passage, and the decision – again, wise to the modern perception – to use the driest and flattest part of the cave in the EN and LN periods. In other words, if we accept the preliminary hypothesis that the cave in the Early Neolithic had "profane" (shelter) and "ritual" use, compared to the Late Neolithic occupation of traveling shepherds for short periods, these two different groups were using the cave space somewhat differently. Furthermore, the EN groups used almost every part of the cave, including the inhospitable position in the area of Trench 2, deep in the lower passage between Cham-

konfiguraciji objekta. Ubačena u AutoCAD program, daje mogućnost iscrtavanja presjeka komora i mjerenja svih prostornih dimenzija. Dorađeni, ovi modeli mogu poslužiti i kao osnova za naknadne 3D vizualizacije i rekonstrukcije (sl. 18).

Evaluacija izrade nacrtne dokumentacije primjenom fotogrametrijske metode generiranja oblaka točaka iz niza fotografija u arheološkim istraživanjima špilja

Probna primjena fotogrametrije zasnovane na 3D fotoskeniranju, uz uporabu Agisoft softvera i u kombinaciji s EDM-om, pokazala se korisnom zbog brzine i točnosti prikupljenih podataka. U zahtjevnim uvjetima podzemnih istraživanja ovaj način snimanja smanjuje mogućnost pogreške i opterećenosti tima koji provodi snimanje. Ipak, navedena fotogrametrijska metoda u špiljama stvara izrazito zahtjevne tehničke izazove pri osvjetljenju područja koje se želi snimiti. U Maloj pećini rad s LED rasvjetom s prijenosnim baterijama nije omogućio konzistentnu teksturu fotografija potrebnih za PhotoScan softver. Stoga, iako je snimanje pravilno provedeno, 3D modeli nisu najbolje kvalitete. Nije riječ o softverski ili metodološki uvjetovanome problemu, nego tehničkom koji se može riješiti korištenjem različitih tehnika osvjetljenja i/ili naprednije opreme. Uzimajući u obzir problematiku vezanu uz izradu nacrta u špiljskom okolišu, PhotoScan se može prilagoditi kao softver za mapiranje/snimanje špiljskih objekata, a simultano se može koristiti za snimanje sondi i istraženih struktura. Zbog brzine, preciznosti i učinkovitosti, fotoskeniranje može poslužiti kao alat koji može umanjiti veće pogreške koje snimanje u špiljskim lokalitetima nosi u odnosu na arheologiju na otvorenome.

RASPRAVA I ZAKLJUČNE NAPOMENE

U istraživanju Male (Nove) pećine definirane su dvije jasne faze korištenja objekta, mlađa s tragovima kasnoneolitičke hvarske kulture pronađenima samo u Sondi 1 te starija s *Impresso* kulturnom skupinom zabilježenom u sve tri sonde. Sličan kronološki slijed u razdoblju mlađega kamenog doba zabilježen je na nekoliko špiljskih lokaliteta u jadranskome zaleđu kao što su Hateljska pećina, Ravlića pećina i Zelena pećina (Benac 1957; Marijanović 1981; 2000; za apsolutno datiranje v. Vander Linden, Pandžić, Orton 2014: 18–19), ali i na pojedinim obalnim i otočkim lokalitetima, što su potvrdila novija istraživanja u Grapčevoj špilji (Forenbaher, Kaiser 2008).

U Maloj pećini zabilježena je jasna diferencijacija između korištenih pozicija kao i prostornoga rasporeda unutar objekta između mlađega i starijeg neolitika, a nakon provedene mikromorfološke analize dobiveni podaci zasigurno će doprinjeti boljem razumijevanju ovoga problema. Ipak, na sadašnjem stupnju istraženosti, možemo primjetiti nezgodnu poziciju, barem iz perspektive modernoga promatrača, ranoneolitičke strukture u Sondi 2 smještene na završetku niskoga prolaza te smisleniji odabir pozicije u objektu (opet iz moderne percepcije) u razdoblju ranoga i kasnog neolitika. Drugim riječima, ako prihvatimo preliminarnu hipotezu da je u ranome neolitiku Mala pećina korištena u profane (sklonište) i „ritualne" svrhe u usporedbi s kasnim

bers 2 and 3. The LN groups were using only the first chamber, close to the entrance at the limit between twilight and the dark zone. During the LN, visitors deliberately selected the flattest and driest space for occupation compared to the EN groups that used the whole cave, including the wettest, darkest and most confined spaces of the cave.

In conclusion we can state several facts resulting from the recent research in Mala Pećina:

1) Pottery finds and bones along with the modest settlement remains in the LN and EN layers in Trench 1 can support the idea that the cave was used as a temporary shelter for moving groups – probably shepherds and not hunters, based on the bone assemblage dominated by domesticated species.

2) The absolute date from the area of Trench 2 places the EN occupation in Mala Pećina in the first half of the 6th millennium (Beta-287818: 5780–5640 calBC) that fits well with the established chronological framework for the Impressed Ware culture in the eastern Adriatic (Forenbaher et al. 2013). Furthermore, the presence of both coastal and hinterland impressed ware in the same contexts supports the assumption that the Adriatic EN is not isolated from the hinterland EN. On the contrary, the Neolithic groups in both areas might have been in mutual contact even from the very first centuries of the 6th millennium (Spataro 2009), and Mala Pećina might be the point in the region that connected the ecosystems separated by the Dinaric Alps – the coast and the hinterlands. As also presented in the short report of Drnić and Trimmis (2018), the Dinaric Alps might be that "marginal space" where different cultural groups were in contact and exchanged ideas and objects. This is still a research hypothesis mainly because the material from Mala Pećina looks overly "coastal" (e.g. lithics sourced in the Split-Kaštela area, impressed style pottery assemblage similar to coastal sites such as the Zemunica cave). Isotopic studies on the animal bones could give additional evidence about the mobility of the aforementioned groups; however, the zooarchaeological assemblage of the cave at this stage of research is too small to support a comprehensive isotopic study. There are certain indications, though, that the groups that visited Mala Pećina in the first half of the 6th millennium were in contact with the groups that lived further inland. The similarities of certain impressed motifs with the material from Zelena and Hateljska caves in Herzegovina, the variety of tempering of the impressed pottery sherds, along with the presence of barbotine pottery in the same contexts with the typical coastal cardium impressed style, could be the supporting evidence.[6]

3) The EN horizon in Mala Pećina has a typical EN "package" for the Eastern Adriatic region, with pottery, domesticated animals and plants, and one example of a polished tool. The EN groups, as presented by the pottery, lithics, plants, and bones assemblages, were neither living inside the cave nor staying inside for long periods. The visits were probably

6 Mala Pećina is not the only site where impressed ware co-exists with hinterland – Balkan – pottery. Evidence has been unearthed for the co-existence of the Impressed Ware Culture and the Starčevo-Criş-Körös in Albania and at Obre I in central Bosnia (Spataro 2009: 73, 78).

neolitikom kada su objekt kao sklonište posjećivali putujući stočari, jasno je da su ove skupine koristile špiljski prostor na različite načine. Nadalje, ranoneolitičke skupine koristile su gotovo sve dijelove špilje, uključujući i negostoljubivu poziciju na dnu niskoga prolaza između dvorana 2 i 3 gdje se nalazi Sonda 2. Kasnoneolitičke skupine koristile su samo prvu dvoranu smještenu bliže ulazu u objekt na granici zone sumraka i mraka. U istome razdoblju posjetitelji su za korištenje svjesno odabrali najravniji i najsuši dio špilje u odnosu na rani neolitik kada je korišten gotovo cijeli špiljski prostor, uključujući i najvlažnije, najmračnije i najskrovitije pozicije.

U zaključku možemo navesti nekoliko podataka koji proizlaze iz dosadašnjih istraživanja Male pećine:

1) Nalazi keramike i kostiju, zajedno sa skromnim naseobinskim ostacima iz razdoblja kasnoga i ranog neolitika iz Sonde 1, podupiru pretpostavku kako su špilju kao privremeno sklonište koristile mobilne skupine, vjerojatno pastira, a ne lovaca, na što ukazuju nalazi kostiju među kojima dominiraju domesticirane vrste.

2) Apsolutni datum s pozicije Sonde 2 smješta ranoneolitičku uporabu Male pećine u prvu polovicu šestoga tisućljeća pr. Kr. (Beta-287818: 5780–5640 calBC) što se dobro uklapa u utvrđeni kronološki okvir za *impresso* kulturnu skupinu na istočnojadranskoj obali (Forenbaher et al. 2013). Nadalje, prisustvo *impresso* keramike s motivima karakterističnim za obalni prostor i unutrašnjost u istome kontekstu ukazuje da u ranome neolitiku jadranski prostor nije bio izoliran od unutrašnjosti. Naprotiv, neolitičke skupine s oba prostora mogle su biti u kontaktu od prvih stoljeća šestoga tisućljeća (Spataro 2009), a Mala pećina mogla je biti pozicija u području koje spaja dva velika ekosustava: obalni i kontinentalni. Kao što je predstavljeno u kratkom izvještaju (Trimmis, Drnić 2018), Dinaridi su mogli biti „marginalni prostor" gdje su skupine različitih kulturnih tradicija bile u kontaktu te su izmjenjivale ideje i predmete. Ovo je samo radna hipoteza, osobito ako se u obzir uzme da materijal iz Male pećine nosi znatna obilježja obalne tradicije. Primjerice, sirovima za izradu cijepanih alatki vjerojatno potječe s prostora između Splita i Kaštela, a dio keramike s *impresso* ukrasom odražava sličnosti s materijalom s priobalnih lokaliteta kao što je špilja Zemunica. Analize stabilnih izotopa iz životinjskih kostiju zasigurno bi omogućile dodatne podatke o mobilnosti prethodno spomenutih skupina, ali je prikupljeni zooarheološki materijal na ovome stupnju istraženosti premalenoga obima da bi omogućio sveobuhvatnu analizu. Ipak, postoje određene indicije da su skupine koje su posjećivale Malu pećinu u prvoj polovici šestoga tisućljeća pr. Kr. bile u kontaktu sa zajednicama koje su nastanjivale područja dublje u unutrašnjosti. Sličnost pojedinih *impresso* motiva s nalazima iz Zelene i Hateljske pećine u Hercegovini, različite primjese dodavane u *impresso* keramiku, kao i prisutnost barbotinske keramike u istome kontekstu s ulomcima ukrašenima tipičnim obalnim kardium *impresso* stilom mogli bi ići u prilog ovoj tvrdnji.[6]

6 Mala pećina nije jedini lokalitet na kojem je *impresso* keramika zabilježena zajedno s keramikom iz unutrašnjosti Balkanskoga poluotoka. Dokazi o koegzistenciji *impresso* kulturne skupine i kulture Starčevo–Criş–Körös zabilježeni su u Albaniji kao i u središnjoj Bosni na lokalitetu Obre I (Spataro 2009: 73, 78).

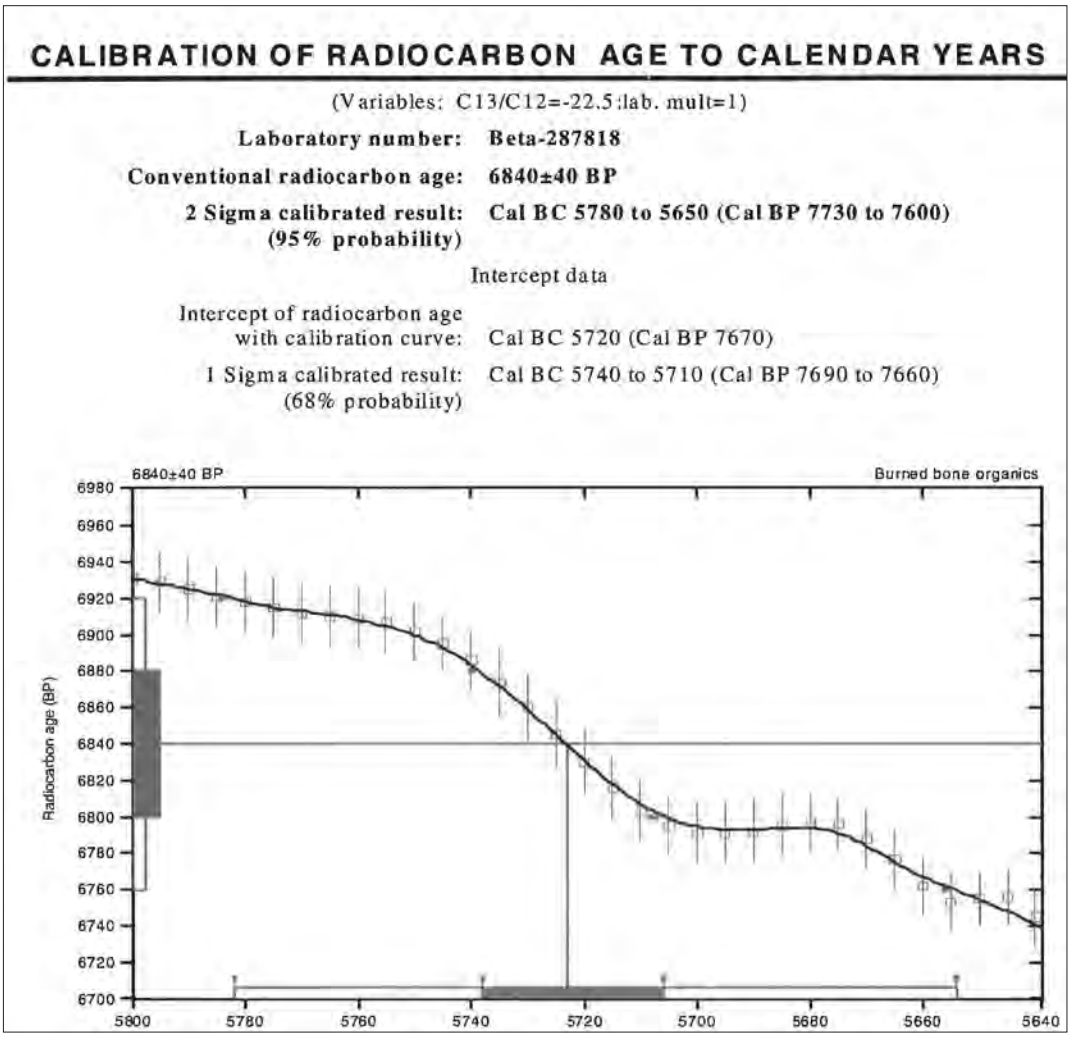


Fig. 19 AMS date from the bone sample at the position of Trench 2 (Beta Analytics)
Sl. 19 AMS datum s koštanoga uzorka s pozicije Sonde 2 (Beta Analytics)

of short-term character. However, more research is required in order to investigate the patterns and the duration of these activities.

4) Some data gathered in the Mala Pećina excavation could indicate some sort of ritual activities in the cave in the EN period, as suggested for the LN phase of the Grapčeva cave on the island of Hvar (Forenbaher, Kaiser 2008: 141–145). This is suggested by the complex morphology of the cave, with a narrow entrance and three chambers and low passages that support the idea of a *"liminal zone between the everyday and underground worlds"*. In addition, the presence of a simple stone structure in Trench 2, placed in the most inhospitable position in the cave and accompanied by a much larger pottery assemblage (with a high percentage of decorated fragments), in comparison to the settlement layers in Trench 1, could fit into this working hypothesis. Again, it is important to emphasise that further framework are required to confirm this claim!

The behaviour of people selecting caves, or part of a cave, with particular microenvironmental characteristics in order to undertake particular activities, which are different for

3) Ranoneolitički horizont u Maloj pećini sadrži tipičan ranoneolitički „paket" za prostor istočne jadranske obale s keramikom, domensticiranim životinjama i biljkama te jednom glačanom alatkom. Ranoneolitičke skupine, kao što je predstavljeno u poglavljima o keramici, litici te biljnim i životinjskim ostacima, nisu živjele niti su se zadržavale u objektu duže vrijeme. Te su posjete vjerojatno bile kratkotrajne, ali je potrebno provesti dodatna istraživanja kako bi se istražili obrasci i trajanje tih aktivnosti.

4) Neki podaci prikupljeni u istraživanju Male pećine mogli bi ukazivati na postojanje određenih ritualnih aktivnosti u objektu u razdoblju ranoga neolitika, kao što je predloženo i za kasnoneolitičku fazu Grapčeve špilje na otoku Hvaru (Forenbaher, Kaiser 2008: 126–137). Na to upućuje složena morfologija špilje s uskim ulazom i tri dvorane spojene niskim prolazima, što bi išlo u prilog pretpostavci o *„liminalnoj zoni između svakodnevnog i podzemnog svijeta"*. Nadalje, postojanje jednostavne kamene strukture na najneudobnijoj poziciji u špilji (u Sondi 2) s tragovima gorenja, uz znatno veći broj keramičkih nalaza (s višim postotkom ukrašenih ulomaka) u odnosu na naseobinske slojeve

different environments, can be seen in the wider southeastern European context (the Balkans and Greece) (Sampson 2008; Trimmis forthcoming). There are certain indications that such a change in occupation patterns between the Early and Late Neolithic could also be observed in Mala Pećina, possibly reflecting at least a partial shift in social practices at the site.

ACKNOWLEDGMENTS

The excavations in Mala Pećina were supported by the Department of Archaeology and Conservation at Cardiff University, the British Cave Research Association, the Conservation Department of the Ministry of Culture of the Republic of Croatia in Trogir, the DISKF Caving Club from Zagreb, and the Archaeological Museum in Zagreb. The authors are grateful to Boris Watz, Rosie Dyvig, Victoria Alexander, Petros Alexopoulos, and Roxanne Lyons for their unconditional help during the analysis of the assemblages and Kristina Brkić and Miljenka Galić for pottery drawings. K. P. Trimmis has been partially supported for the Mala Pećina study by the Greek Archaeological Committee UK Matti Egon II scholarship as part of his PhD studies. He is also grateful to Vaggelis, Stella and Konstantina for their support during the last stages of this paper.

u Sondi 1, uklapa se u ovu hipotezu. Ponovno, potrebno je naglasiti kako su za jasniju potvrdu ove tvrdnje potrebna dodatna istraživanja!

Različita ponašanja ljudi koji odabiru špilje ili njihove dijelove, s određenim mikrookolišnim obilježjima u svrhu poduzimanja određenih aktivnosti, zabilježena su na širem jugoistočnoeuropskome prostoru (Balkan i Grčka) (Sampson 2008; Trimmis forthcoming). Postoje određene indicije da se navedena promjena u obrascima zaposjedanja prostora između ranoga i kasnog neolitika može primjetiti i u Maloj pećini, odražavajući barem djelomičnu promjenu u društvenim praksama na nalazištu.

ZAHVALE

Istraživanje Male pećine poduprli su Odsjek za Arheologiju i konzervaciju Sveučilišta u Cardiffu, British Cave Research Association, Konzervatorski odjel Ministarstva kulture Republike Hrvatske u Trogiru, Speleološki klub DISKF-Zagreb i Arheološki muzej u Zagrebu. Autori su zahvalni Borisu Watzu, Rosie Dyvig, Victorii Alexander, Petrosu Alexopoulosu i Roxanne Lyons na bezuvjetnoj pomoći pri analizi nalaza i podataka te Kristini Brkić i Miljenki Galić koje su crtale nalaze. K. P. Trimmis je za istraživanje Male pećine bio djelomično podržavan od strane Grčkoga arheološkog odbora za Ujedinjeno kraljevstvo – Matti Egon II stipendije u okviru doktorskih studija, a zahvalan je Vaggelisu, Stelli i Konstantini na podršci tijekom završne faze ovoga rada.

Translation / Prijevod
Kristina Brkić i Ivan Drnić

Proofreading / Lektura
Marko Maras

BIBLIOGRAPHY / LITERATURA

Antonović, D. 2003, *Neolitska industrija glačanog kamena u Srbiji*, Arheološki Institut, Beograd.

Bačić, B. 1973, Vela Gromača kod Kavrana, *Histria Archaeologica*, Vol. IV/1, 5–29.

Batović, Š. 1966, *Stariji neolit u Dalmaciji*, Arheološki muzej Zadar, Zadar.

Batović, Š. 1979, Jadranska zona, in: *Praistorija jugoslavenskih zemalja. II: Neolitsko doba*, Benac A. (ed.), Sarajevo, 473-635.

Behrensmeyer, A. K. 1978, Taphonomic and ecologic information from bone weathering, Palobiology, Vol. 4/2, 150–162.

Benac, A. 1956, Prehistorijska gradina Zecovi kod Prijedora / La Gradina Prehistorique de Zecovi pres de Prijedor, *Glasnik Zemaljskog Muzeja*, Vol. XI, 147–166.

Biagi, P., Shennan, S., Spataro, M. 2005, Rapid Rivers and Slow Seas? New data for the radiocarbon chronology of the Balkan Peninsula, in: *Prehistoric Archaeology & Anthropological Theory and Education*, Reports of Prehistoric Research Projects 6–7, Nikolova L., Higgins J. (eds.), 43–51.

Boardman, S., Jones, G. 1990, Experiments on the effects of charring on cereal plant components, *Journal of Archaeological Science*, Vol. 17/1, 1–11.

Bordes, F. 1961, *Typologie du Paléolithique Ancien et Moyen*, Delmas, Bordeaux.

Borić, D., Price, T. D. 2013, Strontium isotopes document greater human mobility at the start of the Balkan Neolithic, *Proceedings of the National Academy of Sciences*, Vol. 110 (9), 3298–3303.

Brusić, Z. 1995, Naselje iz starijeg neolitika u Vrbici kod Bribira, *Diadora*, Vol. 16-17, 1–49.

Budja, M. 2001, The Transition to Farming in Southeast Europe: Perspectives from Pottery, *Documenta Praehistorica*, Vol. 28, 27–48.

Budja, M. 2010, The neolithisation of South-Eastern Europe: From Y-Chromosome dispersals to Ceramic Figurines, in: *The Spread Of The Neolithic To Central Europe*, Gronenborn D., Petrasch J. (eds.), International Symposium, Mainz 24–26 June 2005, RGZM – Tagungen Band 4, Römisch-Germanisches Zentralmuseum, Verlag des Römisch-Germanischen Zentralmuseums Mainz, Mainz, 107–139.

Cappers, R. T. J., Bekker, R. M., Jans, J. E. A. 2006, *Digital Seed Atlas of the Netherlands*, Groningen Archaeological Studies 4, Barkhuis Publishing, Eelde.

Chapman, J. C., Müller, J. 1990, Early farmers in the Mediterranean basin: the Dalmatian evidence, *Antiquity*, Vol. 64, 127–134.

Čečuk, B. 1974, Kamene i koštane rukotvorine Markove spilje II, *Arheološki radovi i rasprave*, Vol. VII, 221–258.

Čečuk, B., Radić, D. 2005, *Vela spila: višeslojno pretpovijesno nalazište – Vela Luka, otok Korčula,* Centar za kulturu, Vela Luka..

Debénath, A., Dibble, H. I. 1994, *Handbook of Palaeolithic Typology. Lower and Middle Paleolithic of Europe*, University of Pennsylvania, Philadephia.

Drnić, I., Terzić, T., Garašić, M., Krpina, I., Watz, B., Kresnik, G., Ajduković, K. 2010, Recentna istraživanja u Novoj pećini kod Sutine, in: *Prvi hrvatski speleološki kongres: Sažeci radova*, Garašić M., Kovačević M.-S. (eds.), Zagreb, 36–37.

Forenbaher, S., Kaiser, T. 2008, Grapčeva špilja, Književni krug Split, Split.

Forenbaher, S., Kaiser, T., Miracle, P. T. 2013, Dating the East Adriatic Neolithic, *European Journal of Archaeology*, Vol. 16, 589–609.

Forenbaher, S., Miracle, P. T. 2005, The spread of farming in the eastern Adriatic, *Antiquity*, Vol. 79, 514–528.

Forenbaher, S., Perhoč, Z. 2015, Izrađevine od lomljenog kamena iz Nakovane (Pelješac): kontinuitet i promjene od ranog neolitika do kraja prapovijesti, *Prilozi Instituta za arheologiju u Zagrebu*, Vol. 32, 5–74.

Granić, M. 1882, Nova pećina (špilja), *Viestnik Hrvatskog arkeologičkog družtva*, Vol. 4, 79–80.

Grant, A. 1982, The use of tooth wear as a guide to the age of domestic ungulates, in: *Ageing and Sexing Animal Bones from Archaeological Sites*, Wilson B., Grigson C., Payne S. (eds.), British Archaeological Report British Series 109, Oxford, 91–108.

Horvat, K., Vujević, D. 2017, Pokrovnik – materijalna kultura neolitičkog naselja, *Prilozi Instituta za arheologiju u Zagrebu*, Vol. 34, 45–81.

Hillman, G. C. 1981, Reconstructing crop husbandry practices from the charred remains of crops, in: *Farming Practice in British prehistory*, Mercer R. (ed.), Edinburgh University Press, Edinburgh, 123–162.

Hillman, G. C. 1984, Interpretation of archaeological plant remains: application of ethnographic models from Turkey, in: *Plants and Ancient Man: Studies in palaeoethnobotany*, Casparie W. A., Van Zeist W. (eds.), Rotterdam, 1–41.

Horvat, K. 2015, Polje niže Vrcelja – nalazište ranog neolitika na benkovačkom području, *Vjesnik za arheologiju i historiju dalmatinsku*, Vol. 108, 9–35.

Inizan, M. L., Reduron-Ballinger, M., Roche, H., Tixier, J. 1999, *Technology and Terminology of Knapped Stone*, Cercle de Recherches et d'Etudes Prehistoriques, Nanterre.

Jacomet, S. 2006, *Identification of Cereal Remains from Archaeological Sites*, 2nd Edition, Institute for Prehistory and Archaeological Science, Basel.

Jones, G. 1981, Crop processing at Assiros Toumba: a taphonomic study, *Zeitschrift für Archäologie*, Vol. 15, 105–111.

Kliškić, D. 2004, Prapovijesni lokaliteti na prostoru Neorića i Sutine, in: *Zbornik o Zagori*, knjiga 7, Veić Z. (ed.), Split, 91–140.

Korona, M. 2009, Kremeni artefakti, in: *Crno vrilo 2*, Marijanović B. (ed.), Sveučilište u Zadru, Odjel za arheologiju, Zadar.

Kroll, H. 1992, Einkorn from Feudvar, Vojvodina, II. What is the difference between emmer-like two-seeded einkorn and emmer?, *Review of Palaeobotany and Palynoloy*, Vol. 73, 181–185.

Madgwick, R. 2011, *Investigating the potential of holistic taphonomic analysis in archaeological research*, Unpublished PhD thesis, Cardiff University, Cardiff.

Marijanović, B. 1981, Ravlića pećina (Peć Mlini), Glasnik Zemaljskog muzeja Bosne i Hercegovine, n.s. Vol. 35/36, 1–97.

Marijanović, B. 2000, *Prilozi za prapovijest u zaleđu jadranske obale*, Monografije 2, Sveučilište u Zadru, Odjel za arheologiju, Zadar.

Marijanović, B. 2005, *Gudnja – višeslojno prapovijesno nalazište*, Dubrovački muzeji – Arheološki muzej, Dubrovnik.

Marjanović, B. 2009a, *Crno vrilo 1*, Sveučilište u Zadru, Odjel za arheologiju, Zadar.

Marjanović, B. (ed.) 2009b, *Crno vrilo 2*, Sveučilište u Zadru, Odjel za arheologiju, Zadar.

Marković, Č. 1985, *Neolit Crne Gore*, Centar za balkanološka ispitivanja 5, Univerzitet u Beogradu, Filozofski fakultet, Beograd.

Martinelli, M. C. 1990, Industrie litiche di alcuni siti neolitici della Dalmazia e loro raffronti con contemporanee industrie dell'Italia sudadriatica e delle Isole Eolie, *Rassegna di Archeologia*, Vol. 9, 125–152.

Miller, N., Smart, T. 1984, Intentional burning of dung as fuel: a mechanism for the incorporation of charred seeds into the archaeological record, *Journal of Ethnobiology*, Vol. 4/1, 15–28.

Müller, J. 1994, *Das ostadriatische Frühneolithikum: Die Impresso-Kultur und Neolithsierung des Adraraumes*, Prähistorische Archäeologie in Südosteeuropa, Band 9, Wissenschaftverlag Volker Spiess, Berlin.

Orton, D. 2012, Herding, settlement, and chronology in the Balkan Neolithic, *European Journal of Archaeology*, Vol. 15, 5–40.

Patterson, L. W. 1983, Criteria for determining the attributes of man-made lithics, *Journal of Field Archaeology*, Vol. 10/3, 297–307.

Reed, K. 2015, From the Field to the Hearth: plant remains from Neolithic Croatia (ca. 6000-4000 cal BC), *Vegetation History and Archaeobotany*, Vol. 24/5, 601–619.

Semenov, S. A. 1964, Prehistoric Technology: An Experimental Study of the oldest Tools and Artefacts from traces of Manufacture and Wear, Cory, Adams and Mackay, London.

Serjeantson, D. 1996, The animal bones, in: *Refuse and Disposal at Area 16 East Runnymede*, Runnymede Bridge Research Excavations, Volume 2, Needham S., Spence A. (eds.), London, 194–222.

Shipman, P., Foster, G., Schoeninger, M. 1984, Burnt bones and teeth: an experimental study of color, morphology, crystal structure and shrinkage, *Journal of Archaeological Science*, Vol. 11/4, 307–325.

Spataro, M. 2002, *The First Farming Communities of the Adriatic: Pottery Production and Circulation in the Early and Middle Neolithic*, Edizioni Svevo, Trieste.

Šošić Klindžić, R. 2010, *Proizvodnja cijepanih kamenih artefakata ranih poljodjelskih zajednica na prostoru istočne Hrvatske*, Doktorska disertacija, Sveučilište u Zagrebu, Zagreb.

Šošić-Klindžić, R., Radović, S., Težak-Gregl, T., Šlaus, M., Perhoč, Z., Altherr, R., Hulina, M., Gerometta, K., Boschian, G., Vukosavljević,

N., Ahern, J. C. M., Janković, I., Richards, M., Karavanić, I. 2015, Late Upper Paleolithic, early Mesolithic and early Neolithic from the cave site Zemunica near Bisko (Dalmatia, Croatia), *Euroasian Prehistory,* Vol. 12/1–2, 3–46.

Trimmis, K. P., Drnić, I. 2018, Connecting Early Neolithic worlds: excavating Mala (Nova) pećina in Dalmatian Zagora, Croatia, *Antiquity*, 92 (362), e3, 1–6.

Van der Veen, M. 2007, Formation processes of desiccated and carbonized plant remains – the identification of routine practice, *Journal of Archaeological Science*, Vol. 34/6, 968–990.

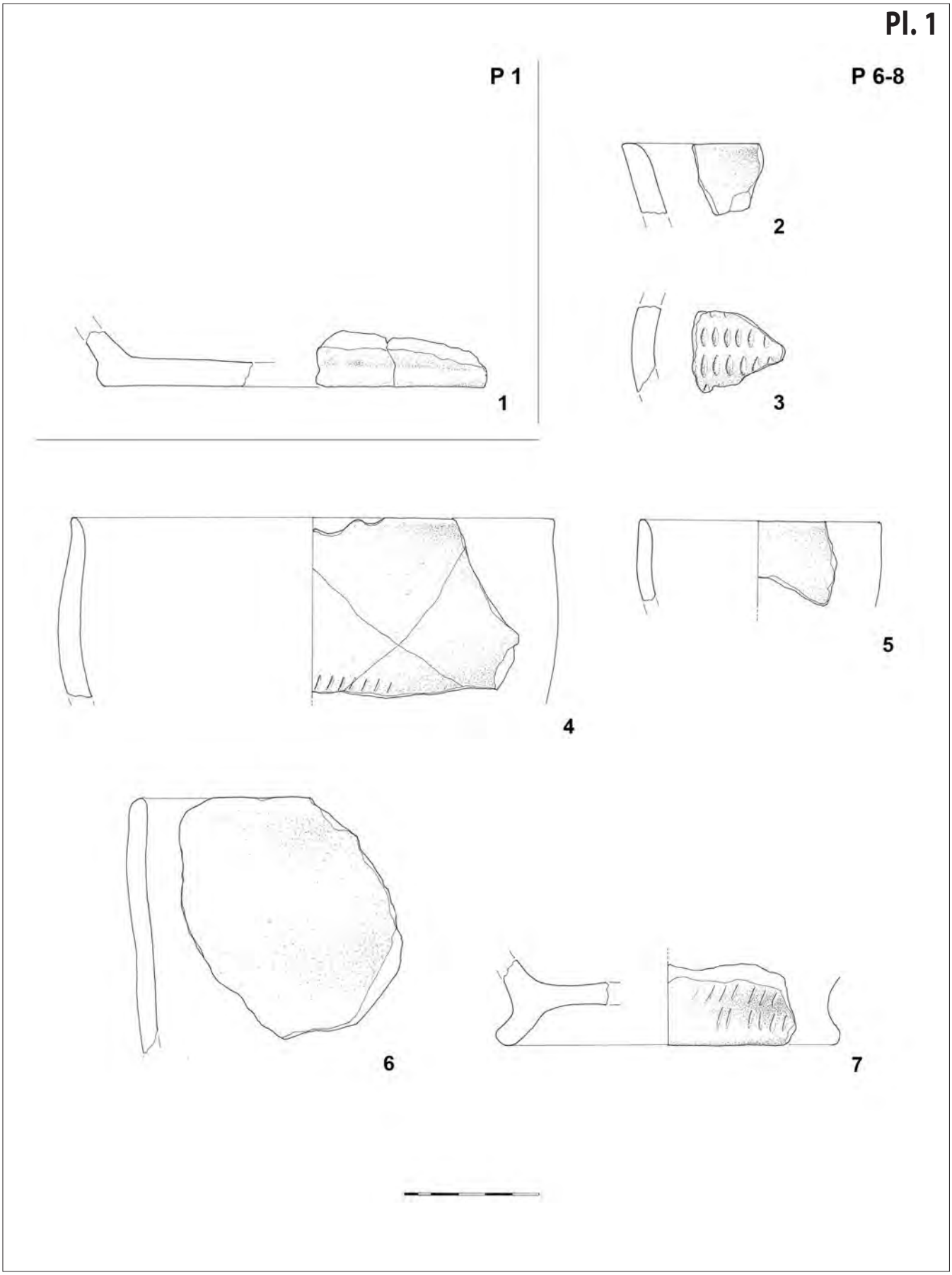
Vander Linden, M., Pandžić, I., Orton, D. 2014, New radiocarbon dates for the Neolithic period in Bosnia & Herzegovina, *Godišnjak Centra za balkanološka ispitivanja*, Vol. 43, 7–34.

Villa, P., Courtin, J. 1983, The Interpretation of Stratified Sites: A view from Underground, *Journal of Archaeological Science*, Vol. 10, 267–281.

Vukosavljević, N. 2012, *Organizacija litičke proizvodnje lovačko-sakupljačkih zajednica na prijelazu iz pleistocena u holocen u Dalmaciji*, Doktorska disertacija, Sveučilište u Zagrebu, Zagreb.

Vukosavljević, N., Perhoč, Z., Čečuk, B., Karavanić, I. 2011, Kasnoglacijalna industrija lomljenog kamena pećine Kopačine, *Vjesnik za arheologiju i povijest dalmatinsku*, Vol. 104, 7–54.

Zohary, D., Hopf, M., Weiss, E. 2012, *Domestication of plants in the old world: the origin and spread of domesticated plants in south-west Asia, Europe and the Mediterranean Basin*, Oxford University Press, Oxford.



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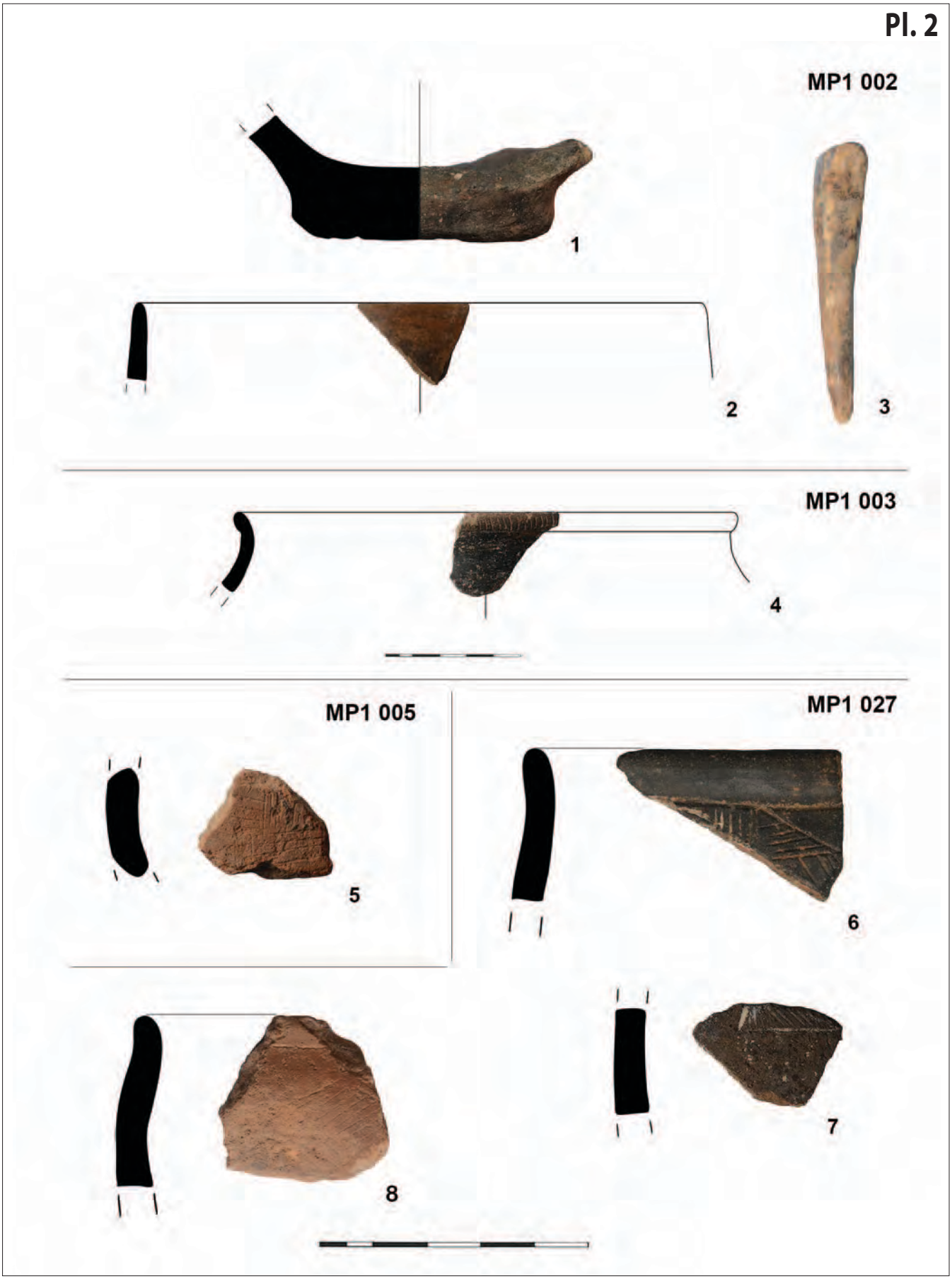

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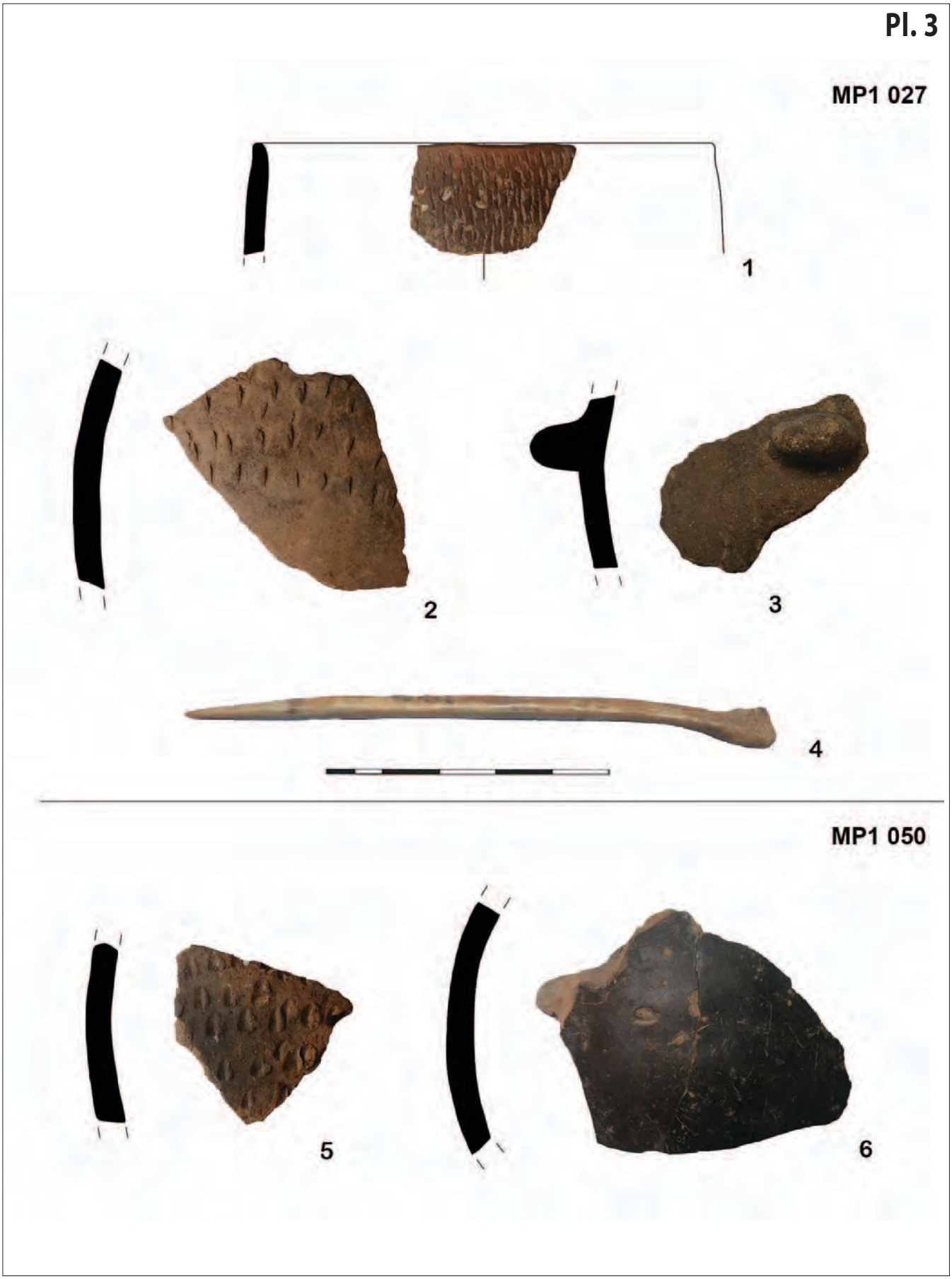

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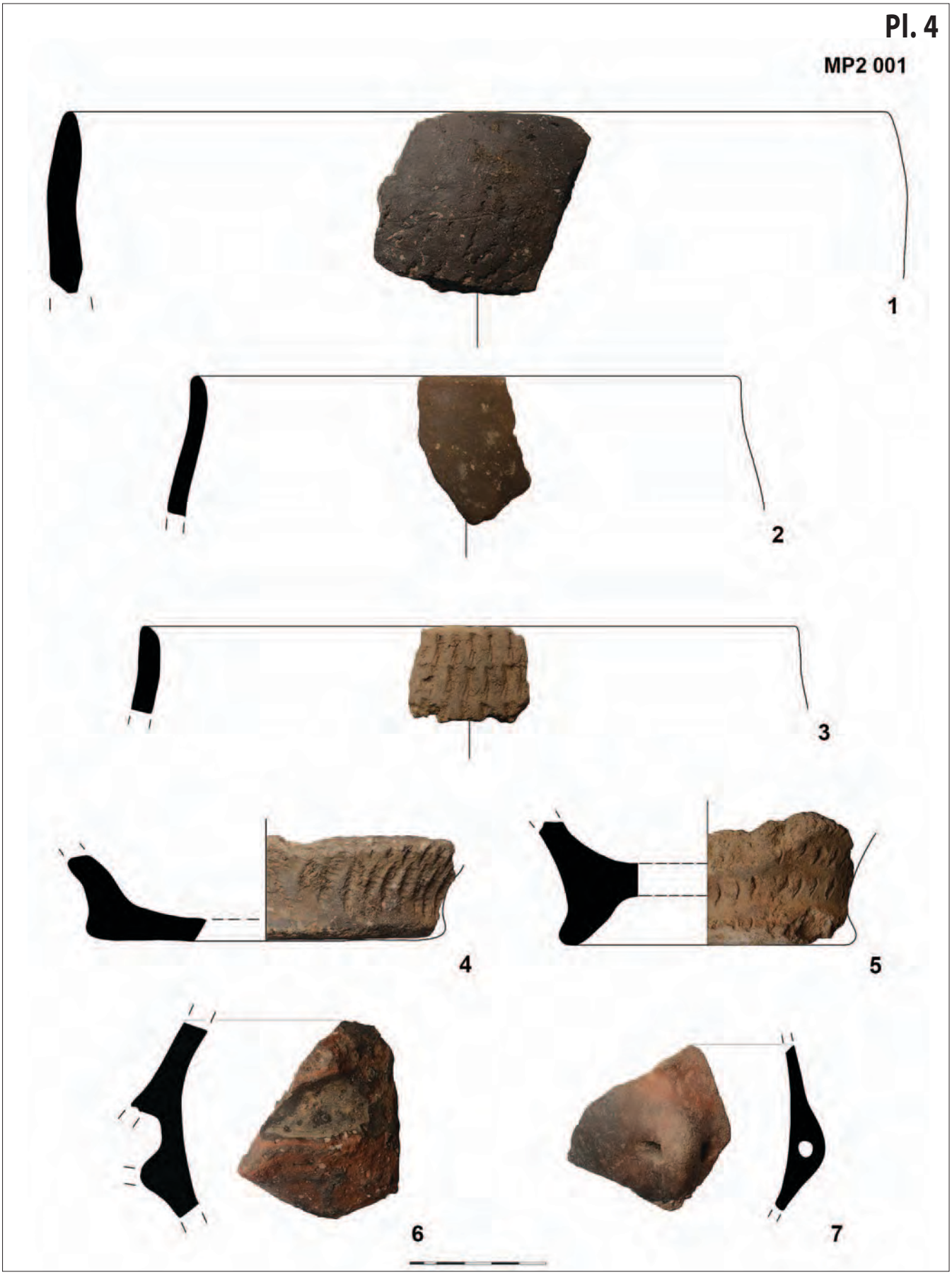

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Pl. 5

Pl. 5 1–7 (1:1) (izradili: K. Brkić, I. Drnić)
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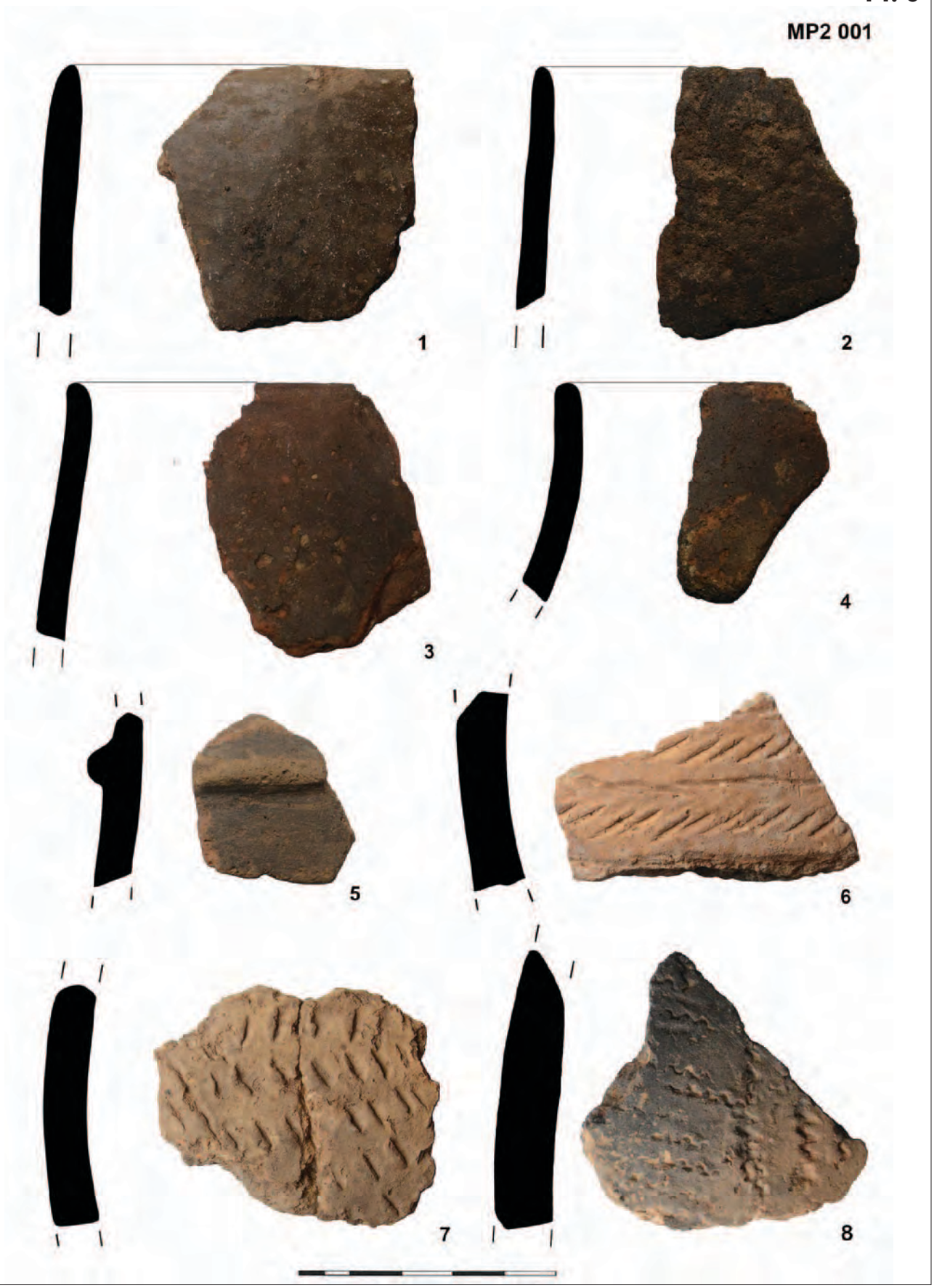
Pl. 6



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Pl. 7

Pl. 7 1–3 (1:2), 4–7 (1:1) (izradili: K. Brkić, I. Drnić)
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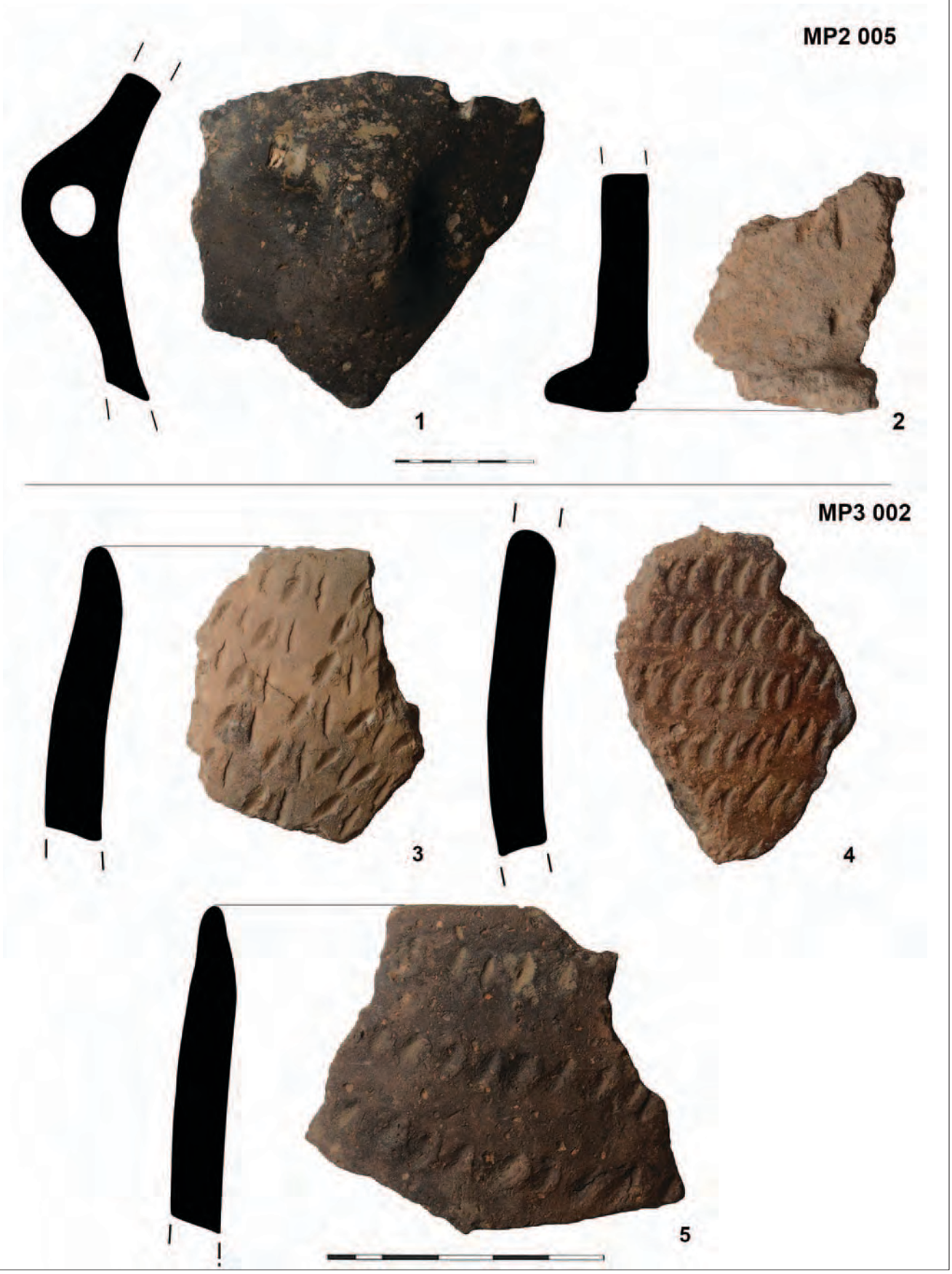
Pl. 8



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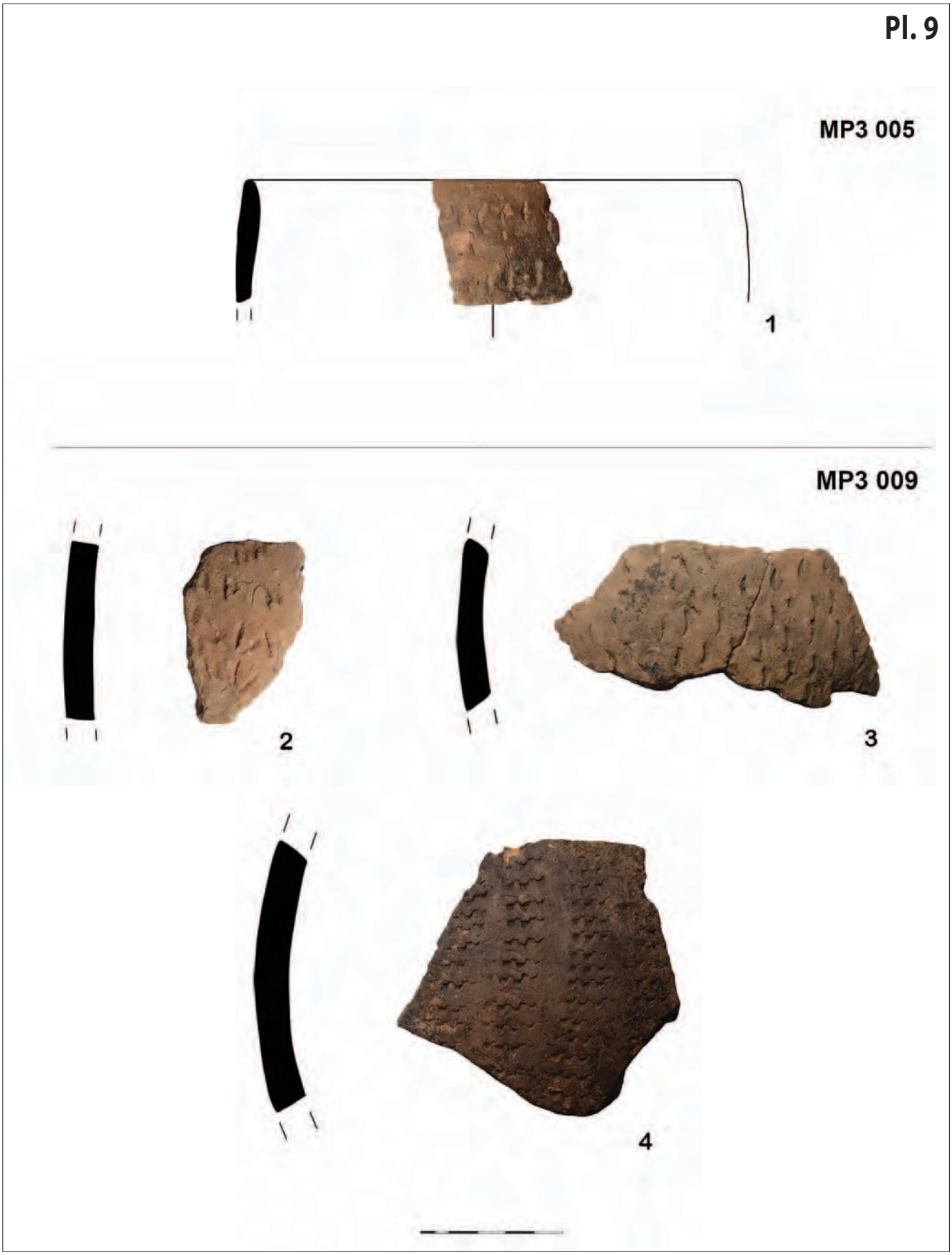
Pl. 9



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