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INA MILOGLAV

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CERAMICS IN ARCHAEOLOGY - POTTERY OF THE VUČEDOL CULTURE IN THE VINKOVCI REGION

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Ceramics in Archaeology - Pottery of the Vučedol Culture in the Vinkovci Region

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Tiskano povodom 70 godina Gradskog muzeja Vinkovci
Published on the occasion of the 70th anniversary of the Vinkovci Town Museum

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PREDGOVOR

*Ima mjesta (*Vinkovci op.a.) *i krajeva gdje se gotovo u serijama rađaju ljudi skloni jednoj određenoj struci. Evo takav je ovaj naš slavonski kraj, jer baš na tom nevelikom prostoru sjeveroistočne Hrvatske rodila se legija znamenitih radnika s područja arheologije i povijesti…kako vidimo taj niz neprekidno teče skoro već dva stoljeća* piše Vanja Radauš 1973. povodom 50-e godišnjice smrti velikog hrvatskog arheologa, rođenog Vinkovčanina prof. dr. Josipa Brunšmida. Ovu tezu mogli bismo proširiti i da svi arheolozi koji jednom iskopavaju u Vinkovcima, ostaju neraskidivo vezani za ovaj arheologijom prebogati grad. Tako je i autorica knjige dr. sc. Ina Miloglav (Gale za one koji je se sjećaju iz vinkovačkih godina), radeći od 2001. do 2004. u Gradskom muzeju Vinkovci, ostala radno (i prijateljski) vezana za Vinkovce, te kao temu doktorske disertacije odabrala vučedolske lokalitete Ervenica u Vinkovcima i Damića gradina u Starim Mikanovcima.

Časopis *Acta Musei Cibalensis* glasilo Gradskog muzeja Vinkovci pokrenuto je 1966., a autorstvo prvog broja pripalo je još jednom znamenitom vinkovačkom arheologu prof. dr. Stojanu Dimitrijeviću, koji je cijeli život ostao znanstveno vezan za Vinkovce, istražujući i promovirajući kulture zahvaljujući kojima možemo reći da su Vinkovci kontinuirano naseljeni već više od 8000 godina. *Acta Musei Cibalensis* 7, n.s. 5 monografski obrađuje jednu kulturu, odnosno radi se o prerađenoj i prvim dijelom nadopunjenoj doktorskoj disertaciji *Kasna vučedolska kultura u Bosutskoj nizini na temelju keramičkih nalaza.* Ovaj broj posvećen je 70-oj godišnjici osnutka Gradskog muzeja Vinkovci, koji je osnovan zahvaljujući otkupu (najvećim dijelom arheološke) zbirke šumara Mate Medvedovića.

Knjiga je podijeljena na dva dijela, prvi dio knjige proizlazi iz radnog mjesta autorice na Katedri za arheometriju i metodologiju Odsjeka za arheologiju Filozofskog fakulteta u Zagrebu, u kojem se uhvatila u koštac s onim dijelom arheologije koji nije baš popularan kod arheologa, a to je prebrojavanje, klasificiranje i tipiziranje desetaka tisuća keramičkih ulomaka. Ali kako sama autorica kaže *slažeći podatke poput slagalice čini nam se kao da sami sudjelujemo u stvaranju keramičkih posuda i ulazimo u živote ljudi koji su ih napravili*. Keramika je jedan od najčešćih materijala koji arheolozi obrađuju i analiziraju, pružajući nebrojene i važne informacije o kulturnim, socijalnim, ekonomskim, religioznim i tehnološkim postignućima određene zajednice i razdoblja u kojem su pojedine posude nastale. Ovaj dio knjige koji se bavi analitičkim tehnikama i teorijskim okvirima o keramičkoj tehnologiji, kao i parametrima za obradu keramičkog materijala, vrlo je koristan i važan svakom arheologu koji se bavi keramičkim nalazima kao vodećem izvoru arheoloških podataka.

Drugi dio knjige zanimljiv je i ostalim čitateljima, ne samo stručnjacima. Iako je arheologija danas interdisciplinarna znanost, što se iščitava i iz knjige Ine Miloglav, bez arheobotanike ne možemo zamisliti rekonstrukciju krajolika ili prehrambene navike stanovništva, dok se arheozoologija bavi proučavanjem životinjskih ostataka na arheološkim lokalitetima. Tako npr. saznajemo da je dominantna gospodarska grana Vučedolaca na Ervenici oko 2880.-2480. g. pr. Kr. bilo stočarstvo te da su najviše uzgajali goveda. Mnoge od analiza koje su napravljene na ulomcima vučedolskih posuda pružaju nam „nezamislive“ podatke o keramičkom posuđu. Arheološki biomarkeri na jednoj šalici s Ervenice pokazali su ostatke mliječnih masti te ju možemo interpretirati kao šalicu za mlijeko, dok se na osnovi ostataka masti s keramičkog cjedila s Damića gradine zaključuje kako su Vučedolci proizvodili sir. Osim toga, petrografske analize keramičkih ulomaka pokazale su da mineralni sastav keramike odgovara mineralnom sastavu prapora na kojem se nalaze Ervenica i Damića gradina, što je dokaz da se posuđe izrađivalo od lokalnih sirovina. Napravljen je i test standardizacije na keramičkom materijalu čiji rezultati ukazuju na standardiziranu proizvodnju keramičkih posuda, posebno određenog tipa zdjela. Na osnovi rezultata autorica zaključuje da je u obrađenim vučedolskim naseljima postojala organizirana keramička proizvodnja sa specijaliziranim lončarima.

Knjiga obiluje i etnoarheološkim istraživanjima koja arheolozima pružaju mogućnost provjere informacija skupljenih tijekom arheoloških istraživanja. Osim toga, ima i mnogo etnoarheoloških zanimljivosti kao npr. da je prosječna udaljenost eksploatiranja gline u odnosu na naselje od 3 do 4 km, ili da životni vijek posude za kuhanje traje od nekoliko mjeseci do 1,3 godine, ili da su posude za konzumaciju i serviranje većinom ukrašene itd. I na kraju u kombinaciji s arheološkim podacima, etnoarheologijom i eksperimentalnom arheologijom rekonstruiraju se obrasci ljudskog ponašanja u prošlosti.

Osim studentima arheologije i arheolozima kojima je keramika predmet izučavanja, knjiga se može preporučiti kao uvod u lončarstvo, kao i svim zainteresiranima koji žele nešto više naučiti o vučedolskoj kulturi. Knjiga koja je paralelno prevedena na engleski jezik opremljena je fantastičnim crtežima, prerano preminulog kolege Krešimira Rončevića. Svaki arheolog prije nego što se ozbiljnije uhvati u koštac s tisućama keramičkih ulomaka obavezno bi trebao pročitati ovu knjigu, a kao što sama autorica kaže *naša zadaća kao arheologa je prepoznati razliku između onoga što znamo i onoga što možemo zamisliti o keramičkoj posudi, što vrijedi i za sve ostale predmete koji su dio materijalne kulture čovjeka u prošlosti.*

Maja Krznarić Škrivanko
Gradski muzej Vinkovci

FOREWORD

There are places [such as Vinkovci] *and regions in which successions of people are born who share an affinity for a certain profession. Our Slavonia is one such region, since in this relatively small area in north-eastern Croatia a legion of eminent workers in the field of archaeology and history has been born… as we can see, the series has been almost uninterrupted for nearly two centuries.* This was written by Vanja Radauš in 1973, on the occasion of the 50th anniversary of the death of the great Croatian archaeologist, and native of Vinkovci, Prof. Josip Brunšmid. We could expand this thesis and say that all archaeologists, once they have excavated in Vinkovci, remain strongly attached to this town of extremely rich archaeological heritage. The same is true of the author of this book, Dr. Ina Miloglav (or Gale, for those who remember her from the years she spent in Vinkovci), who worked in the Vinkovci Town Museum between 2001 and 2004, and has remained professionally (and through her friendships) tied to Vinkovci. Moreover, for her doctoral thesis, she chose the Vučedol sites of Ervenica, in Vinkovci, and Damića Gradina, in Stari Mikanovci.

The journal *Acta Musei Cibalensis,* published by the Vinkovci Town Museum, was launched in 1966; the author of the first issue was yet another renowned archaeologist from Vinkovci, Prof. Stojan Dimitrijević, whose scientific interests remained linked to Vinkovci throughout his life, and who explored and promoted various cultures which allow us to say that Vinkovci has been settled continuously for more than 8000 years. *Acta Musei Cibalensis* 7, n.s. 5 is a monograph dedicated to a single culture; actually, this is the revised doctoral thesis *Late Vučedol Culture in the Bosut Plain on the Basis of Pottery Finds,* to which the first part of the book has been added. This issue is dedicated to the 70th anniversary of the foundation of the Vinkovci Town Museum, which was established thanks to the purchase of a collection (primarily archaeological) from the forester Mato Medvedović.

The book is divided into two parts: the first part stems from the author's position in the Subdepartment of Archaeometry and Methodology at the Department of Archaeology of the Faculty of Humanities and Social Sciences of Zagreb University, where she deals with an aspect of archaeology which is not very popular among archaeologists: counting, classifying and typologically describing tens of thousands of pottery sherds. But, as the author herself put it, *We put together pieces of information as if piecing together a jigsaw puzzle, as though we were participating in the creation of the pottery vessels and entering the lives of the people who made them.* Pottery is one of the materials most frequently processed and analysed by archaeologists, since it provides infinite and important information about the cultural, social, economic, religious and technological achievements of a community and about the period in which the vessel was made. This part of the book discusses analytical techniques and theoretical frameworks of pottery technology, and parameters for the processing of archaeological pottery. As such, it is very useful and pertinent for any archaeologist dealing with pottery finds as the leading source of archaeological data.

The second part of the book is also interesting to a broader readership, and not just for experts. Much as archaeology is nowadays an interdisciplinary science – which can also be read from Ina Miloglav's book – we could not imagine reconstructing a landscape or the dietary habits of a population without archaeobotany, while archaeozoology studies animal remains found at archaeological sites. For example, we have learned that, in the period between around 2880–2480 BC, the predominant economic activity of the Vučedol population of Ervenica was animal herding, and that they mostly raised cattle. Many analyses done on sherds of Vučedol pottery have yielded 'unimaginable' data on the pottery. The archaeological biomarkers from a cup recovered from Ervenica have revealed residues of milk fat, allowing us to interpret it as a milk cup, while the fat residues on a pottery strainer from Damića Gradina lead to the conclusion that the Vučedol population produced cheese. In addition, petrographic analysis of pottery sherds has shown that the mineral composition of the pottery corresponds to the mineral composition of the loess that Ervenica and Damića Gradina sit on, which confirms that vessels were produced from local raw materials. A standardization test has also been conducted on the pottery material, and its results suggest that the production of pottery was standardized, especially when it comes to a certain type of bowl. On the basis of the results obtained, the author has concluded that the pottery production in these two Vučedol settlements was organized and that it involved specialized potters.

The book also provides abundant data on ethnoarchaeological research, which allows archaeologists to verify information collected during archaeological investigations. Besides, it brings plenty of interesting ethnoarchaeological data, such as, for example, that the average distance between the settlement and the clay it exploited was between 3 and 4 km, that the lifespan of a cooking pot ranged between several months and 1.3 years, and that the majority of vessels for food consumption and serving were decorated, etc. Finally, combining archaeological data, ethnoarchaeology and experimental archaeology, patterns of past human behaviour are reconstructed.

We can recommend this book not only to students of archaeology and archaeologists who study pottery, but also as a general introduction to pottery, and for all those interested in learning about the Vučedol Culture. The book has been translated into English, and it comes with marvelous drawings by our prematurely deceased colleague, Krešimir Rončević. Before seriously tackling thousands of pottery sherds, every archaeologist should read this book; and, as the author herself puts it, *as archaeologists, we have the task of distinguishing between what we know and what we can assume about a pottery vessel, or about any other object which belongs to man's past material culture.*

Maja Krznarić Škrivanko
Vinkovci Town Museum

PRVI DIO

1. UVOD

Keramički nalazi kod arheologa izazivaju snažne emocije: ili ih obožavaju, ili ih mrze.
(Orton et al. 1993: 3)

Orton, Tyers i Vince (1993) zapravo su izvrsno pogodili arheološko viđenje keramičkih ulomaka, ili ih volite ili ih mrzite, tu nema sredine. Tako jedan dio arheologa vidi keramičke ulomke kao nepresušan izvor informacija, fascinantno proučavajući svaki ulomak, dok drugi na keramičke ulomke gledaju kao ometajući faktor tijekom arheološkog iskopavanja te kao crnu rupu u procesu obrade nakon istraživanja (Orton et al. 1993: 3). Obrada keramičkog materijala dio je uobičajenog arheološkog posla većine arheologa ili barem onih koji aktivno sudjeluju na arheološkim istraživanjima. Bez obzira na sklonost prema pojedinom razdoblju, materijalu ili vrsti predmeta, većina arheologa susreće se barem s primarnom obradom keramičkog materijala prilikom pisanja stručnih izvještaja nakon završenog arheološkog istraživanja. Mi ostali, kojima interes ide dalje od primarne obrade, na keramičke ulomke gledamo s posebnim žarom, polako otkrivajući skrivene i često nevidljive zapise koje u sebi krije keramička posuda, svjesni neograničenih mogućnosti obrade i interpretacije. Slažući podatke poput slagalice čini nam se kao da sami sudjelujemo u stvaranju keramičke posude i ulazimo u živote ljudi koji su ih napravili. Ti obrasci ljudskog ponašanja u arheologiji najvidljiviji su upravo na predmetima svakodnevne upotrebe, odnosno objektima koji su produkt ljudskih aktivnosti i koji igraju aktivnu ulogu u stvaranju značenja i tradicije. Zato je vrlo važno poticati svijest da su se keramičke posude, baš kao i svi ostali proizvodi koji su dio ljudske aktivnosti u prošlosti, proizvodile i upotrebljavale u društvenom kontekstu, da su dio sociokulturnih interakcija i da ih jedino kao takve možemo i moramo promatrati, analizirati i interpretirati.

Lončari su oduvijek proizvodili keramičke posude za nekoga te su se prilagođavali socioekonomskim zahtjevima zajednice. Izbor sirovine, primjesa, tehnike ili oblika posude ovisio je o nizu međusobno povezanih faktora koji zajedno tvore lanac operacija u keramičkoj proizvodnji. Keramička tehnologija nije se puno mijenjala od prapovijesti do današnjih dana, o čemu svjedoče mnoge etnoarheološke studije na primjerima današnjih tradicijskih zajednica. Upravo zbog tako duge tehnološke tradicije koju možemo pratiti tisućama godina danas smo u prilici uspoređivati, provjeravati i povezivati obrasce ljudskog ponašanja i elemenata materijalne kulture u okvirima etnoarheologije i eksperimentalne arheologije. Ovakav pristup iznimno je dragocjen i neophodan za razumijevanje arheoloških procesa u prošlosti.

Baš kao i u prapovijesti, tehnologija izrade keramičkih posuda može se i danas najbolje razumijeti kao društvena tradicija, odnosno set tehnoloških praksi povijesno povezanih kroz vrijeme i prostor, gdje se znanje i iskustvo nasljeđuju kroz društveno učenje (Jordan & Zvelebil 2010a: 51). Svaki lončar razvija svoj osobni stil, odnosno identifikacijski pečat koji je uvjetovan tradicijskim nasljeđem, socioekonomskim potrebama zajednice ili okolišnim faktorima (dostupnost i vrsta sirovine), kao dio svog društvenog identiteta. Kako bismo saznali, naučili i shvatili obrasce ljudskog ponašanja u prošlosti naša zadaća nije samo opisati, analizirati i sačuvati arheološke predmete već pokušati istražiti, inerpretirati i razumjeti znanje, vještine i uvjete nastanka tih predmeta. Keramičke posude zato ne smijemo gledati samo kao predmete napravljene od gline koji služe za pohranu/serviranje/kuhanje namirnica, već kao „objekte" koji u sebi nose cijelu mrežu socijalnih odnosa. Ljudi su izrađivali keramičke posude, upotrebljavali, distribuirali, razbijali i odbacivali u kontekstu svakodnevnog života. Arheolozi nalaze keramičke ulomke u jednom od ovih pet arheoloških situacija i naša je metodološka zadaća da ih identificiramo tijekom istraživanja kako bismo skupili što više podataka koji će nam pomoći interpretirati životni ciklus posude u okvirima njezina socijalnog, ekonomskog, političkog ili religijskog života. Stoga bi keramičke posude trebale činiti okvir za istraživanje ljudskog ponašanja u prošlosti, a ne samo za određivanje kronoloških smjernica. One su naša veza s prošlim vremenima i predstavljaju jedan trenutak u vremenu. Taj trenutak u sebi nosi odgovore na ključna pitanja o funkcioniranju i organizaciji društva te nas polako uvodi u otkrivanje socijalne dimenzije ljudskog ponašanja u prošlosti.

Tehnologija proizvodnje keramičkih posuda zapravo je vrlo kompleksan i nimalo jednostavan proces koji zahtjeva od lončara, ili skupine lončara, niz međusobno povezanih i dobro promišljenih aktivnosti. Prvi dio ove knjige posvećen je upravo tim aktivnostima, odnosno proizvodnim koracima i tehnološkim izborima lončara koji utječu na konačan izgled i upotrebna svojstva keramičke posude. Kada bi napravili anketu s pitanjem da li izrada keramičke posude spada u jednostavan ili težak zadatak mislim da bi većina ispitanika bez puno promišljanja odgovorila: jednostavan. Namjera ove knjige je uvjeriti čitatelja upravo u suprotno, jer izrada keramičke posude nikako nije jednostavna aktivnost. Sigurna sam da većina arheologa misli da bi mogla bez problema napraviti keramičku posudu. Međutim, jedno je napraviti jednostavan oblik iz grude gline u kojoj ćemo držati uredski pribor, a sasvim drugo izraditi posudu koja treba izdržati velike temperaturne promjene, mehanička oštećenja te ostati nepropusna što je duže moguće. Zato je s pravom J. M. Skibo (1995) nazvao posude za kuhanje „sofisticiranim tehnološkim postignućem".

O keramici je napisano više tekstova nego o bilo kojem drugom arheološkom artefaktu. Tehnološki aspekt, proizvodni sustav, specijalizacija zanata, funkcija proizvoda, recikliranje, samo su neki od segmenata koji imaju posebno mjesto u analizi keramičkog materijala, a kojima arheolozi pristupaju koristeći različite analitičke tehnike, metode i teorijske okvire. Može se reći da je analiza keramičkog materijala jedan od najbrže rastućih segmenata u arheološkim i etnoarheološkim istraživanjima u posljednjih 40 godina. Mnoga su arheološka, etnoarheološka, arheometrijska i eksperimentalna istraživanja usmjerena na funkciju, stil i porijeklo (za pregled vidi: Rice 1996) te sastav i proizvodnju keramičkog materijala (za pregled vidi: Rice 1996a). Ono što je svima zajedničko jest činjenica da keramički proizvodi imaju veliko značenje pri interpretaciji kulturne, socijalne, ekonomske, prostorne i kronološke komponente. Analiza keramičkog materijala zapravo je najbolji primjer interdisciplinarnosti unutar arheološke struke, a s obzirom na veliku količinu podataka, metoda i analiza dobila je i posebno ime – „keramologija" (Buko 2008).

Općenito gledajući keramografska istraživanja mogu se podijeliti na tri glavna područja istraživanja: proizvodnja, upotreba i keramički stratifikacijski procesi. Kod svakog od njih postoji šest pitanja na koja arheolozi pokušavaju dobiti odgovore: kada?, gdje?, zašto?, koliko?, kako? i tko? Kada se sagledaju zajedno, ova pitanja i njihovi odgovori tvore okvir za sva istraživanja keramičkog materijala (Buko 2008: 15). Upravo se obradom materijala sa dva vučedolska lokaliteta na vinkovačkom području pokušalo odgovoriti na neka od ovih pitanja, a rezultati su prikazani u drugom dijelu knjige. Ovakav pristup zahtijevao je interdisciplinarno istraživanje koje je uključilo:

1.) Tipološku obradu keramičkih nalaza prema morfološkim karakteristikama
2.) Deskriptivnu statistiku s pomoću *SPSS* programa (*Statistical Package for the Social Sciences*)

3.) Definiranje modela keramičke proizvodnje koji uključuje specijalizaciju zanata, standardizaciju proizvoda i organizaciju proizvodnje. Statistički test napravljen je s pomoću koeficijenta varijacije, koji se kao standardna statistička metoda koristi prilikom definiranja standardizacije proizvoda
4.) Tehnološki segment upotpunjen je mineraloško-petrografskom analizom i metodom rendgenske difrakcije na prahu (XRD)
5.) Funkcionalna komponenta keramičkih posuda interpretirana je s pomoću rezultata analize plinske kromatografije-masene spektrometrije (GC-MS)
6.) Ekonomski segment vučedolske zajednice, koji uključuje poljoprivrednu i gospodarsku aktivnost te prehrambene navike stanovništva upotpunjen je arheobotaničkom i osteološkom analizom
7.) Oba naselja apsolutno su datirana analizom 14C

Knjiga je ciljano podijeljana u dva dijela. Prvi dio posvećen je pregledu analitičkih tehnika i teorijskih okvira o keramičkoj tehnologiji te parametrima za obradu keramičkog materijala. Kako u hrvatskoj stručnoj literaturi ovakva vrsta preglednog teksta ne postoji nadam se da će ova knjiga poslužiti i studentima za samostalan rad pri obradi i analizi keramičkog materijala te ih potaknuti na neka nova razmišljanja i propitivanja o keramičkim posudama.

Drugi dio donosi rezultate provedenih analiza na dva vučedolska lokaliteta na vinkovačkom području: Ervenici u Vinkovcima i Damića gradini u Starim Mikanovcima, a dio je doktorata *Kasna vučedolska kultura u Bosutskoj nizini na temelju keramičkih nalaza*. Pojedini djelovi objavljeni su u domaćim i međunarodnim časopisima (Miloglav 2011; 2012a; 2012b; 2013; 2014; 2016), te predstavljeni na znanstvenim konferencijama.

Hrvatski tekst prati engleski prijevod na kraju knjige u kojem se nalaze ponovljene tablice i grafovi u engleskoj verziji jer je riječ o podacima koji su integralni dio teksta. Slike se ne ponavljaju u engleskoj verziji već su prikazane dvojezično s referiranjem na broj slike i stranice u tekstu.

Kako je drugi dio knjige interdisciplinaran, nekoliko je kolega kojima dugujem zahvalu za obavljene analize i njihovu interpretaciju. Dr. sc. Marta Mileusnić s Rudarsko-geološko-naftnog fakulteta Sveučilišta u Zagrebu i student Kristijan Bakarić napravili su mineraloško-petrografsku analizu keramičkih ulomaka s oba lokaliteta i rendgensku difrakciju na prahu (XRD). Dr. sc. Tajana Trbojević-Vukičević s Veterinarskog faulteta Sveučilišta u Zagrebu analizirala je i interpretirala životinjske kosti s lokaliteta na Ervenici, a dr. sc. Kelly Reed sa Sveučilišta u Leicesteru s istog je lokaliteta obradila arheobotaničke nalaze. Veliku zahvalnost dugujem djelatnicima arheološkog odjela Gradskog muzeja Vinkovci, posebno Maji Krznarić Škrivanko, na ustupljenom materijalu i dokumentaciji s navedenih lokaliteta. Posebna zahvala ide kolegi i prijatelju Krešimiru Rončeviću za prekrasne table s materijalom i ilustracije koje prate ovu knjigu, a najviše za potporu i savjete. Nekoliko je kolega i prijatelja kojima također dugujem zahvalu za tehničku pomoć, korisne savjete, inspirativne razgovore o keramičkim ulomcima i potporu tijekom pisanja ove knjige: Andreji Kudelić, Jasni Vuković, prof. Tihomili Težak-Gregl, Martini Rončević i Maji Ukas. I za kraj najveće hvala za strpljenje i potporu ide Mati i Lovri.

2. ARHEOMETRIJA – ARHEOLOGIJA - ETNOARHEOLOGIJA: MEĐUSOBNO POVEZANE DISCIPLINE

Razne analitičke tehnike, pristupi i metode u obradi keramičkog materijala intenzivno se razvijaju od sredine prošloga stoljeća. Danas možemo reći da se arheologija nalazi između arheometrije i etnoarheologije, kao čvrsta poveznica u rekonstrukciji ljudske aktivnosti i ponašanja u prošlosti. Posebno mjesto unutar arheologije u ovom procesu ima i eksperimentalna arheologija kojom potvrđujemo ili odbacujemo rezultate i zaključke provedenih istraživanja te nastojimo objasniti tehnološke izbore i promjene.

ARHEOMETRIJA KERAMIKE

Arheometrijske analize pružaju nam podatke o izvoru i mineralnom sastavu sirovine, recepturi lončarske smjese (vrsta i omjer gline i primjesa), uvjetima pečenja (atmosfera i temperatura) te ostalim aspektima koji su vezani za keramičku proizvodnju.

Arheometrija kao znanstvena disciplina počela se razvijati sredinom 19. st. kada je i započela znanstvena analiza materijala od kojeg je napravljena keramička posuda (Peacock 1970). Međutim, sam naziv pojavio se tek 1958. godine kao naslov engleskog časopisa *Archaeometry*. U 19. stoljeću arheometrija se razvijala uglavnom na sveučilištima baveći se analitičkim pitanjima u području društveno-humanističkih znanosti, a tek pretkraj 19. i početkom 20. st. osnivaju se prvi specijalizirani znanstveni laboratoriji u muzejima i arheološkim institucijama (Tite 1991). Zapravo će tehnološki aspekt u proizvodnji keramičkih posuda, koji se počeo znanstveno razvijati sredinom prošloga stoljeća, označiti polagani kraj proučavanja keramičkih posuda isključivo kroz kronološko-tipološku analizu i interpretaciju (Matson 1942).

Istraživanje materijala od kojeg je napravljena keramička posuda uspješno se provodi u posljednjih 70-ak godina s ciljem razumijevanja znanja i vještina koje su bile potrebne da se određeni predmet napravi, a ne samo da ga se sačuva od propadanja i stavi u kronološki okvir (Vandiver 2001). S obzirom na ograničene informacije koje dobijemo arheološkim istraživanjima, suradnja s ostalim zanstvenim disciplinama neophodna je kako bismo dobili što više informacija o arheološkom zapisu, odnosno uvjetima i načinu na koji je čovjek živio u prošlosti.

Današnja suvremena arheologija vrlo je raznovrsna disciplina koja obuhvaća interesne skupine koje se fokusiraju na različite periode, regije, teorijske okvire i metodološke tehnike. Raznovrsnost je pozitivna, ali može sa sobom nositi i probleme u komunikaciji (Jones 2004). Primarni fokus arheometrije uvijek su bila fizička i mehanička svojstva materijalne kulture koja uključuju znanstvenike iz prirodnih zanosti poput kemije, fizike, biologije, geologije itd. Međutim, nedostatkom komunikacije na relaciji „arheolog – stručnjak prirodnih znanosti" i obratno dolazi do gubljenja temeljnih informacija, a arheometrija često postaje sama sebi svrhom. Nedostatak komunikacije i znanstvenog diskursa vidljiv je u domaćim arheološkim publikacijama gdje smo vrlo često svjedoci nepreglednog broja grafova i tablica, bez dodatnih znanstvenih interpretacija i zaključaka. Umjesto opisa mehaničkih i fizičkih svojstava određenog artefakta ili materijala, fokus bi trebao biti usmjeren na pitanja na koji način su ta svojstva uključena u socijalni i kulturni život ljudi koji su ih napravili, koristili, razmjenjivali i na kraju odbacivali (tehnološki izbor, organizacija proizvodnje, socijalni odnosi, adaptacija na krajolik, tehnološki recepti itd.). To, naravno, uključuje sve dostupne analitičke tehnike kojima se arheolozi koriste. Bitan faktor u ovoj komunikaciji je i „vrsta arheologa“, odnosno radi li se o terenskom, akademskom ili muzejskom arheologu, te njegova teorijska i naučena stajališta. S obzirom na prirodu posla i teorijske stavove njegovi će zahtjevi i pitanja biti različiti (Tite 1991).

Nekoliko je faktora koji su bitni za funkcioniranje i opstanak veze arheolog – stručnjak prirodnih znanosti. Prvo, svaki zanstvenik koji se bavi arheometrijom trebao bi arheologu s kojim radi na početku objasniti osnovnu metodologiju analitičke tehnike, njezina ograničenja, implementaciju i statističke pogreške. Isto tako svaki arheolog bi drugom znanstveniku trebao objasniti arheološku metodologiju, njezina ograničenja, kontekst i prirodu nalaza te svakako znati postaviti pitanja na koja traži odgovor (Maggetti 1994; 2006). Ovdje dolazimo do ključnog problema koji se javlja kada je riječ o arheologiji. Vrlo često arheolog ne zna postaviti istraživačko pitanje na koje želi dobiti odgovor ili je to pitanje krivo postavljeno, pa zapravo nije jasno što arheolog želi dobiti određenom analizom. Ovakav početak komunikacije rezultira lošom suradnjom, gubitkom utrošenog radnog vremena i financijskih sredstava. Upravo zbog toga minimum predznanja iz arheometrije i arheologije dobitna je kombinacija koja može poboljšati i razviti kvalitetnu međusobnu komunikaciju koja na kraju rezultira i kvalitetnijom interpretacijom podataka. U tom smilu arheolozi bi trebali biti upoznati s osnovnim karakteristikama i mogućnostima analitičke metode i materijala koji šalju na analizu, kao i s ograničenjima metode u smislu konačne interpretacije da bi mogli raspravljati, procjenjivati i donositi znanstvene zaključke prema dobivenim rezultatima. Možda je to najbolje napisao M. S. Tite (1991) kad je rekao da „arheolog treba postaviti odgovarajuće pitanje o znanstvenoj tehnici koja se primjenjuje a stručnjak za prirodne znanosti treba pružiti podatke koje arheolog traži i tako izbjeći tipičnu situaciju u kojoj se tehnikom traži problem.“

Sljedeći problem izravno je vezan uz prethodni, a odnosi se na odabir reprezentativnih uzoraka kojima želimo dobiti odgovore na unaprijed postavljena pitanja. Način uzimanja uzoraka iz nepreglednog broja keramičke građe odredit će i rezultate dobivene analize, zato uzorkovanje mora biti sistematično i primjereno postavljenoj hipotezi. Nekoliko je vrsta i načina uzorkovanja, a svaki arheolog trebao bi prema vrsti i prirodi građe koju obrađuje odrediti koji će način uzorkovanja primijeniti u smislu reprezentativnosti podataka (npr. slučajno ili namjerno uzorkovanje). Uzorkovanje ima za cilj odgovoriti na već postavljena istraživačka pitanja/hipoteze, a način uzorkovanja treba biti usklađen s postavljenim analitičkim problemom i prirodom analitičke informacije. Npr. ako želimo saznati je li receptura lončarske smjese ista ili različita za pojedine funkcionalne oblike, odnosno je li lončar svojim tehnološkim izborom namjerno koristio specifične omjere gline i određenih vrsta primjesa za različite funkcionalne oblike (lonac, zdjela, šalica), onda ćemo uzorkovati različite funkcionalne oblike koje smo prethodnom obradom izdvojili. Ne možemo očekivati da će nasumično uzimanje keramičkih ulomaka iz jedne vrećice biti relevantan statistički i u konačnici interpretativni podatak ako uzorak nije reprezentativan. To znači da uzorak mora imati sve tipične karakteristike populacije, u našem slučaju keramičke građe.

Na kraju dolazimo do problema interpretacije dobivenih podataka koja bi trebala biti sistematična i komparativna, što znači da se dobiveni podaci bilo koje analize ne smiju i ne mogu interpretirati samostalno. Oni se trebaju gledati u širem kontekstu zajedno sa svim ostalim provedenim analizama i relevantnim podacima (arheološki kontekst odlaganja, obrada materijala, arheobotanika, arheozoologija, kemijske analize itd.). Ono što mislim da smo zaboravili negdje „po putu“ je postavljati pitanja *zašto* je neki predmet napravljen, a ne *kako*? Naša interpretacija trebala bi se usmjeriti na definiranje socijalnih, ekonomskih ili tradicijskih elemenata i veza, a istraživačka pitanja se mogu postaviti iz različitih perspektiva: kroz integraciju socijalnih pitanja i dobivenih analiza.

Generalno gledajući, istraživanja svakog arheološkog artefakta pa tako i keramičkih posuda, mogu se podijeliti na tri glavna područja istraživanja. Prvi je usmjeren na porijeko sirovine, a uključuje određivanje mjesta odakle se vadila glina za izradu keramičkih posuda, kako bi se utvrdili putovi trgovine ili razmjene, te međusobni kontakti između različitih kulturoloških grupa. Analitičke tehnike uključuju mineraloško-petrografske i kemijske analize kao što su: metoda rendgenske difrakcije na prahu (*X-Ray Diffraction* - XRD), metoda rendgenske florescencije (*X-Ray Flourescence* - XRF), metoda neutronske aktivizacije (*Instrumental Neutron Activation Analysis* - INNA), metoda pretražnim elektronskim mikroskopom u kombinaciji s energetsko disperzivnom analizom rendgenskim zrakama (*Scanning Electron Microscope-Energy Dispersive X-Ray Spectroscopy* – SEM-EDX/EDS), metoda infracrvene spektroskopije s Fourierovom transformacijom (*Fourier Transform Infrared Spectrometry* -FT-IR).

Drugi se odnosi na tehnološka istraživanja koja uključuju materijal i tehniku izrade, a analize sirovine i primjesa mogu nam ukazati na proizvodne procese, tehnološke odabire i promjene koristeći iste analitičke tehnike. Za utvrđivanje atmosfere i temperature pečenja te tehnike izrade posuda najučinkovitija metoda je mikroskopija izbrusaka (eng. *thin section* – tanki isječak pripremljen za ispitivanje pod petrografskim mikroskopom).

Treći segment uključuje funkcionalni element, odnosno određivanje uporabne funkcije proizvoda u svakodnevnom životu (Tite 1999; 2008). Veliku ulogu kod analize funkcionalnog elementa ima analiza plinske kromatografije-masene spektrometrije (*Gas Chromatography-Mass Spectrometry* – GC-MS) koja se u arheologiji intenzivno koristi zadnjih 20-ak godina, a kojom određujemo porijeklo životinjskih i biljnih masti koje su apsorbirane u stijenci keramičke posude. Više o ovoj metodi i rezultatima na analiziranom vučedolskom materijalu bit će riječi u drugom dijelu knjige (Poglavlje 15). I na kraju, u kombinaciji s arheološkim podacima, etnoarheologijom i eksperimentalnom arheologijom slažemo slagalicu do potpunije slike kojom rekonstruiramo obrasce ljudskog ponašanja u prošlosti.

ETNOARHEOLOGIJA

Etnoarheologija kao termin javlja se sredinom 70-ih godina prošlog stoljeća. Prvi put upotrijebio ga je Jesse Walter Fewkes 1900. godine i otad je ovaj termin doživio mnoge varijacije: aktivna arheologija, etnografija za arheologiju, arheo-etnografija, arheološka etnografija, živa arheologija, etnoanalogija (za pregled vidi: Arthur & Weedman 2005). Definicija etnoarheologije u terminološkoj bazi hrvatskog strukovnog nazivlja (STRUNA) glasi: „znanstvena disciplina koja proučava suvremena društva s ciljem razumijevanja ljudskog ponašanja kao temelja materijalne kulture u prošlosti".

Danas se etnoarheološka istraživanja tumače kao „arheološki orijentirana etnografska istraživanja" (Kramer 1985: 77), odnosno „etnografija s arheološkim utjecajem/predznakom" (Gullick 1985). Cilj etnoarheoloških istraživanja je poboljšati razumijevanje i veze između ljudskog ponašanja u prošlosti i elemenata materijalne kulture koji su sačuvani u arheološkom zapisu.

Keramičke posude izrađuju se neprekinuto od kraja gornjega paleolitka do danas, a javljaju se na svim geografskim područjima tvoreći dugu tradiciju kroz prostor i vrijeme. Kao i u prapovijesnim vremenima tako i danas keramičke posude igraju ključnu ulogu u socijalnom, ekonomskom i duhovnom životu zajednice. Kako se tehnologija izrade keramičkih posuda nije puno mijenjala od prapovijesti do danas, etnografska istraživanja dragocjen su nam izvor podataka, pogotovo kada je riječ o organizaciji proizvodnje, tehnološkom izboru, specijalizaciji zanata, podjeli poslova ili ponudi i potražnji – segmentima koji nisu uvijek jasni i prepoznatljivi u arheološkom kontekstu. Zajednice koje i danas žive tradicionalnim načinom života pružaju nam uvid u cjelokupan proces lončarskih aktivnosti jer koriste tradicionalnu tehnologiju lišenu suvremenog načina života.

Istraživanja koja su mjerljiva i dostupna u etnoarheološkom kontekstu posebno su zanimljiva s aspekta obrazaca za odlaganje otpada u naselju (eng. *disposal patterns, refuse disposal*) i životnog vijeka posude (eng. *ceramics uselife*). Prvi segment posebno je zanimljiv arheolozima jer nam otvara nove poglede prilikom interpretacije materijalnih ostatka u arheološom kontekstu (DeBoer & Lathrap 1979; Hayden & Cannon 1983; Deal 1985; Arnold 1990; 1991; Deal & Hagstrum 1995; Schiffer 1996; Stanton et al. 2008). Drugi segment otvara nam nova pitanja o karakteristikama keramičke građe koju obrađujemo jer životni vijek posude koji je vezan za njezinu primarnu i sekundarnu funkciju za života određuje i karakteristike cijele građe (Foster 1960; David 1972; DeBoer 1974; Longacre 1985; Deal & Hagstrum 1995; Shott 1996; Tani & Longacre 1999; Sullivan 2008).

Baš kao i u prapovijesti, tehnologija izrade keramičkih posuda može se i danas najbolje razumijeti kao društvena tradicija koja se prenosi s generacije na generaciju kroz prostor i vrijeme. Danas nam etnoarheološka istraživanja pomažu da povežemo obrasce ponašanja i elemente materijalne kulturne baštine, kako bismo bolje razumijeli arheološke procese u prošlosti. Ona nam omogućava da se zaista približimo vezi između posude i čovjeka. Možda je najbolja definicija ona koju su u svom radu napisali David & Kramer (2001): „Etnoarheologija nije ni teorija ni metoda, nego istraživačka strategija koja obuhvaća širok spektar pristupa kako bismo razumjeli vezu između materijalne kulture do kulture u cjelini, uspoređujući današnji društveni kontekst i arheološki zapis, te istražujući te veze kako bismo mogli razumjeti arheološki koncept i poboljšati interpretaciju".

3. PORIJEKLO KERAMIČKIH POSUDA

Riječ keramika potječe od grčke riječi *keramos* što znači glina, *keramikos* označava proizvod napravljen od gline, a k*eramike tehne* vještinu pečenja keramike. U hrvatskom jeziku upotrebljavamo još i riječ lončarija i lončarstvo. Pojam lončarija obuhvaća sve lončarske, tj. keramičke proizvode, a lončarstvo označuje lončarsku vještinu, odnosno umijeće (Miloglav 2011; 2014). Izrada keramičkih posuda često nije izolirana aktivnost u kojoj sudjeluje samo jedna osoba, već nekoliko ljudi u zajednici može biti zaduženo za različite radnje u proizvodnom postupku (nabava sirovine i primjesa, oblikovanje, tretiranje i ukrašavanje, pečenje posude). Bez obzira na mogućnost sudjelovanja nekoliko osoba u izradi keramičke posude obično je jedan pojedinac zadužen za njen konačan izgled i karakteristike, a to je lončar.

Keramika je jedan od najčešćih materijala koji arheolozi obrađuju i analiziraju. Razlog tome je možda i činjenica što su keramički ulomci i statistički najbrojniji nalazi na arheološkim lokalitetima. Nekoliko je bitnih faktora koji tome idu u prilog. Glina je, bez dvojbe, jedan od najobilatijih, najjeftinijih i najprilagodljivijih dostupnih prirodnih materijala odavno prepoznat kao korisna sirovina za eksploataciju (Rice 1987: 7). Druga dva, sigurno ne manje bitna faktora, su kratko vrijeme uporabe te njezina otpornost na mnoge mehanizme u arheološkom okruženju, poput oksidacije i bakteriološkog propadanja (Banning 2000: 161).

Keramika je u biti kombinacija četiri osnovna elementa: zemlje, vatre, vode i zraka. Transformaciji gline u keramičke proizvode prethodili su drveni, kameni i koštani predmeti, što ne znači da glina i njezine karakteristike nisu bile već tada poznate i prepoznate. Nekoliko najranijih predmeta načinjenih od gline ukazuju na poznavanje tri važna principa uporabe ovog sirovinskog materijala. Jedan od prvih je spoznaja da je vlažna glina plastična te da se može oblikovati i zadržati takvu formu nakon sušenja. Druga važna prekretnica u eksploataciji gline leži u otkriću vatre kao termalnog izvora koji transformira glinu u proizvod koji je čvrst i trajan. Dodavanje različitih materijala u glinu kako bi se poboljšala njezina kvaliteta i čvrstoća, dovodi do konačnog razumijevanja svih mogućnosti koje nudi glina kao materijal pogodan za daljnju obradu i maksimalnu uporabljivost u svakodnevnom životu (Rice 1987: 8). Međutim, još uvijek nije potpuno jasno kada je izrada keramičkih posuda postala važna u ljudskoj povijesti i zauzela primat u izradi svakodnevnih uporabnih predmeta. Poznato je da su lovačko-sakupljačke zajednice počele više manipulirati glinom u kasnom pleistocenu i ranom holocenu (Rice 1999). Proizvodnja keramičkog posuđa i drugih utilitarnih predmeta značajnije se ipak razvija s procesom neolitizacije, sjedilačkim načinom života, kultivacijom biljaka i domestikacijom životinja. Naime, keramičke posude podložne su lomljenu i teške za transportiranje pa je vjerojatno da su imale manju važnost kod lovačkih zajednica koje su se stalno selile. S druge strane, keramičke posude su najpogodnije za pripremu hrane termičkom obradom s vodom, a na taj način određene namirnice poput sjemenki i žitarica mnogo se lakše konzumiraju (Sinopoli 1991: 1-2).

NAJSTARIJE KERAMIČKE POSUDE

Mnogo je teorija o nastanku keramičkih posuda, odnosno spoznaji da se izlaganjem gline vatri dobiva oblik koji je čvrst i trajan. Donedavno tradicionalno se smatralo da je otkriće keramičkih posuda vezano za tzv. neolitički paket te da je prve keramičke posude izradilo sjedilačko stanovništvo zajedno s početkom kultivacije biljaka i domestikacijom životinja. Naše poimanje povijesti tehnologije i tehnoloških promjena dugo je bilo uvjetovano društveno-evolucijskim idejama o napretku koje su nastale sredinom 19. st. Moć ideje o neolitičkoj revoluciji postala je toliko utjecajna da su arheolozi teško mogli odvojiti otkriće keramičke tehnologije od neolitičkog paketa ili od generalnih procesa koji su vezani za početke poljoprivrede (Jordan & Zvelebil 2010a: 45-47).

Današnje stanje istraživanja i dobiveni radiokarbonski datumi u posljednjih nekoliko godina pokazali su dugotrajno i samostalno korištenje keramičkih posuda još krajem pleistocena, puno prije prelaska na poljoprivredne aktivnosti u holocenu (Chi 2002; Kuzmin 2002; 2010; Bougard 2003; Keally et al. 2004; Kuzmin & Vetrov 2007; Boaretto et al. 2009; Jordan & Zvelebil 2010; Wu et al. 2012; Craig et al. 2013). Pojava najranijih keramičkih posuda u Kini, Japanu i Rusiji pokazuje da keramičke posude imaju neovisnu tehnološku povijest bez ikakve asocijacije s počecima poljoprivrede u neolitiku te da su za nju zaslužne lovačko-sakupljačke zajednice gornjeg paleolitka. Nakon otkrića keramičkih posuda u istočnoj Aziji ova praksa se polako uklopila u društveni život lovačko-sakupljačkih zajednica u različito vrijeme i na različite načine, šireći se na istočni i zapadni Sibir te na kraju u istočnu i sjevernu Europu. Ovi podaci o ranoj povijesti keramike u sjevernoj Euroaziji razbijaju vezu između lovačko-sakupljačkih i poljoprivrednih zajednica koju su utvrdili europski arheolozi 19. i 20. st. (Jordan & Zvelebil 2010a).

Dosadašnji datumi pokazuju da se keramičke posude javljaju u Japanu oko 13,500 BP (oko 16,750–15,700 cal BP), u južnoj Kini od oko 14,800-14,000 BP (18,500-17,500 cal BP) (Boaretto et al. 2009) te u Rusiji od 13,300 BP (oko 16,500–14,900 cal BP) (Keally et al. 2004; Kuzmin 2010). Nedavni datumi iz Kine (pećina Xianrendong) dali su najstarije datume povezane s upotrebom keramičkih posuda, a kreću se između 20,000-19,000 cal BP (Wu et al. 2012). Ove, zasad, najranije posude pečene su na niskim temperaturama (između 400-500°C), jednostavnog su oblika uglavnom zaobljenog dna, ukrašene su linijama, vrpčastim otiscima s uzorcima tekstila, a većina ih ima tragove čađe na vanjskom dijelu posude indicirajući upotrebu na vatri (Keally et al. 2004; Boaretto et al. 2009; Jordan & Zvelebil 2010a; Wu et al. 2012). Analize fitolita iz pećine pokazale su ostatke divlje i kultivirane riže, što pokazuje da je kultivirana riža bila dio uobičajene prehrane tijekom ovog razdoblja (Chi 2002: 31). Kao i na ostalim nalazištima prevladavaju razne vrste riba i mekušaca (Chi 2002). Analize organskih ostataka na najranijim posudama japanske kulture Jomon (15,000-11,800 cal BP) pokazale su ostatke slatkovodnih i morskih proizvoda u stijenkama posuda što ukazuje na najraniju upotrebu keramičkih posuda za pripremu ovih namirnica, osobito morskih (Craig et al. 2013).

Što se tiče tehnologije i lončarske smjese, vidljiva je razlika između keramičkih posuda na ova tri udaljena prostora. Najranije posude iz Japana pokazuju jednostavnu formu s ravnim i koničnim dnom, primjese od organskog materijala (biljnih vlakana) te ukrašavanje površine utiskivanjem i urezivanjem (Keally et al. 2004: 349). U Rusiji (područje oko rijeke Amur) posude imaju slične oblike, debele stijenke i sadrže primjese trave, a ukrašene su vertikalnim urezima, cik-cak linijama te utiskivanjem vrpčastog motiva (Keally et al. 2004: 349). U južnoj Kini posude imaju zaobljeno dno, a kao primjesu koriste veća zrnca kvarcita te većinom imaju rukom zaglađenu površinu (Chi 2002: 32; Keally et al. 2004: 349). Vrlo zanimljiva primjesa nađena je na manjem broju ulomaka u pećini Xianrendong, a radi se o grogu, odnosno usitnjenoj keramici (Chi 2002: 33), što pomiče granice upotrebe groga kao namjerno dodavane primjese. Zanimljivo je da su keramičke posude u sjevernoj Kini, koje su nešto mlađeg datuma, drugačije i oblikom i sastavom smjese. Svi oblici pripadaju vrčevima, a od primjesa se koristio kvarc, pijesak, školjke i tinjac što svjedoči o različitim kulturološkim tradicijama (Chi 2002).

Iz priloženog se vidi da se najranije posude javljaju na različitim i vrlo udaljenim područjima u gotovo istom vremenskom razdoblju, kulturološki neovisne jedna o drugoj. S obzirom na različite načine oblikovanja, ukrašavanja i dodavanja primjesa vjerojatno se razvoj keramičkih posuda odvijao neovisno na spomenutim područjima prije nego što bi bio rezultat migracija ili tehnoloških razmjena (Keally et al. 2004).

NOVA TEHNOLOGIJA – RAZLOZI NASTANKA KERAMIČKIH POSUDA

Henry Lewis Morgan još je krajem 19. stoljeća pojavu keramičkih posuda definirao u okviru društveno-kulturnog razvoja, odnosno razlike između barbarizma i divljaštva. Morgan nije povezivao keramiku s poljoprivredom, po njemu je izum keramičkih posuda bio odvojen korak u društvenom i tehnološkom razvoju ljudskog roda, od divljaštva do barbarizma. Tek će Sir John Lubbock 1865. napraviti poveznicu između kultivacije biljaka, domestikacije životinja i otkrića keramičkih posuda, kao međusobno povezanih dijelova koji čine neolitik. U zapadnoj Europi njegovi će argumenti naići na opće prihvaćanje koje je zahvaljujući Gordonu Childu imalo snažan utjecaj te je postalo dio definicje „neolitičkog paketa" (za pregled vidi: Jordan & Zvelebil 2010a: 45-48).

Mnogo je zapravo teorija o porijeklu i nastanku keramičkih posuda. Jedna od pretpostavki je da je izrada keramičkih posuda bila inspirirana pukotinama u zemlji koje su nastale nakon što se zemlja posuši poslije obilnih kiša (Goffer 2007: 239-240). Ostale teorije mogu se generalno sažeti na: „arhitektonsku" i „kulinarsku" hipotezu, socijalnu/simboličku uvjetovanost i pojam intenziviranja resursa (za pregled vidi: Rice 1999; također: Miloglav 2011).

„Arhitektonska hipoteza" temelji se na usporedbama korištenja gline za konstruktivne elemente pri građenju i za konstrukciju keramičkih posuda. Tako bi prve keramičke posude nastale kao imitacija arhitektonskih tehnika koje su se već prije koristile u izgradnji kuća, a uključuju miješanje gline i slame kako bi se dobila jedna vrsta žbuke ili pak način na koji su se pravili glineni blokovi koji su se također koristili u gradnji (ćerpiči – nepečena opeka sušena na suncu).

Zagovornici ***„kulinarske hipoteze"*** smatraju da su keramičke posude nastale nakon spoznaje da glina koja je ostavljena na suncu i koja se stvrdne, može poslužiti za kuhanje, skladištenje hrane ili tekućine. Nastanak keramičkih posuda povezuje se s oblaganjem unutrašnjosti košara glinom tako što su se ovakvi spremnici sušili na suncu kako bi postali nepropusni. Također se naglašava da se glina koristila za oblaganje peći ili jama za pečenje koje su služile za zagrijavanje kamenja i da se tada već došlo do spoznaje da se glina može stvrdnuti kada se posuši ili zagrije.

Upotreba vrućeg kamenja za zagrijavanje tekućine i kuhanje hrane u košarama, životinjskim kožama ili drvenim posudama zabilježena je na mnogim arheološkim i etnološkim primjerima. Najranijom pripravom hrane na ovaj način nije se mogla postići visoka i dugotrajna temperatura tekućine u kojoj se kuhaju namirnice biljnog ili životinjskog porijekla niti su takvi predmeti mogli služiti dugotrajnoj upotrebi. Ova tehnika zahtijeva veliku količinu goriva kako bi se kamenje zagrijalo i bilo efikasno u procesu kuhanja. Kamenje se stavlja neposredno pored izvora vatre ili najčešće direktno u vatru te se vruće ubacuje u spremnike od kore, kamena, drva ili u košare u kojima se nalazi tekućina s namirnicama. Temperatura se prenosi s kamenja na tekućinu, a cijeli proces se ponavlja dok se tekućina ne zagrije na temperaturu koja je potrebna da bi hrana bila kuhana (Nelson 2010).

Za razliku od spomenutih spremnika, koji su većinom organskog porijekla, keramičke posude se mogu staviti direktno na vatru, a poteškoće u održavanju visoke temperature u posudama s velikom količinom tekućine nisu predstavljale više nikakav problem. Upravo zato neki autori smatraju da su keramičke posude ušle u širu upotrebu jer zahtijevaju manje pažnje u nadziranju kuhanja hrane u usporedbi s uporabom zagrijavanja kamenja u životinjskim mješinama, koži ili košarama. Gledano iz toga kuta keramičke posude predstavljale bi tehnološko pojednostavljenje koje je na koncu omogućilo ljudima da se posvete drugim poslovima i dnevnim aktivnostima. U tom smislu naglašava se da je veza između kuhanja i hrane manje bitna od veze između uloženog vremena i radne energije u nadziranju posude za kuhanje (Schiffer & Skibo 1987; Eerkens 2008).

Koncept ***„intenziviranja resursa"*** donekle se poklapa sa ***„socijalnom/simboličkom uvjetovanošću"*** nastanka prvih keramičkih posuda, a odnosi se na promjenu dnevnih aktivnosti kao i na društvenu organizaciju unutar lovačko-sakupljačke zajednice krajem pleistocena/početkom holocena. Kako mobilnost opada, a sjedilački način života raste, linearno je u porastu i potreba za pohranom hrane. Tako se prve keramičke posude povezuju s hranom koja se koristila u posebnim društvenim aktivnostima, poput raznih obreda i žrtvovanja, te specijalnim prilikama. Simbolička funkcija ovih predmeta za posebnu namjenu promatrana je kroz segment ukrašavanja površine i raznih (simboličkih) motiva koji se na njoj nalaze. Jedna od citiranijih teorija u ovom interpretacijskom segmentu nastanka keramičkih posuda odnosi se na pojam „prestižne tehnologije" u smislu ekonomski orijentiranog društveno-političkog scenarija, čiji je idejni začetnik Brian Hayden. Pojava prvih posuda tako se objašnjava kao potreba za zajedničkim blagovanjem i/ili impresioniranjem gostiju u smislu hijerarhijskih razlika unutar društva i naglašavanjem statusa, blagostanja ili moći (za pregled vidi: Budja 2010). Hayden kasnije predlaže upotrebu prvih posuda za pripremu posebnih (luksuznih) jela, u smislu da je nova tehnologija upotrijebljena za proizvodnju prestižnog proizvoda (Hayden 2010). Hayden navodi nekoliko vrsta jela poput juha i variva, te namirnica poput ribljeg ulja, ulja morskih sisavaca, životinjske masti, ulja orašastih plodova i alkohola. Sve navedene namirnice zahtijevaju jako puno uloženog truda i radne energije, goriva i količine namirnica, pogotovo za ekstrakciju ulja, što ga navodi na zaključak da su se ova jela pripremala za posebne prilike.

Međutim, još uvijek ostaje otvoreno pitanje zašto su ljudi počeli upotrebljavati „spremnike" za hranu od gline kada su ih koristili od drugih materijala? Možda je jedan od odgovora u tome što je keramika osigurala novu tehnologiju, odnosno omogućila je da su se neke nove namirnice mogle pripremati u nepropusnim posudama. Posude od pečene gline tako su počele nuditi brojne prednosti, a neke od njih su (Rice 1999: 8):

1. povećanje efikasnosti u pripremi novih namirnica, posebno žitarica (ječma, pšenice) tako što su ih mogli kuhati na vatri ili peći
2. povećanje kapaciteta i dugotrajnosti čuvanja hrane
3. poboljšanje kvalitete prehrane pripremom svježih namirnica – uništavanje štetnih bakterija, poboljšanje probave
4. smanjivanje vremena potrebnog za nadziranje kuhanja u keramičkoj posudi u usporedbi s prijašnjim predmetima načinjenim od kamena, kože, kore ili košara
5. mogućnost korištenja hrane koja sadrži toksin, a koja se nije mogla koristiti u svakodnevnoj prehrani bez termičke obrade

Nastanak keramičkih posuda još nije do kraja razjašnjen, a pitanje je hoće li ikada i biti. Razloga je moglo biti nekoliko i sigurno je da se moraju sagledati u širokom spektru promjena koje su se dogodile krajem pleistocena - početkom holocena. Potreba za novom tehnologijom vjerojatno je uzrokovana mnogim životnim, klimatskim i ekološkim faktorima. Etnoarheološka istraživanja provedena među 862 zajednice pokazala su da je izrada posuda vrlo rijetka kod nesjedilačkih i vrlo malih zajednica (samo 12%) (Arnold 1985).

Lovačko-sakupljačke zajednice koje su živjele polusjedilačkim i sjedilačkim životom imale su nekoliko prednosti za izradu keramičkih posuda: nisu bili ograničeni vremenom izrade posude (postupak traje od nekoliko dana do nekoliko tjedana), niti vremenskim prilikama koje utječu na izradu i sušenje posude. S obzirom na sezonsko seljenje kod izrazito mobilnih zajednica izrada posuda u tom je smislu ovisila i o drugim aktivnostima u zajednici koje nisu ostavljale dovoljno vremena za izradu keramičkih posuda. To se prije svega odnosi na sakupljanje plodova koji sazrijevaju za vrijeme sušnog vremena, pa je branje i pohrana ovih namirnica sigurno bilo prioritetnije za zajednicu (Eerkensen et al. 2002; Eerkensen 2008). Koji god su razlozi bili ključni za eksploataciju gline u svakodnevnom životu, najbitnija je bila spoznaja da se manipulacijom gline i vatre mogu proizvesti predmeti koji služe za kuhanje/spremanje/skladištenje hrane ili tekućine. Tako pojava keramičkih posuda predstavlja sažimanje ljudskog iskustva i znanja koje je vezano za izbor materijala, tehnološke procese i potrebu. One predstavljaju kompromis između potrebe i karakteristika dostupne sirovine, dizajna, tehnologije izrade i konačne upotrebe (Rice 1999).

Iako još ostaju nejasni razlozi koji su doveli do prve upotrebe keramičkih posuda složila bih se s onim razmišljanjima da je nastanak keramičkih posuda uvjetovan utilitarnom potrebom za vodootpornim predmetom u svrhu skladištenja i pripreme hrane na vatri. Ovakav tehnološki inovativan proizvod omogućio je novom predmetu sve karateristike koje nisu imali spremnici poput košara, kože ili drva. Tragovi upotrebe na vatri pokazuju da su se keramičke posude koristile za kuhanje od „prvog dana“ te da nije bilo nikakve tehnološke tranzicije i prilagodbe u uporabnom smislu. Primarno služeći za termičku pripremu hrane keramičke posude posebno su pogodne za pripremu juha i variva jer maksimiziraju nutritivne vrijednosti i zadržavaju sokove i okuse što rezultira boljom i kvalitetnijom prehranom. Iako kuhanje pospješuje lakšu probavu mesa, većina njegovih nutritivnih vrijednosti je izgubljena tijekom prženja na otvorenoj vatri. Lagano vrenje mesa npr. u gulašu u vodootpornom spremniku sprječava gubitak hranjivih tvari konzervirajući visoko kalorične masti. Upotreba vatre osim što je bila bitna za ekstrakciju ulja, biljnih sokova i životinjskih masti iz određenih namirnica jednako tako je omogućavala da ta ulja i sokovi začepe pore na keramici i učine je nepropusnom (Rice 1999).

Koji god razlozi nastanka keramičkih posuda bili jedno je sigurno, a to je da su doprinijele boljoj kvaliteti života u svakom smislu. Na najjednostavnijoj razini poboljšale su prehrambene navike i aktivnosti vezane za pripremu, skladištenje i transport hrane. Kao aktivni predmeti sudjelovali su u religioznim i pogrebnim običajima, zajedničkim blagovanjima, pokazivanju moći, statusnog položaja i identiteta zajednice te su bile i ostale dio neprekidne i neprekinute sociokulturne interakcije.

4. LONČARSKA SMJESA

GLINA

Općenito gledajući keramika se sastoji od tri osnovna sirovinska materijala: *glinovitog materijala* - gnjecavog finozrnatog sedimenta koji postaje plastičan kada je mokar; *neplastičnih primjesa* – minerala i organskih tvari koje se prirodno nalaze u glini ili su joj namjerno dodane kako bi glina bila podatnija za obradu (feldspat, kalcijev karbonat, pijesak, kremen, kalcit); *vode* – koja se dodaje glini i njenim primjesama da bi postala plastična. Ostali sirovinski materijal koji je uključen u keramičku proizvodnju su razne boje i goriva koja se koriste pri pečenju (Sinopoli 1991: 9).

Od svih materijala koji se koriste u obradi keramike najvažnija je, naravno, glina. Samo značenje riječi glina razlikuje se ovisno o području interesa. Tako u geologiji glina označava finozrnate minerale formirane kao rezultat raspadanja silikatnih stijena djelovanjem atmosferilija. U kemijskoj mineralogiji glina je nekonsolidirani mineral koji pripada grupi poznatoj pod nazivom glineni minerali, a u znanostima koje se bave proučavanjem i analiziranjem tla riječ glina označava anorganske dijelove tla koji su napravljeni od vrlo malih čestica. U arheologiji glina označava materijal koji sadrži čestice minerala, a koji pomiješan s vodom poprima plastičnost, pri sušenju postaje krut, a zagrijavanjem na određenoj temperaturi postiže tvrdoću, čvrstoću, kemijsku i fizičku stabilnost (Goffer 2007: 231).

U osnovi, glina je kompleksni materijal čije su najosnovnije karakteristike vrlo male čestice (manje od 0,002 mm u promjeru) i razmjerno veliki udio minerala (Orton et al. 1993: 114). To je mineraloški sediment nastao raspadanjem različitih magmatskih i silikatnih stijena pod djelovanjem atmosferilija i drugih utjecaja (mehaničko, kemijsko i organsko raspadanje). Sastoji se od mineraloških čestica (tzv. glinenih minerala) aluminijevih silikata koji sadrže vodu (kaoliniti, montmoriloniti, iliti, haloziti, nontroniti, alofani itd.) i raznih drugih primjesa poput kremena, hidroksida željeza, karbonata, ortoklasa i organskih ostataka (Zlatunić 2005: 63). Gline (glinena tla i glinene stijene) čine 70% svih sedimentnih stijena, a dijelimo ih na primarne i sekundarne.

Primarne gline su one naslage koje su manje-više ostale na istoj lokaciji kao i izvorne stijene iz kojih su nastale. Ove su gline nastale iz različitih vrsta stijena poput granita, bazalta, diorita i nekih drugih vulkanskih stijena. To je razlog zašto se u prirodnom sastavu gline nalaze minerali koji su ostaci stijena iz kojih je glina nastala (Rice 1987: 31-38). Primarne gline su dosta čiste, nisu kontaminirane drugim materijalima, imaju jednoličnu strukturu i vrlo fine čestice (ispod 0,002 mm u promjeru). Najčešće su bezbojne ili imaju bijelu boju, a vrlo mala mješavina minerala poput kvarca ili željeznih oksida može im dati žutu, smeđu ili zelenu boju. Više od 20 različitih tipova minerala u primarnim glinama može se odrediti prema njihovoj kemijskoj kompoziciji (kaolinit, ilit, halozit, montmorilonit, klorit, sepiolit itd.) (Goffer 2007: 231-234).

Sekundarne gline (sedimentne ili transportirane) nastale su pomicanjem sa svog originalnog mjesta raznim prirodnim procesima poput erozija, valova, vjetra, leda itd. Ove su gline mnogo češće i puno su homogenije i finije teksture, što je rezultat sortiranja i taloženja, a najčešće u sebi imaju 5-10% organskog sastava (Rice 1987: 31-38). Finije čestice omogućuju mokroj sekundarnoj glini puno veću plastičnost i prilagodljivost, pa su ove gline puno povoljnije za obradu i pečenje od primarnih. Sekundarne gline karakterizira i veliki udio neglinenih čestica (više od 50%)

poput pijeska, vapnenca, željeznih oksida i organskih tvari, što je rezultat njihova pomicanja s originalnog mjesta. Željezni oksidi dat će glini žutu, crvenu, smeđu i ponekad zelenu boju, dok će organske tvari potamniti svaku glinu (Goffer 2007: 234-235). Mnoge sekundarne gline postaju čvrste i tvrde nakon pečenja na relativno niskim temperaturama, ali su s druge strane previše plastične za oblikovanje i pucaju tijekom sušenja i pečenja. Njihovo se svojstvo može poboljšati dodavanjem neplastičnih primjesa, odnosno materijala koji ne razvijaju plastičnost u kontaktu s vodom (Rye 1988: 31).

Izbor sirovine može biti uvjetovan različitim faktorima, o čemu će više biti riječi u sljedećim poglavljima, međutim, tri su osnovne karakteristike gline koje su bitne za svakog lončara: oblikovnost, plastičnost i mogućnost kontroliranja smjese (Bronitsky 1986: 212-218). Uobičajeno se ove tri karakteristike koriste pod pojmom obradivost. Obradivost podrazumijeva vezu između gline, vode i primjesa, a njihov omjer ovisi o lončarevoj subjektivnoj procjeni, prema stečenom znanju, iskustvu i vještini (Rye 1981: 20-21). Općenito, glina je manje obradiva ako je u nju dodana veća količina primjesa, međutim, upravo će dodavanje veće količine primjesa dati posudi bolju otpornost na termalne stresove. Karakteristike gline, veličina zrnaca i omjer dodanih primjesa međusobno su povezani faktori koji će utjecati na obradivost lončarske smjese.

PRIMJESE

Stijene su sastavljene od minerala, pa se zato mnogi minerali prirodno nalaze u sastavu gline. Druga vrsta minerala koja se javlja u glini je sekundarnog karaktera, odnosno lončar ju naknadno dodaje kako bi se poboljšala kvaliteta gline za oblikovanje i pečenje. Mnogi su materijali dodavani u glinu, počevši od organskih materijala do minerala i stijena. Pritom je izbor materijala bio ograničen geografski, što znači da se za izradu keramike najčešće koristila sirovina iz okolice (Gibson & Woods 1997: 33).

Primjese (eng. *tempering*) su neplastični materijali koje je lončar namjerno dodavao u glinoviti materijal kako bi se smanjilo skupljanje i pucanje posude tijekom sušenja, povećala otpornost na termalni stres, tvrdoća i čvrstoća posude nakon pečenja. Dodavanje raznih primjesa u glinovitu smjesu jedan su od najstarijih tehnoloških odabira u keramičkoj proizvodnji, a mogu se podijeliti u četiri kategorije:

1. ***Minerali*** - su najčešće dodavana primjesa, a najrašireniji među njima su kvarc i kalcit, o čijim će karakteristikama biti više riječi u slijedećem poglavlju. Tradicionalno, dodavanje pijeska vrlo je uobičajeno u izradi keramičkih posuda radi velike koncentracije kvarca i feldspata (Albero 2014: 69). Eksperimenti su pokazali da dodavanje pijeska kao primjese poboljšava prijenos topline na sadržaj posude te takve posude imaju bolji efekt zagrijavanja, a shodno tome u kraćem roku postižu ključanje vode od posuda s primjesama organskih tvari (Skibo et al. 1989: 131-132).
2. ***Različite vrste metamorfnih, sedimentnih i eruptivnih stijena*** - poput granita, bazalta, vapnenca, filita itd.
3. ***Organski materijal*** - može se naći kao prirodni sastav sirovine u omjeru do čak 17%, međutim uglavnom se radi o namjerno dodanoj primjesi. O količini organskih tvari u lončarskoj smjesi ovisan je redukcijski način pečenja jer se zbog nedostatka kisika potrebnih za oksidaciju, pretvaraju u drveni ugljen. Na taj način ostavljaju crne tragove unutar pora keramike, zbog čega je keramika pečena redukcijski sive (kada ima malo organskog mate-

rijala) ili crne boje (zbog gara, odnosno neizgorenog ugljika). Sagorijevanjem na visokim temperaturama organski materijali ostavljaju pukotine koje povećavaju poroznost i propusnost. Najčešće dodavan organski materijal su trava, razna biljna vlakna, slama, školjke, pljeva i balega. Posude s primjesama školjki tako će dati posudi veću čvrstoću i otpornost na termalni stres (Skibo 2013: 44). Ponešto drugačije primjese uključuju dodavanje mlijeka, krvi i ostalih tekućih primjesa što je potvrđeno u Egiptu (Albero 2014: 70).

Posude s organskim primjesama većinom su se tumačile kao kulturološki uvjetovana pojava koja je bila logičan slijed u procesu prelaska na izradu keramičkih posuda nakon spremnika od košara, drvenih posuda ili životinjske kože, dodajući travu u glinu kao svojevrsnu poveznicu između ove dvije tehnologije. Dodavanje suhe balege u glinenu smjesu kod ranoneolitičkih posuda neki autori tumače kao simboličan, a ne tehnološki, odabir koji označava promjenu gospodarskih aktivnosti s poljodjelstva na stočarstvo, dok bi dodavanje mineralnih primjesa upućivalo na zaposjedanje nove zemlje i njezinu kultivaciju (Gheorghiu 2008: 172-175). Gledano tehnološki, posude s organskim primjesama imaju slabiji efekt zagrijavanja, što ne odgovara njihovoj primarnoj funkciji pa su razna tumačenja išla u smjeru negiranja upotrebe ovih posuda za kuhanje na vatri već s vrućim kamenjem (vidi: Jordan & Zvelebil 2010a: 43-44; Skibo 2013: 41). Međutim, kao što smo spomenuli u prijašnjem poglavlju, na najranijim posudama nađeni su tragovi čađe na vanjskim dijelovima posuda što nedvojbeno ukazuje na kuhanje hrane na vatri (Keally et al. 2004; Boaretto et al. 2009; Jordan & Zvelebil 2010; Wu et al. 2012), a analize organskih ostataka potvrdile su ostatke slatkovodnih i morskih proizvoda koji su se u njima pripremali (Craig et al. 2013). Kao što je već naglašeno, upravo je mogućnost kuhanja na vatri bila glavna prednost nove tehnologije nad posudama od drva, životinjske kože ili košara (Skibo 2013: 43).

Analize i eksperimetni pokazali su da posude koje u sebi imaju dodane organske primjese imaju nekoliko tehno-funkcionalnih karakteristika (Skibo et al. 1989):

a) otporne su na lomljenja i mehaničke udarce ako su organske primjese krupnozrnate i manje zastupljene
b) lakše su od posuda s mineralnim primjesama pa su ovakve posude pogodnije za transport
c) provedeni eksperimenti pokazali su da posude koje u sebi imaju primjese organskih tvari i minerala imaju veću otpornost na termalni stres od onih s primjesama pijeska ili bez ikakvih dodanih primjesa (Skibo et al. 1989; Schiffer et al. 1994). Također, primjese organskog materijala posudi osiguravaju veći stupanj čvrstoće kao rezultat čvrstog spajanja pora (Schiffer et al. 1994)
d) lakše su za izradu i oblikovanje jer je ova primjesa uvijek dostupna u naselju i na mjestu izrade posude. Osim toga posude s organskim primjesama brže se suše (Skibo 2013: 41-43)
e) jedan od nedostataka je slabiji efekt zagrijavanja, pa posude s ovom vrstom primjese zahtijevaju dodatna tretiranja površine (Skibo 2013: 43)

4. ***Antropogene primjese*** - grog (smrvljena keramika) je jedina primjesa koja nije prirodnog porijekla već ju je napravio čovjek. Grog je, uz organski materijal, najčešća namjerno dodavana primjesa, a nalazimo ga u keramičkim posudama još od neolitika (Thomas 1991; Hamilton 2002; Spataro 2002; 2011; McClure et al. 2006; Arnăut & Ursu-Naniu 2008; Kreiter et al. 2009; Quin et al. 2010; Vuković 2010; Kreiter 2014). Kao što smo vidjeli u poglavlju o porijeklu keramičkih posuda, grog je nađen i kod najranijih keramičkih posuda u Kini (Chi 2002). U mlađim razdobljima (posebno u brončanom dobu) vrlo često se u smjesi mogu uočiti veća zrna groga koja sadrže u sebi još starija zrna (Mason & Coper 1999; Gherdán et al. 2007; Kreiter 2007; Kudelić 2015), što nam ukazuje na dugu tradiciju recikliranja posuda (*Slika 80*).

Jedan od razloga njegova dugog tehnološkog zapisa jest dostupnost, s obzirom na to da se radi o sekundarno upotrebljavanim dijelovima razbijenih posuda kojih u naselju uvijek ima. Grog se kao primjesa javlja u dva oblika: a) jednakih mineralnih karakteristika kao posuda „domaćin" i b) različitih mineralnih karakteristika (Whitbread 1986: 82). Analizirajući keramički materijal pod polarizacijskim mikroskopom ponekad je teško razlikovati primjese groga od glinovitih peleta (eng. *clay pellets*) (Cuomo di Caprio & Vaughan 1993). Oni se mogu nalaziti u glinovitoj smjesi kao namjerno dodane suhe čestice gline ili kao prirodne inkluzije koje su formirane u okolišu taloženja. Ipak, po nekim karakteristikama glinovite pelete moguće je prepoznati po velikom stupnju zaobljenosti, sličnom obliku i boji koja može biti tamnija od glinovite smjese zbog koncentracije oksida (Whitbread 1986).

Iako je napravljen od gline, grog nema veličinu zrnaca karakterističnu za glinu jer su mineralne osobine uništene tijekom pečenja (Velde & Druc 1999: 83), međutim njegovo namjerno dodavanje u glinenu smjesu dat će posudi veću otpornost na termalne stresove i razna mehanička oštećenja. Grog će također biti koristan pri sušenju posude jer zrna keramike apsorbiraju vlagu te na taj način doprinose ravnomjernom sušenju.

Dodavanje groga općenito je vezano za funkcionalnu karakteristiku posude te se uobičajeno povezuje s posudama za kuhanje zbog svog nižeg koeficijenta termalne ekspanzije. Međutim, neka etnografska istraživanja pokazuju da se upravo kod takvih posuda grog izbjegavao. Tako zajednice Yuma i Mohave u jugozapadnoj Americi koriste grog u svim vrstama posuda osim u posudama za kuhanje. Yume koriste kao primjesu granit, a Mohave pijesak. Zajednica Hopi također koristi pijesak za posude za kuhanje i skladištenje, a u ostale vrste posuda ne dodaju nikakve primjese. Na Jukatanu koriste vapnenac za posude u kojima su držali vodu, a kalcit za posude za kuhanje (Plog 1980: 85-86). S druge strane, etnoarheološka istraživanja provedena na području tri tradicijske zajednice u Pakistanu pokazuju da su za izradu posuda za kuhanje koristili dvije različite primjese, grog i pijesak, i to na posebnim dijelovima posude. Za izradu ruba posude koriste miješavinu od 50% gline i 50% pijeska radi lakšeg oblikovanja, a za dno posude koriste isključivo primjese groga radi otpornosti na visoke temperature (Spataro 2004: 173). Na ovim primjerima vidimo različite tehnološke tradicije koje koriste različite recepture za određenu namjenu posuda.

Grog kao primjesa rijetko se nalazi samostalno u lončarskoj smjesi, a zajedno s drugim primjesama rezultirat će različitom kvalitetom smjese. Njegova upotreba povezana je s kulturološkom tradicijom i promjenama u keramičkoj tehnologiji koje rezultiraju različitim recepturama. Istraživanja mađarskog neolitika pokazala su da su lončari u ranom neolitiku kao primjesu koristili isključivo organski materijal, u srednjem neolitiku dolazi do njegova opadanja, a u kasnom neolitiku zamijenit će ga upotreba groga (Kreiter 2014). Posve drugačija lončarska praksa dokumentirana je prilikom istraživanja španjolskog neolitika gdje je grog bio dominantna primjesa tijekom ranog neolitika, u srednjem neolitiku polako nestaje te ga zamjenjuje kalcit, dok u kasnom neolitiku kalcit postaje jedina dodavana primjesa u lončarsku smjesu (McClure et al. 2006).

Da grog nema samo reciklirajuće karakteristike svjedoče neka etnografska istraživanja pa tako u jugoistočnoj Aziji (Laos) lončari sami rade grog tako da miješaju glinu i rižine ljuskice, peku ga i potom namjerno razbijaju kako bi usitnjene dijelove upotrijebili za izradu posuda (Rice 1987: 412; Shippen 2005: 44). Glinene kugle na niskim temperaturama i danas se peku na Tajlandu, kako bi se razbijene i usitnjene koristile kao grog (Velde & Druc 1999: 83). Etnoarheološka istraživanja u zapadnoj Keniji, prema procjeni tamošnjih lončara, pokazuju da od jedne razbijene posude mogu napraviti tri nove posude iste veličine (Dietler & Herbich 1989: 152).

Osim funkcionalnih karakteristika i tehnološko-tradicijske prakse, dodavanje groga povezano je i sa simboličkom interpretacijom neprekinute transformacije jedne posude u drugu, odnosno dodavanja primjesa predaka u sljedeću generaciju posuda (Gamble 2007: 198). Etnoarheološka istraživanja raznim tradicijskim praksama svjedoče o simboličkoj upotrebi groga, povezujući život i smrt osobe sa životom posude. Jedan od primjera dolazi iz peruanskih Anda gdje se nakon smrti osobe namjerno razbijaju sve posude koje je za života koristio te se jedan dio razbijenih ulomaka odvaja kako bi se kao grog koristio za izradu nove posude (DeBoer 1974: 340). U zapadnoj Africi kroz posude je izražena veza oca i sina. Naime, kada otac umre sin razbija dio ruba očeve posude i u obliku groga ugrađuje ga u novu posudu (Sterner 1989 prema Kreiter 2007: 132). Primjese groga također se tumače tako da je razbijena posuda, koja se u obliku groga reproducira u novu, mogla imati posebno značenje za zajednicu. S druge strane, izbjegavanje groga kao primjese tumači se kao namjerno izbjegavanje dodavanja starih razbijenih posuda radi značenja, odnosno praznovjerja, koje sa sobom unose u novu posudu (za pregled vidi: Hamilton 2002). Kontinuitet života koji na simboličan način reflektira nastavak života na istom mjestu, odnosno društveni i materijalni kontinuitet zabilježen je još od neolitika namjernim paljenjem kuća. Tako su stare kuće inkorporirane u nove namjernim paljenjem te ponovnom gradnjom na temeljima stare kako bi se uspostavio simbolički kontinuitet mjesta u odnosu na neko domaćinstvo u prošlosti (Whittle 1996; Stevanović 1997; Tringham 2000; Tripković 2009).

Kao što je prikazno u ovom kratkom pregledu izbor primjesa ne mora imati isključivo tehno-funkcionalne karakteristike već može biti uvjetovan društvenim, ideološkim, simboličkim i tradicijskim značenjima, što svakako treba imati na umu.

5. FIZIČKE KARAKTERISTIKE KERAMIKE

Općenito gledajući analiza keramike temelji se na tri primarna parametra: funkcionalnom, tehnološkom i stilskom. Unutar svakog od njih postoji nekoliko varijanti koje su bitne za klasifikaciju keramičkih oblika. Mnogo je autora koji se bave analizom i klasifikacijom keramičkih predmeta, ali je najviše traga ostavila Anna O. Shepard koja se prva vrlo sustavno upustila u problematiku analize keramike i njezine deskripcije (Shepard 1985). Ona smatra da je predmet analize i opisa keramike obradiv ako se promatraju četiri aspekta: *fizičke karakteristike, vrsta materijala, tehnika i stil.* Poznavanje fizičkih karakteristika keramike osnovni je preduvjet analize i obrade keramičkog materijala te shvaćanja tehnološkog izbora i uvjeta keramičke proizvodnje. Fizičke karakteristike keramike uključuju boju, tvrdoću, čvrstoću, poroznost i teksturu. To su međusobno povezane osobine keramičke posude koje utječu na njenu kvalitetu i životni vijek.

BOJA

Boja je prva karakteristika keramičkog ulomka koju primjećujemo prilikom obrade. Spajajući ulomke koji pripadaju istoj posudi boja će nam u pravilu biti prvi kriterij po kojem odabiremo ulomke. Međutim, nekoliko je faktora koji utječu na boju pojedine posude. Primarni faktori su sastav gline te atmosfera, temperatura i trajanje pečenja. Sekundarni faktori su produkt uvjeta nakon pečenja, kao što su taloženje ugljena tijekom izlaganja posude na vatri (posebno vidljivo na donjim dijelovima posude), taloženje supstancija iz zemlje nakon odbacivanja keramičkog predmeta, istrošenost nakon dugotrajne uporabe, ispiranje vodom iz tla, pretjerano izlaganje visokim temperaturama u slučaju požara itd. Svi sekundarni faktori trebaju biti prepoznati prije opisivanja boje keramičke posude.

Određivanje boje keramike već se standardno radi s pomoću *Munsell Soil Color Charts*, kojim dobivamo tri vizualne i međusobno povezane varijable. To su: nijansa *(hue)* ili pozicija boje u spektru, zatim njena vrijednost *(value)*, odnosno intenzitet svijetlih i tamnih tonova te jačina *(chroma/brightness)*, tj. čistoća same boje (Shepard 1985: 103-113). Međutim, treba naglasiti da se određivanje boje po Munsellu u osnovi koristi za određivanje boje geološkog sloja, a ne pečene zemlje/gline. Boja nam svakako može puno toga reći o glini i metodi pečenja, odnosno radi li se o redukcijskom ili oksidacijskom načinu pečenja, međutim uvijek se nameće pitanje je li potrebno detaljno opisivati boju keramičkog ulomka bez dodatnih analiza i koliko nam je kriterij boje važan za klasifikaciju keramike. Boja keramike nam je bitna samo ukoliko se sagleda u kombinaciji s drugim varijablama.

Uobičajeno je da se atmosfera pečenja dijeli na oksidacijsku i redukcijsku i na onu koja može biti neutralna. Ako je protok zraka neometan i ima dovoljno slobodnog kisika koji se lako veže za elemente na površini ili unutrašnjosti glinenih predmeta, tada je riječ o oksidacijskoj atmosferi pečenja. Boje koje se dobivaju ovim načinom pečenja crvene su nijanse. Ako posuda koja je pečena oksidacijski sadrži željezo, ono će oksidirati, a keramika će biti žućkaste boje (pečenje ispod 850°C), ali ako se peče na višoj temperaturi (iznad 850°C) jače oksidirani željezni ioni dat će keramici žutu ili crvenu boju. Atmosfera koja nema dovoljno slobodnog kisika (sadrži plinove koji uzimaju kisik iz gline) naziva se redukcijskom, a daje boje od crne do sive. Ovakav način pečenja posve je ovisan o količini organskih tvari u glinenoj smjesi koje se zbog nedostatka kisika potrebnog za oksidaciju pretvaraju u drveni ugljen. Na taj način ostavljaju crne tragove unutar pora keramike zbog čega je keramika pečena redukcijski sive (kada ima malo organskog materijala) ili crne boje (zbog gara, odnosno neizgorenog ugljika). Pri zagrijavanju na visokoj temperaturi keramika u čijem se sastavu nalaze primarne gline (npr. kaolin) bit će bijele boje. Međutim, znamo da je većina keramičkog posuđa određena nekom bojom, a to je prije svega rezultat korištenja sekundarnih glina koje u sebi sadrže minerale koji im daju boju. Npr. željezni oksidi dat će keramici žutu, smeđu ili crvenu boju, a manganovi oksidi tamnu ili crnu (Goffer 2007: 242-245). Kao što je vidljivo, boja površine pečene gline posve je ovisna o spojevima željeza u masi i o atmosferi pečenja. Zbog toga kod opisa predmeta i njegove boje možemo govoriti samo o boji površine predmeta nakon pečenja, a ne o boji gline (Horvat 1999: 46-55).

Nije uvijek jednostavno odrediti boju keramičke površine, pogotovo kod keramičkih posuda koje su bile izložene naglim i učestalim promjenama temperature (kod pečenja te kod namjernog ili slučajnog gorenja u požaru). Ovakvi sekundarni faktori vrlo su česti na prapovijesnoj keramici, stoga određivanje boje po Munsellu nije pouzdan podatak za određivanje atmosfere pečenja (*Slika 1*).

Atmosfera i temperatura pečenja može se dobro vidjeti na izbruscima (eng. *thin section*) po prisutnosti ili odsutnosti nekih minerala ili organskih tvari koji, kada su izloženi određenim temperaturama, mijenjaju mineralni sastav i strukturu. Organske tvari tako izgaraju na temperaturama od 300 do 500°C, kalcit nestaje na temperaturi od 700 do 750°C u oksidacijskoj atmosferi te na 750°C u redukcijskoj (Spataro 2002: 39).

Najmanje izložen promjenama boje je presjek, odnosno jezgra keramike koja nam može mnogo reći o uvjetima i načinu pečenja. Iako definiranje atmosfere pečenja samo prema boji presjeka nije uvijek „najsretnije“ rješenje, ipak je najbliže određivanju uvjeta pečenja, barem kada je riječ samo o obradi keramičke građe. Mineraloško-petrografske i kemijske analize, kao i eksperimentalna arheologija u tom smislu dat će nam pouzdanije podatke. U literaturi postoji nekoliko vrsta standarda za određivanje boje presjeka keramike. Jedan od prvih, koji su preuzeli i drugi autori, donio je O. S. Rye (1988: 116). Na obrađenom vučedolskom materijalu u drugom dijelu knjige napravljena je ljestvica od 5 promjena u boji koje su prisutne na keramičkim ulomcima.

Slika 1 –primjer sekundarnog gorenja posude
Fig. 1 – Example of the secondary burning of a vessel

TVRDOĆA

Tvrdoća keramike usko je povezana s temperaturom pečenja, a ovom varijablom možemo utvrditi dugotrajnost uporabe pojedine posude i njezinu sposobnost da izdrži sve mehaničke promjene tijekom korištenja. Poput boje keramike, tako i tvrdoća ovisi o kombinaciji nekoliko faktora. Najvažniji su svakako uvjeti i temperatura pečenja, obrada površine, vrsta primjesa u glini i njezina mikrostrukturna obilježja. Općenito gledajući, tvrdoća gline raste s rastom temperature pečenja. Primjese u glini također utječu na tvrdoću keramike, posebno ako snižavaju temperaturu pri kojoj počinje spajanje u čvrstu masu što na kraju rezultira čvrstom površinom otpornom na deformacije. S druge strane, primjese soli u glini smanjit će tvrdoću površine ako se koncentriraju na površini kao mekani talog. Mikrostrukturna obilježja, uključujući veličinu zrnaca i poroznost, utjecat će također na tvrdoću keramike. Tako će finozrnati i neporozni materijali stvoriti veću otpornost na deformacije i lomove te će biti tvrđi i dugotrajniji (Rice 1987: 354-355).

Tvrdoća minerala uobičajeno se mjeri s pomoću Mohsove ljestvice tvrdoće koju je ovaj austrijski mineralog definirao još davne 1922. godine. Predložena skala relativne tvrdoće sastoji se od 10 minerala koji su posloženi od najmekšeg (talk – tvrdoća 1) do najtvrđeg (dijamant – tvrdoća 10). Skala naravno nije linearna, u smislu apsolutne tvrdoće jer je dijamant puno puta veće tvrdoće od talka (Rapp 2009: 19). Međutim, vrlo je važno znati čemu služi ovo mjerenje i što nam rezultati govore. Mjerenje s pomoću Mohsove ljestvice tvrdoće zapravo se koristi za primarnu identifikaciju minerala, nešto kao „brzo skeniranje“ prije konačne determinacije mineralnog sastava glinene smjese koja se radi optičkim ili kemijskim analizama u laboratorijima. Definiranje tvrdoće prema Mohsovoj skali na kraju se svodi na grubu procjenu tvrdoće minerala koja vrlo često postaje sama sebi svrhom (Adams 1966). Danas se često koristi za određivanje dobro ili loše pečene keramike, međutim arheometrijske analize dat će nam puno preciznije i vjerodostojnije rezultate.

ČVRSTOĆA

Zajedno s tvrdoćom ova varijabla određuje usko povezane osobine pečene keramike. Čvrstoća keramike određuje njezinu sposobnost da izdrži razne vrste lomova i mehaničkih stresova. Mnogo je uvjeta koji utječu na čvrstoću keramike: tekstura, struktura gline, poroznost, metoda pripreme, tehnika izrade, temperatura i trajanje pečenja te veličina posude i uvjeti nakon odbacivanja keramike (Shepard 1985: 130-131).

Jedna od najvažnijih osobina čvrstoće keramičke posude je njezina sposobnost da izdrži pucanja i lomove tijekom naglih i učestalih promjena u temperaturi te otpornost na udarce i opterećenja. Kako je većina posuda služila za termičku pripremu hrane, tako je reakcija posude na *termalne stresove* kojima je izložena jedna od najosnovnijih karakteristika na koje se trebalo misliti prilikom odabira gline i primjesa. Sposobnost posude da izdrži konstantna zagrijavanja i hlađenja može se analizirati laboratorijskim i raznim eksperimentalnim metodama koje utvrđuju njezinu otpornost na termalne šokove/stresove. Kod posuda za kuhanje vanjski dijelovi posude bit će više izloženi stresu pri visokim temperaturama od unutarnjih, čije su stijenke hladnije zbog sadržaja posude. To može dovesti do bržeg pucanja posude i naposljetku do lomljenja ili ljuštenja. Vanjsko pucanje posude može uslijediti i tijekom hlađenja, kada je unutrašnjost toplija od vanjskog dijela posude. Pravilnim odabirom gline i primjesa, povećanjem količine i veličine pora te odabirom oblika posude koji će uspješno provoditi toplinu smanjit će se razina stresa i izbjeći eventualna oštećenja.

Treba naglasiti da otpornost posude na termalni stres nije svojstvo materijala već kompleksni parametar koji ne ovisi samo o fizičkim karakteristikama materijala kao što je koeficijent termalne ekspanzije, mehanička čvrstoća i izdržljivosti već, što je važnije, o uvjetima termalnog stresa

(Müller et al. 2014). Provedeni eksperimenti pokazali su da ograničeni termalni stres može biti djelotvoran za posude koje su stalno izložene takvim uvjetima, zato što se povećava energija raspršivanja lomova oko zrnaca primjesa (Müller et al. 2014). Također, pokazalo se da su posude s većom količinom primjesa otpornije na termalni stres. Razlog tome je što će kod posuda za kuhanje unutrašnja temperatura dostići 100°C, dok će vanjska biti između 500-600°C što u konačnici izaziva termalni stres u obliku mikro pukotina. Ako se ne spriječe ove pukotine vrlo brzo proširit će se na cijelu posudu i uzrokovati nepopravljiva oštećenja. Posude s niskim ili nikakvim otporom na termalni stres popucat će već pri prvom kontaktu s vatrom. Sve što sprečava nastajanje mikro pukotina povećava otpornost na termalni stres, poput izbora i količine primjesa ili tretiranja površine (Skibo 2013: 40). Zato posude za kuhanje imaju veliku količinu primjesa (čak do 40%), što su pokazala arheometrijska, etnoarheološka i eksperimentalna istraživanja (Plog 1980; Bronitsky & Hamer 1986; Skibo et al. 1989; Skibo & Schiffer 1995; Tite et al. 2001; Pierce 2005; Tite 2008; Skibo 2013; Albero 2014; Müller et al. 2014). Također se pokazalo da gline finozrnate teksture sporije provode toplinu, pa će se tijekom zagrijavanja posude vanjski dio brže zagrijavati od unutrašnjeg. To će izazvati veliki stupanj termalnog stresa za razliku od posuda čija krupna veličina zrnaca omogućuje bržu i ravnomjerniju apsorpciju topline. Zato posude za kuhanje većinom imaju krupnozrnatu teksturu (Skibo et al. 1989; Spataro 2003; Skibo 2013).

Uobičajeno se smatra da je pri odabiru smjese vrlo važno koristiti minerale i ostale primjese koji imaju manji ili sličan koeficijent termalne ekspanzije (poput feldspata, kalcita, plagioklasa, tinjca) te grog i mrvljene školjke. Međutim, neke od spomenutih primjesa negativno će utjecati na kvalitetu posude te prouzročiti pucanja i oštećenja. Također se smatra da dodavanje kalcita i groga ima veliku ulogu u smanjivanju termalnog stresa kod posuda koje su konstantno izložene naglom zagrijavanju, međutim neke karakteristike ovih primjesa mogu biti i pozitivne i negativne (Schiffer et al. 1994; Skibo & Schiffer 1995).

Dodavanje kalcita s jedne strane povećava plastičnost dok je glina još mokra, međutim s druge strane njegova prisutnost može uzrokovati probleme kod posude tijekom pečenja na srednjim temperaturama. Kada se peče u oksidacijskoj atmosferi na temperaturama iznad 600-870°C kalcit se pretvara u vapno. Kada dođe do hlađenja vapno reagira i tvori kalcijev hidroksid, proces koji je popraćen ekspanzijom volumena te uzrokuje pucanje i ljuštenja koja u ekstremnim slučajevima mogu uništiti posudu (Müller et al. 2014).

Druga primjesa koja se često spominje u posudama koje su služile za kuhanje je grog, čije karakteristike su navedene u prethodnom poglavlju. S obzirom na to da grog ima sličan koeficijent termalne ekspanzije kao i glina, zapravo osigurava vrlo malu otpornost na termalni stres. Razlog tome je što velika količina glinenih minerala ne smanjuje učinkovito širenje lomova te uzrokuje pukotine u česticama (Albero 2014: 154). Međutim, dodavanje groga u manjem omjeru poboljšat će otpornost posude na termalni stres u usporedbi s posudama koje u sebi nemaju primjese (Skibo et al. 1989; Skibo 2013). Eksperimentalne analize su pokazale da je količina od 5% groga optimalna za proizvodnju keramike, dok je dodavanje groga u omjeru većem od 5% štetno za mehaničku snagu posude pečene na svim temperaturama (Vierira & Monteiro 2004).

Kvarc, jedan od najčešćih prirodnih i dodavanih primjesa u glini, ima vrlo veliku sposobnost termalnog širenja i zbog toga nije najpogodniji za upotrebu kod posuda za kuhanje. Međutim u malim količinama i jako usitnjen daje keramici veću otpornost na temperaturne promjene. Također, fino usitnjena zrnca kvarca dat će posudi dodatnu čvrstoću (Bronitsky & Hamer 1986). Kvarc svoju prvu fazu prolazi na 573°C, stoga će promjene koje se događaju na ovoj temperaturi uzrokovati određeni stres na posudi, ako je ovaj mineral prisutan u značajnijim količinama tako uzrokujući širenje lomova na keramičkoj stijenci. S druge strane, manja količina finozrnatog kvarca reducirat će negativni efekt različite termalne ekspanzije primjese i glinovite smjese i tako spriječiti pucanje posude (Albero 2014: 154). Eksperimenti su pokazali da više od 10% primjesa kvarca u glinovitoj smjesi uzrokuje individualne zone oštećenja koje u interakciji stvaraju veliku mrežu pukotina koja pokriva cijelu posudu. Tijekom pucanja, upravo će ta mreža mikropukotina poticati skretanje loma, čime se povećava raspršavanje energije i doprinosi izdržljivosti materijala, odnosno posude (Müller et al. 2014). Te će mikropukotine tijekom izlaganja posude vatri omogućiti slobodan prostor za neometano stezanje.

Eksperimenti i provedene analize pokazali su da tehnološkim izborom lončar može povećati otpornost posude na termalni stres: *1)* odabirom gline i primjesa, *2)* debljinom stijenki, *3)* oblikom i veličinom posude (osjetljivost na termalni stres linearno se povećava s veličinom posude), *4)* temperaturom pečenja i *5)* tretmanom unutrašnje i vanjske stijenke posude (posebno kod posuda pečenih na nižim temperaturama). Reguliranje prijenosa tekućine s unutrašnje na vanjsku stranu posude tijekom kuhanja te način na koji se toplina prenosi s vatre na unutrašnju stranu posude može se postići pravilnim tretmanom površine.

Glačane i djelomično uglačane stijenke na unutrašnjoj strani posude, osim što će posudi osigurati vodootpornost, smanjit će njezino eventualno pucanje jer je prosječna temperatura u stijenkama posude niža te se na taj način manji termalni stupanj prenosi na površinu i stvara manji stres. Kod posuda čija unutrašnjost ima nisku propusnost otpornost na termalna pucanja i lomove može se povećati ako se vanjska strana posude tretira jačom teksturom (npr. barbotinom) (Schiffer et al. 1994; Skibo & Schiffer 1995).

Oblik posude također može utjecati na otpor posude termalnom stresu. Ujednačena debljina stijenki posude i izostanak oštrih obrisa te naglih promjena u obliku posude, smanjit će izloženost posude termalnom stresu, odnosno pucanju. Upravo zato posude koje su služile za kuhanje najčešće imaju jednostavnu formu (Rye 1988: 27; Sinopoli 1991: 14-15; Skibo & Schiffer 1995: 83; Skibo 2013: 52). Posude s tanjim stijenkama bit će otpornije na termalni stres jer brže provode toplinu od onih s debljim stijenkama. Potonje imaju prednost zadržavanja stalne temperature sadržaja posude, međutim teže su i nisu prikladne za transport ili stalno pomicanje.

Kao što smo vidjeli nema jednostavne formule kojom bi se postigla tvrdoća i čvrstoća posude i njezina otpornost na termalne i mehaničke stresove. Neke će primjese biti dobre, neke loše, što ovisi o nizu parametara (veličina posude, debljina stijenke, upotreba posude, kulturološka tradicija). Određene primjese dat će posudi potrebnu plastičnost, spriječiti pucanje tijekom sušenja, dok će s druge strane utjecati na povećanje termalnog stresa. Općenito gledajući, s rastom temperature opada otpornost na termalni stres pa posude pečene na nižim temperaturama (poput posuda za kuhanje) imaju veću otpornost na termalne šokove. Međutim, niže temperature pečenja povećat će propusnost posude pa lončar mora pribjeći nekom drugom tehnološkom izboru kako bi poboljšao karakteristike keramičke posude (poput načina na koji će tretirati površinu). Veliku ulogu pritom imaju veličina zrnaca i njihova količina u lončarskoj smjesi.

Razna testiranja čvrstoće posude odavno su prepoznata kod analiziranja keramičkih posuda, ovisno o vrsti interesa. Kako je čvrstoća posude produkt raznih procesa koji se odvijaju tijekom izrade posude, tako su i analize usmjerene u različitim pravcima. Veliku ulogu u ovom segmentu ima eksperimentalna arheologija, koja pokušava odrediti koliki je utjecaj određenih varijabli na čvrstoću posude, kao što su npr. primjese i njihova kvaliteta (Skibo et al. 1989; Cogswell et al. 1998), temperatura pečenja, tretman površine, otpornost posude na termalne šokove itd. (Schiffer et al. 1994; Pierce 2005; Maggetti et al. 2010; Rasmussen et al. 2012; Müller et al. 2014). Kod mjerenja čvrstoće posude treba uzeti u obzir promjene na keramici koje se događaju tijekom dugotrajne upotrebe, istrošenosti i izlaganja visokim temperaturama, zatim okruženje u kojem je posuda odložena u arheološkom kontekstu (prisutnost soli, vlage, smrzavanja tla) te samu morfologiju posude (Neupert 1994).

Mnogo je različitih testova mjerenja čvrstoće keramičkih ulomaka primjenjivano u arheologiji (Munz & Fett 2001: 125-136), a relativno nova metoda mjerenja *bal-on-three-ball test* (B3B) danas se primjenjuje zbog svoje jednostavnosti i ekonomičnosti. Metoda se primjenjuje tako da se ulomak stavi na tri jednake čelične kugle koje su jednako udaljene od centra ulomka i koje se međusobno dodiruju, a na vrh ulomka stavi se četvrta kugla. Teret na uzorku se povećava u jednakim razmacima dok ne dođe do pucanja ulomka. Vrijeme i način pucanja na keramičkom ulomku izazvani ovakvim načinom pritiska služe za mjerenje stupnja čvrstoće (Neupert 1994; Danzer et al. 2007). Upravo je na ovom testu dokazano da korištenje groga umjesto pijeska povećava čvrstoću posude čak do 70% (Neupert 1994).

POROZNOST

Poroznost je jedna od najosnovnijih osobina keramike, i općenito nam daje korisne informacije o strukturi posude. Ona ovisi o veličini pora i keramičke posude, odnosno o uvjetima koji dopuštaju plinovima i tekućinama da prođu kroz porozno tijelo posude. Također, na poroznost utječe veličina čestica gline i njihova distribucija, oblik primjesa, tehnika izrade i pečenje (Velde & Druc 1999: 160).

Pore se mogu okarakterizirati prema njihovu obliku, veličini i mjestu te se javljaju kao zatvorene ili otvorene na vanjskom dijelu površine. Količina pora unutar keramike određuje njezinu poroznost, dok su faktori koji utječu na poroznost veličina, oblik, gradacija i gustoća čestica, specifična mješavina gline i tretman kojemu je materijal izložen tijekom proizvodnje (Rice 1987: 350-351). Tako će posude uglačane površine ili one tretirane barbotinom lakše zadržavati tekućinu, što čini takvu posudu nepropusnom. Posude s propusnom vanjskom stijenkom primaju vlagu iz atmosfere koja se zadržava na vanjskim stijenkama i hladi sadržaj posude. Ovakve posude nisu primjerene za skladištenje ili konzumiranje hrane bez termalne obrade jer na taj način tekućina iz posude nakon kratkog vremena iscuri.

Da bi se poroznost i propusnost smanjila, stijenka posude se često tretira smolama, voskovima ili biljnim sokovima (Rice 1987: 231; Schiffer et al. 1994). Tretiranje posude voskom potvrđeno je kemijskom analizom i na posudama vučedolske kulture o čemu će biti više riječi u drugom dijelu knjige (Poglavlje 15).

Mnoga etnoarheološka istraživanja svjedoče o povećanju vodootpornosti posuda tako da ih se premazuje nakon pečenja, što je uobičajeno za posude koje su pečene na nižim temperaturama. Jedan od primjera potječe iz Ekvadora gdje lončari i dandanas premazuju posude za skladištenje, kuhanje ili serviranje s raznim organskim tekućinama poput smola, rastopljenog voska ili sokova iz lišća biljaka (samostalno ili u kombinacijama), kako bi smanjili njihovu poroznost (Arnold 1985: 140). Zajednica Kalinga na Filipinima (Longacre 1981: 60) premazuje svoje posude smolom bora tako da stvrdnuti komad smole tope na vruću posudu nakon što je maknuta s vatre. Ovaj proces testiran je eksperimentom i pokazalo se da se smola topi na površinu posude kada je posuda maknuta s vatre na temperaturi od 400°C. Rastopljena smola polako se stvrdne na posudi kako se posuda hladi (Schiffer et al. 1994). Tijekom učestale upotrebe i pranja posude smola gubi svoju prvobitnu funkciju, što se događa otprilike nakon 3 mjeseca. Žene u zajednici Kalinga poslije toga više ne koriste ovu posudu za kuhanje jer joj je propusnost povećana te ne dolazi do ključanja vode. Tako posude koje su prije služile za kuhanje u arheološki kontekst dolaze u svojoj sekundarnoj funkciji služeći većinom za skladištenje namirnica (Skibo 2013: 50).

Veličina i oblik pora te njihova količina u velikoj će mjeri utjecati na čvrstoću posude. Što je veća poroznost, manja je čvrstoća posude, a time je i njena trajnost manja. Međutim, ponekad se može dogoditi da pore spriječe ili odgode pucanje keramike tako da ne dopuste širenje lomova (Sinopoli 1991: 13-14). To se događa kada su pore veće te se prilikom pucanja posude lom zaustavi na takvoj „praznini“. Ova će osobina utjecati na maksimalnu otpornost posude na termalne šokove, a najjednostavniji način postizanja većih pora je dodavanje organskih primjesa koje sagorijevaju tijekom pečenja (Rye 1988: 27). Kada organski materijal u glinenoj masi oksidira, prostor koji je prije pečenja bio popunjen ostacima organskih tvari ostaje prazan, a keramika postaje porozna (Goffer 2007: 242). Nadalje, poroznost će utjecati na postotak otpora prema raspadanju i istrošenosti, raznim mehaničkim i kemijskim promjenama, gubitku boje zbog tekućina itd. Isto tako, poroznost povećava apsorpciju ugljika, a to utječe na crnu boju keramike (Shepard 1985: 125-126).

TEKSTURA

Tekstura je prije svega uvjetovana primjesama u glini, njihovom količinom, oblikom i veličinom zrnaca te poroznošću same gline. Promjenjivost veličine zrnaca ovisi o prirodi materijala i načinu pripreme. Neki materijali su korišteni u svom prirodnom obliku dok su drugi zdrobljeni ili pretvoreni u prah (Shepard 1985: 117-121).

6. LANAC OPERACIJA U PROIZVODNOM POSTUPKU IZRADE KERAMIČKIH POSUDA

Moramo upamtiti da su temeljni izvor svakog proizvodnog procesa, koji bi se trebao nalaziti i u središtu naše analize, sami lončari; oni su aktivni subjekti koji donose tehnološke odluke i obavljaju tehničke radnje.

(Sillar & Tite 2000: 9)

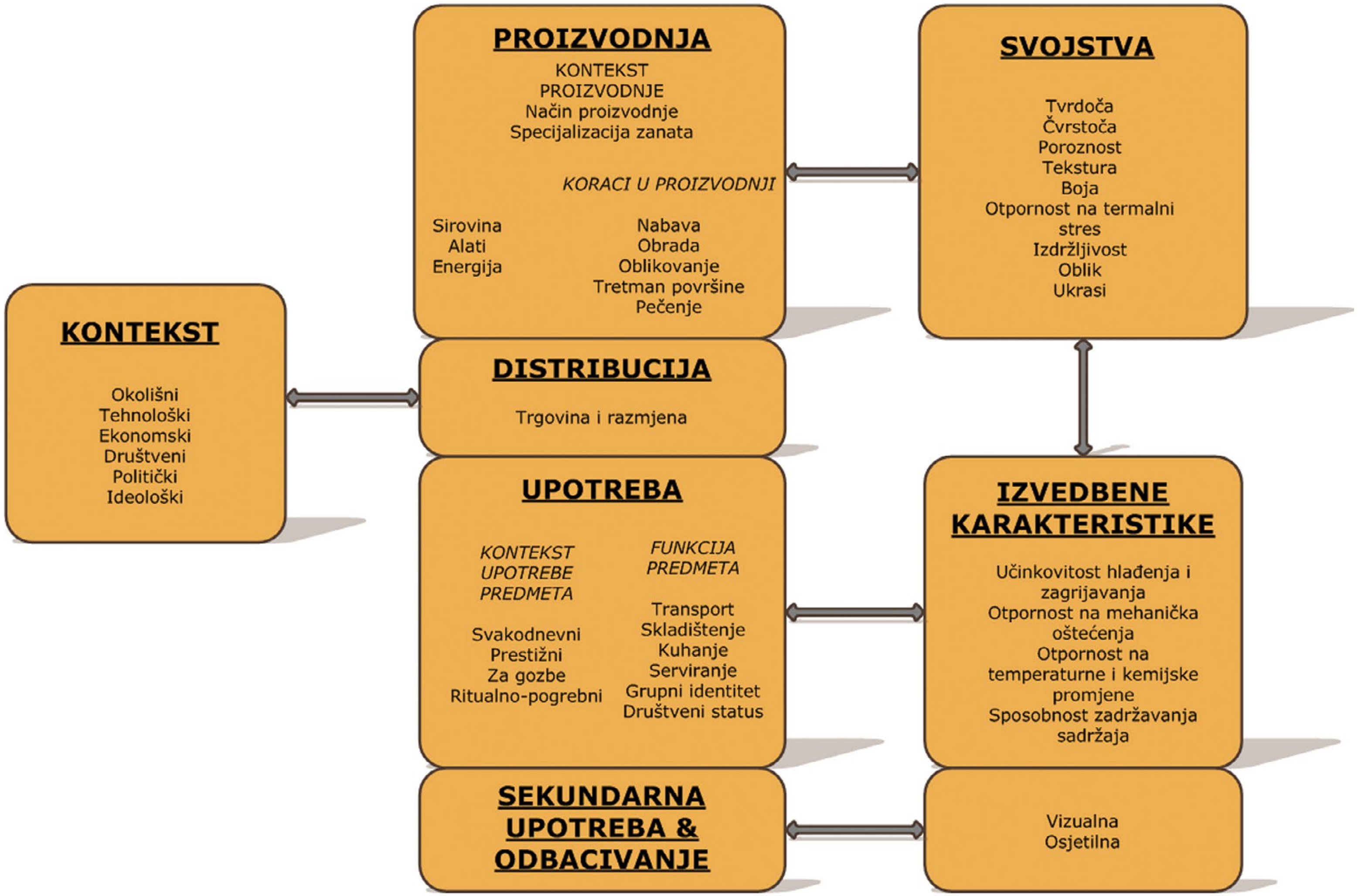
TEHNOLOGIJA I TEHNOLOŠKI IZBOR

Iz prethodnog poglavlja jasno je da izrada svake posude zahtijeva od lončara cijeli niz tehnoloških izbora koji uključuje odabir sirovine (gline) i primjesa, vrstu alata, tehniku izrade te način pečenja. Svaki lončar ili skupina lončara koji na bilo koji način sudjeluju u procesu izrade keramičkih posuda imaju utjecaj na konačan izgled posude. Svi oni imaju nekoliko opcija na raspolaganju kada izrađuju keramičku posudu, a koje svjesno ili nesvjesno odabiru iz nekog određenog razloga (Sillar & Tite 2000). Zadaća arheologa je analizirati i interpretirati tehnološke izbore te istražiti na koji način su se oni razvijali, mijenjali i uklopili u širi društveni koncept.

Jedan od najboljih pristupa je rekonstruirati proizvodni proces analizirajući svaki korak u lancu operacija (*chaîne opératoire*), odnosno seriju tehnoloških sljedova koji transformiraju sirovinski materijal (glinu) u upotrebljiv proizvod (posudu). Ovaj pristup, koji se u istraživanju keramičke tehnologije koristi još od 70-ih godina prošloga stoljeća, omogućio je odmicanje od isključivo tipološke analize keramičkog materijala te otvorio neke nove perspektive (Shepard 1985; Rice 1987; Rye 1988).

Još od prihvaćanja Matsonovog pristupa „Keramičke ekologije“ (Matson 1965) započeo je interes za razumijevanjem keramičke proizvodnje i razloga za njezino mijenjanje kroz vrijeme (za pregled vidi: Tite 1999; Loney 2000). Ovaj procesni način razmišljanja nastojao je utvrditi važnost povezanosti određenih parametara koji su uključeni u proizvodnju i korištenje keramičkih posuda s karakteristikama okoliša (dostupnost i kvaliteta sirovine). U tom smislu naglasak na tehnološki izbor lončara usmjeren je na okolišnu uvjetovanost prije nego na društveni faktor (Albero 2014: 129-130).

Danas se koncept lanca operacija u istraživanju keramičke tehnologije ne može niti zamisliti bez etnoarheologije, arheometrijskih analiza i eksperimentalne arheologije koje nam zajedno omogućuju odgovore na pitanja *zašto* je lončar odabrao baš određeni tehnološki izbor i *koje* su posljedice njegova izbora, u ekonomskom, društvenom i proizvodnom smislu. Proučavanje keramičke tehnologije krenulo je u smjeru analiziranja fizičkih karakteristika gline, primjesa, tretmana površine i uvjeta pečenja koristeći razne arheometrijske analize i naglašavajući njihovu važnost (Tite 1999; 2008; Sillar & Tite 2000; Spataro 2002; Kreiter 2007; Miller 2007). Sredinom 80-ih godina razni eksperimenti usmjereni su na pitanja kako individualni tehnološki izbori, poput izbora primjesa i tretmana površine, utječu na konačne karakteristike posude (Bronitsky & Hamer 1986; Schiffer & Skibo 1987; Skibo et al. 1989; Schiffer et al. 1994; Schiffer 2004; Pierce 2005). Skibo i Schiffer (Schiffer 1975; Skibo & Schiffer 2008) između ostalog predlažu koncept „lanca aktivnosti“ (eng. *behavioral chain*). Za razliku od lanca operacija koji podrazumijeva isključivo proces izrade posude (Lemonnier 1986), ovaj koncept slijedi predmet, aktivnosti i inte-



Slika 2 – prikaz najvažnijih međuodnosa koji utječu na tehnološki odabir u keramičkoj proizvodnji (prema Sillar & Tite 2000: 6, Sl. 1)
Fig. 2 – Overview of the most important interrelationships affecting the technological choices made in pottery production (according to Sillar & Tite 2000: 6, Fig. 1)

rakciju proizvodnje, reupotrebe, recikliranja i konačnog odbacivanja. Iako su međusobno povezani, ovaj pristup posebno je koristan kod analize tragova korištenja na posudi.

Etnoarheološka istraživanja dodatno su unaprijedila razumijevanje funkcioniranja društva u prošlosti jer su idealan okvir za proučavanje veza između prošlosti i sadašnjosti, a isto tako nam pomažu da testiramo određene teoretske okvire i interpretacije (Kramer 1985; Gosselain 1992; Gosselain & Livingstone Smith 1995; Stark 1998; 1999; 2003; Roux 2003; 2011). Poseban doprinos etnoarheologije ide u smjeru definiranja organizacije proizvodnje i specijalizacije zanata pomažući nam da bolje razumijemo u kojoj mjeri su keramičke posude posljedica društvene interakcije između lončara ili grupe lončara (Arnold 1985; 1991; 2000; Stark 1991; Costin 2000). Ova pitanja često su nevidljiva u arheološkom zapisu, posebno kada je riječ o vezi između ponude i potražnje, podjele poslova ili načina distribucije. O ovom segmentu će biti više riječi u drugom dijelu knjige (Poglavlje 17).

Izrada keramičkih posuda, odnosno lanac operacija može se podijeliti u 7 faza koje su međusobno povezane i u interakciji su s društvom u kojoj su se proizvodile. Linearna analiza nikako nije dovoljna jer svaki je tehnološki izbor uvjetovan nizom različitih društvenih, ekonomskih, ideoloških i tradicijskih faktora, koji oblikuju kulturnu percepciju o tome koje su opcije raspoložive (Sillar & Tite 2000) (*Slika 2*). Tehnologija izrade keramike zasniva se na odabiru i pripremi sirovine, tehnici izrade, modifikaciji i dovršavanju posude te ukrašavanju površine. Ona će ovisiti o vrsti gline te vještini, znanju, navikama i afinitetu majstora koji je izrađuje (Banning 2000: 161).

NABAVA I PRIPREMA GLINE ZA OBRADU

Nabava sirovine za izradu proizvoda prvi je korak u tehnološkom izboru lončara. Istraživanja koja se bave tehnološkim procesima i promjenama već su odavno ustanovila da se glina nije vadila slučajno, tek tako, odnosno da je lončar namjerno i selektivno odabirao određenu glinu iz određenog razloga na osnovi njezinih svojstava (Costin 2000).

Nabava gline ovisi o različitim faktorima, u prvom redu o karakteristikama okoliša (geološke i topografske značajke krajolika) i blizini dostupne sirovine, o sposobnosti lončara da prepozna kvalitetnu glinu i njegovu znanju da iz nje oblikuje kvalitetnu keramičku posudu koja će služiti određenoj svrsi. Ostali sekundarni faktori koji utječu na nabavu sirovine mogu biti povezani s kontrolom sirovine, ograničenjem pristupa sirovini, socijalnim statusom lončara, ideološkim i tradicijskim uvjerenjima, organizaciji naselja itd. (Arnold 2000; Costin 2000; Livingstone Smith 2000; Sillar & Tite 2000; Stark 1999; 2003).

Različiti tehnološki izbori lončara objedinjeni su u recepturi glinene, odnosno lončarske smjese, kojom se regulira proces izrade posuda. One su rezultat znanja i iskustva lončara, niza društvenih normi te tehnoloških i tradicijskih praksi. Promjene u keramičkoj tehnologiji, koje utječu i na recepturu, mogu biti uvjetovane društvenim ili okolišnim promjenama, načinom učenja te transferom znanja koje se prenosi s generacije na generaciju kroz prostor i vrijeme. S druge strane, mnoge recepture ostaju nepromijenjene kao rezultat društvenih praksi, iskustva i kulturne tradicije. Izravna posljedica tehnološkog izbora lončara su različiti koraci u proizvodnji keramičkih posuda.

Proučavanje recepture lončarske smjese postala je uobičajena metodologija u istraživanju keramičke građe jer se odmiče od same klasifikacije i opisa keramike, a približava se konceptu tehnološkog izbora koji su lončari koristili u svakodnevnom životu (Albero 2014a).

Nabava gline uključuje vađenje i transportiranje gline do mjesta gdje će se ona obrađivati, pa je zbog toga najčešće riječ o glini iz neposredne okolice naselja (Gibson & Woods 1997). Novija etnoarheološka istraživanja kao prosječnu udaljenost eksploatiranja gline (od mjesta gdje se vadi sirovina do mjesta izrade posuda) navode 3-4 km. Na temelju većeg istraživanja kojim je obuhvaćeno određivanje udaljenosti do mjesta vađenja gline i primjesa predlažu se tri limitirana stupnja energije koje lončar ulaže da bi se opskrbio glinom. Udaljenost koju preferira većina zajednica je 1 km. Drugi stupanj uložene energije, odnosno duljina puta koju lončar treba prijeći je 3 km za nabavu primjesa i 4 km za nabavu gline. Najveća udaljenost je 7 km za nabavu primjesa i gline (Arnold 2000).

Blizina dostupne i kvalitetne sirovine omogućuje lončaru da veći dio uložene radne energije upotrijebi za izradu i oblikovanje posuda, a ne za put do mjesta nabave sirovine. U slučaju da se radi o udaljenijoj lokaciji lončari su glinu mogli skladištiti, jer glina može biti pohranjena od nekoliko mjeseci do čak godinu dana, a da pritom ne izgubi potrebne kvalitete za obradu. Naravno, to zahtijeva odgovarajući način skladištenja jer glina mora biti u mokrom stanju (zamotana u biljna vlakna ili neku vrstu tekstila) i pohranjena na hladno mjesto, a pritom izbjegavajući rizik od smrzavanja. Ovakvi uvjeti omogućuju da glina ostane relativno mokra čak i bez prethodne pripreme te spremna za obradu kada se za to pokaže potreba (Albero 2014: 66). Etnološka istraživanja na području Slavonije, u selu Golo Brdo kraj Požege, pokazuju da su stari lončari glinu vadili ujesen i proljeće te je pohranjivali u podrume, dok su se ljeti bavili lončarenjem. U ovom slučaju radi se upravo o jako udaljenoj lokaciji jer su lončari iz Golog Brda po kvalitetnu glinu putovali čak 18 km (Lechner 2000: 297).

Prema podacima iz etnoarheoloških istraživanja može se pretpostaviti da je udaljenost koju lončar treba prijeći za nabavu sirovine i na prapovijesnim nalazištima bila minimalna te da je glina u naselje dolazila u poluvlažnom stanju. Neka etnoarheološka istraživanja pokazuju da se na područjima gdje postoje ležišta aluvijalnih glina ona vadila u neposrednoj okolici naselja, odmah čistila od većih inkluzija šljunka i organskog materijala te da se u naselje transportirala već oblikovana u kugle, spremna za oblikovanje posuda (Rice 1987: 121). Jedan od primjera dolazi iz Laosa, gdje se nakon vađenja glina ostavljala na suncu da se posuši, potom se razbija i čisti od raznih „neželjenih" primjesa te miješa s vodom (Shippen 2005).

Glina se vadi kopanjem vertikalnih jama, prvo odstranjujući humusni dio koji pokriva i kontaminira glinu, a na bregovitim područjima kopa se direktno iz profila, odnosno padine. Jame mogu biti duboke od 1 do 8 m. Priprema gline zahtijeva čišćenje od raznih organskih i mineralnih tvari koje se u njoj prirodno nalaze (> 5 mm) ili njihovo dodavanje kako bi se poboljšala kvaliteta smjese (Albero 2014). Što je više potrebno modificirati glinu kako bi se dobio konačni proizvod to će više biti načina njezine pripreme, što na kraju rezultira velikim rasponom receptura lončarske smjese. Isto, naravno, vrijedi i obratno (Roux 2011: 81). S druge strane, neke gline ne trebaju nikakvu modifikaciju prije pripreme za obradu (Knappett 2005: 678).

Mnoga etnoarheološka istraživanja svjedoče da lončari ne dodaju nikakve primjese u glinenu smjesu, kao npr. Kalinga lončari na Filipinima (Longacre 1981: 54; Stark et al. 2000), lončari u istočnim planinama Gvatemale (Rice 1987: 121) ili u Japanu (Velde & Druc 1999: 144). Jedini preduvjet dobre gline je da bude dovoljno plastična za daljnju obradu. Međutim, neke zajednice u centralnom Kamerunu kao prvi kriterij za daljnju eksploataciju gline gledaju njezinu boju (bijela, zelena, smeđa), a potom plastičnost. Pritom svaki lončar uzima glinu po vlastitom izboru i željama, peče testnu posudu od prikupljene sirovine i tek se potom odlučuje je li glina dovoljno dobra za daljnju eksploataciju (Gosselain 1992: 565). Neke zajednice miješaju nekoliko vrsta gline kako bi dobili željenu kvalitetu, tako u istočnom Peruu za izradu vrčeva i zdjela miješaju tri vrste gline (bijelu, crvenu i crnu) i tri vrste primjesa (Rice 1987: 121), a ponekad samo dvije (Velde & Druc 1999: 149). Tradicionalni lončari u Japanu također miješaju nekoliko vrsta gline kako bi dobili željene rezultate (Velde & Druc 1999: 144), dok u Kamerunu (Wallaert-Pêtre 2001: 477) i zapadnoj Keniji (Dietler & Herbich 1989: 152) neke zajednice također koriste dvije vrste gline. U Gvatemali koriste različite vrste glina za različitu funkciju, tako žutu glinu koriste za izradu velikih posuda za skladištenje, a bijelu za ostale tipove posuda (Arnold 2000). Sličan primjer zabilježen je i u Slavoniji gdje su tradicionalni lončari u selu Feričanci kraj Osijeka koristili tri vrste gline koje su vadili na tri različite lokacije udaljene od 1 do 3 km od naselja. Žutu glinu, koja je bila najslabije kvalitete, koristili su za sve vrste posuda osim za posude koje idu na vatru i njoj nisu dodavali nikakve primjese. Bijeloj glini, koja je bila najbolje kvalitete, također nisu dodavali nikakve primjese jer „u sebi ima svog kamena", odnosno pijeska. Od plave gline radili su isključivo posude koje su služile za kuhanje i jedino su ovoj vrsti gline dodavali primjese prosijanog riječnog pijeska jer je glina bila „lijena", odnosno nije bila „rastezljiva" (Lechner 2000: 333-334). Porijeklo gline, odnosno nabava sirovine stoga se ne bi trebala uzimati zdravo za gotovo jer izbor lončara, kao što smo vidjeli, nije isključivo vezan za blizinu dostupne kvalitetne sirovine već ovisi o nizu međusobno uvjetovanih faktora.

NABAVA I PRIPREMA PRIMJESA

Namjerno dodavanje raznih primjesa u glinu (minerala, organskih tvari) kako bi se poboljšala njezina kvaliteta, ovisi o vrsti prirodne gline, konačnom obliku i funkciji posude koja se želi dobiti. Različite primjese tako povećavaju poroznost, smanjuju sakupljanje i deformacije tijekom sušenja, eliminiraju mikropukotine i poboljšavaju performanse tijekom pečenja (Bronitsky & Hamer 1986: 90; Rice 1987: 74).

Najčešće namjerno dodavane primjese razne su vrste neplastičnih materijala poput pijeska (kvarc, vuklanski pijesak), šljunka (razni litoklasti), organskih materijala (lišća, smrvljenih školjki) i groga. O karakteristikama najčešće dodavanih primjesa već je bilo riječi u prethodnim poglavljima.

Nakon što je lončar odabrao glinu i primjese koje će u nju dodati slijedi miješanje gline i primjesa s vodom da bi se dobila homogena smjesa koja će omogućiti glini plastičnost potrebnu za obradu.

OBLIKOVANJE PRIPREMLJENE GLINENE SMJESE U ODREĐENI OBLIK

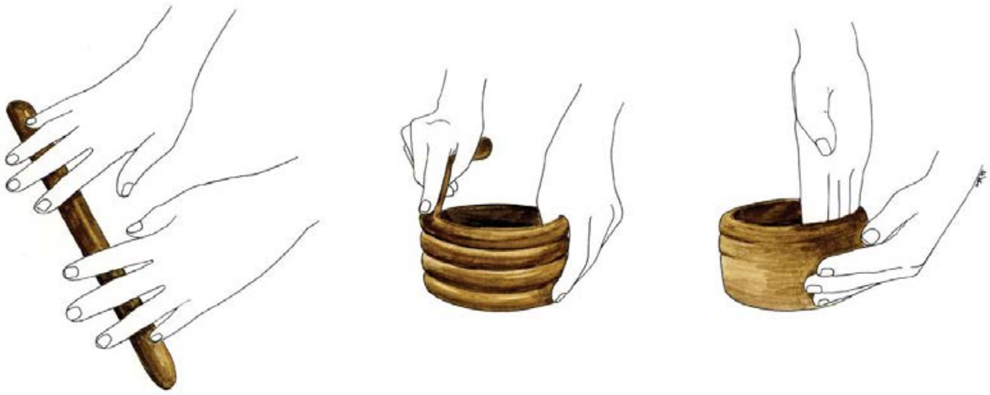
Prije oblikovanja glinene smjese u oblik koji se želio dobiti, pazilo se da smjesa odgovara funkciji buduće posude. Lončar se također vodio tradicijom i potrebama zajednice za određenim proizvodom (oblikom posude). Ovisno o određenom dobu godine i gospodarskim aktivnostima zajednice potreba i potražnja za određenom vrstom posude bila je veća ili manja. Već je naznačeno da tehnološki izbor poput odabira vrste ili količine primjesa može utjecati na mnoge druge karakteristike kako u izradi tako i u upotrebi posude. Npr. posude za kuhanje imaju veću količinu primjesa pa je i njihova izrada mnogo zahtjevnija. Stoga je na lončaru da pronađe optimalno rješenje kako bi zadovoljio sve potrebne karakteristike posude.

Nakon pripremljene smjese lončar pristupa izradi željenog oblika posude koristeći jednu od tri prostoručne tehnike oblikovanja:

a) tehniku izvlačenja iz grude gline (eng. *pinching*) koja je primjerena za oblikovanje manjih posuda s ovalnim ili okruglim dnom. U ručno oblikovanu okruglu glinenu masu pritisne se palac, a drugom rukom se ona vrti, tako da se vrtnjom i stiskanjem stvaraju stijenke buduće posude i time određuje njezina visina i debljina (*Slika 3*).

Slika 3 – Tehnika izvlačenja oblika posude iz grude gline.
Fig. 3 – Technique of pinching a vessel shape from a lump of clay

b) tehniku oblikovanja s pomoću glinenih prstenova (ili kobasica) kojom se izrađuju jednostavne nesimetrične posude mekih profila (eng. *coil building*). Navoji su izrađeni valjanjem gline horizontalno po podlozi ili vertikalno među dlanovima (*Slika 4, 6*).



Slika 4 – Tehnika oblikovanja posude s pomoću glinenih prstenova.
Fig. 4 – Coil-building technique

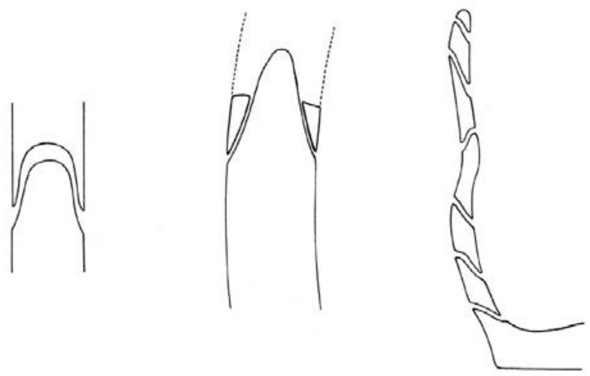
c) tehniku gradnje s pomoću glinenih traka (eng. *slab building)* koju su koristili za izradu izrazito profiliranih posuda (Zlatunić 2005: 70-71) (*Slika 5, 7*).

Slika 5 – Tehnika oblikovanja posude s pomoću glinenih traka
Fig. 5 – Slab-building technique

Svaka od navedenih tehnika ostavlja tragove na unutrašnjoj i/ili vanjskoj strani posude po kojima možemo prepoznati tehnologiju izrade posude. Kompleksnost procesa oblikovanja posude i njezina važnost u keramičkoj proizvodnji može se proučavati mikroskopski i makroskopski, ako je moguće kombinacijom obje metode. Mikroskopske analize uključuju proučavanje keramičkih izbrusaka, posebno na mjestima gdje se spajaju glinene trake ili prstenovi te uočavanje orijentacije primjesa i pora koje također ukazuju na određenu tehniku izrade (Albero 2014: 77-79).

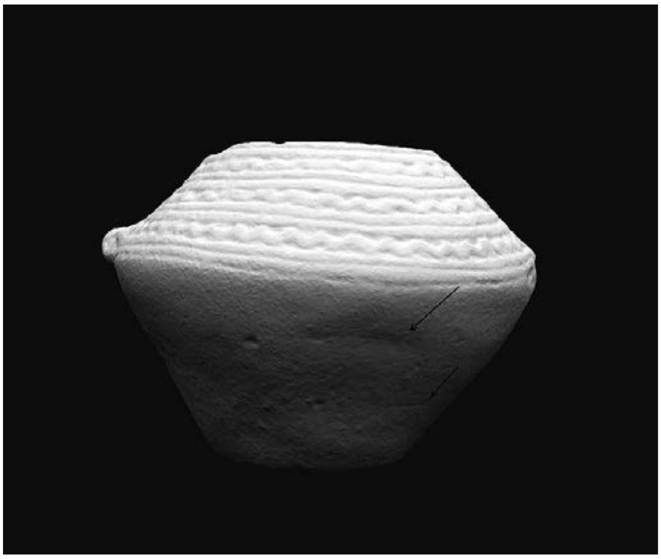
Određena tehnika oblikovanja može biti vidljiva po načinu i mjestu pucanja posude, odnosno nastajanju lomova (*Slika 6, 7*). Iako posuda obično puca na mjestima koja su „najstresnija", odnosno gdje su komadi gline spojeni zajedno u različitim stupnjevima plastičnosti, mjesta lomova posebno su prepoznatljiva kod posuda koje su izrađene tehnikom glinenih traka i prstenova (Albero 2014; Vuković 2014).

Način oblikovanja na nekim posudama vidljiv je i prostim okom, dok neke posude zahtjevaju više pažnje i analize kako bi se uočila tehnika oblikovanja. Dobar primjer je posuda s lokaliteta u Ul. M. Gupca 8a na kojoj je uočena tehnika oblikovanja s pomoću glinenih prstenova (kobasica) tek nakon što je napravljen fotogrametrijski model u softveru *Agisoft PhotoScan*. Finalni model (eng. *Mesh*) koji se sastoji od 645 761 poligona izveden je u programu *MeshLab* u kojem



Slika 6 – Shematski prikaz tehnike oblikovanja posude s pomoću glinenih prstenova i mjestima nastajanja lomova (prema Horvat 1999: 19, Sl. 2a-c)
Fig. 6 – Schematic depiction of the coil-building technique and fracture points (according to Horvat 1999: 19, Fig. 2a-c)

Slika 7 – Shematski prikaz tehnike oblikovanja posude s pomoću glinenih traka i mjestima nastajanja lomova (prema Horvat 1999: 19, Sl. 3b)
Fig. 7 – Schematic depiction of the slab-building technique and fracture points (according to Horvat 1999: 19, Fig. 3b)



Slika 8 – Fotogrametrijski model posude s lokaliteta u Ul. M. Gupca 8a izrađen u softveru Agisoft PhotoScan. Strelice pokazuju mjesta spajanja glinenih prstenova.
Fig. 8 – Photogrammetric model of a vessel from the site at 8a Matija Gubec Street, produced by the Agisoft PhotoScan software program. The arrows point to joints of clay coils.

je osvijetljen iz različitih kutova. Na slici se jasno vide tragovi oblikovanja posude koji nisu bili uočljivi na posudi prilikom obrade (*Slika 8*).

U ovu fazu izrade keramičke posude spada i uklanjanje nesavršenosti prije procesa sušenja, odnosno modifikacija oblika. Ovaj korak vrlo često se može zamijeniti s tretiranjem površine, a zapravo je riječ o finaliziranju oblika posude i uklanjanju nesavršenosti na unutrašnjoj i vanjskoj strani (neujednačene stijenke, micanje viška gline s posude, prikrivanje pukotina itd.). Ovaj dio procesa oblikovanja uključuje dovršavanje posude kada je stanje gline postiglo tvrdoću kože (eng. *leather-hard*), odnosno nije ni suho ni vlažno. Može se raditi rukom ili alatima od drva, kamena (oblutak) te mokrim tekstilom.

Upotreba lončarskog kola u proizvodnji posuda također je prepoznatljiva i vidljiva na površini posude. Spororotirajuće kolo uglavnom se koristilo za završnu fazu obrade posude napravljane prostoručnom tehnikom, a rotacijska naprava kao pomagalo služila je za dovršenje oblikovanja posude. Jedan od najranijih zapisa uporabe rotirajuće naprave, koji se mogao izvesti na četiri načina, jest izrada posude tehnikom nizanja traka, te finaliziranje obrade tehnikom oblikovanja na sporom lončarskom kolu koja uključuje stanjivanje stijenki i oblikovanje ruba (Roux 1998: 749).

Izrada posuda s pomoću kalupa još je jedan od načina oblikovanja posuda, a koji se i danas može pratiti kod tradicijskih lončarskih zajednica. Kalup može biti konkavan ili konveksan, ovisno o tome stavlja li se glina preko ili u kalup, a njime se može oblikovati cijela posuda ili samo jedan njezin dio (najčešće donji). Kalupi mogu biti posebno izrađeni od gline ili drveta, ili od već iskorištenih dijelova slomljenih keramičkih posuda (Rice 1987: 126).

SUŠENJE

Dodavanje vode u glinovitu smjesu potrebno je da bi se dobila željena smjesa pogodna za oblikovanje posude. Količina vode koju glina može primiti obično se kreće između 15-50% njezine težine (Albero 2014: 80). Proces sušenja dosta je osjetljiv te može izazvati pucanje i deformaciju posude ako se ne provodi na zadovoljavajući način. Većina deformacija na posudi tijekom sušenja događa se zbog vode. Naime, voda koja glinu čini plastičnom tijekom sušenja ishlapi, a čestice gline tada se približe jedna drugoj i posuda se uslijed takvog procesa stisne.

Različite gline suše se različitom brzinom. Gline s grubo zrnatom strukturom (poput kaolinita) suše se puno brže od onih koje imaju veću plastičnost i finiju strukturu (montmoriloniti). Vrijeme sušenja ovisi o veličini kapilara kroz koje voda izlazi na površinu i ishlapljuje. Kako se posude smanjuju, odnosno skupljaju tijekom sušenja, deformacije i lomovi javljaju se kada se jedan dio posude suši brže od drugog. Isto tako, ako se posude suše na suncu, isparavanje vode na vanjskoj strani posude bit će brže nego u unutrašnjosti, što će uzrokovati brže sakupljanje vanjskog dijela posude. Zato se sušenje treba odvijati na mjestu koje nije direktno izloženo suncu, barem u početnoj fazi (Rye 1988: 21-24).

Sušenje posude može trajati od nekoliko dana do nekoliko tjedana, ovisno o karakteristikama gline, debljini stijenki, godišnjem dobu i načinu na koji je pripremljena lončarska smjesa (Albero 2014: 80).

TRETIRANJE POVRŠINE

Tretiranje površine posljednji je korak prije samog pečenja posude i obično se radi na kraju faze sušenja. Ovaj korak u keramičkoj proizvodnji uključuje zapravo dvije radnje, a to su tretiranje površine i ukrašavanje, koje za razliku od prethodnog ima isključivo dekorativni karakter. Osim uobičajenog mišljenja da tretman površine ima isključivo estetsku vrijednost on itekako utječe na performanse posude i stvar je tehnološkog izbora lončara: smanjuje propusnost, povećava učinkovitost zagrijavanja i otpornost na mehanička oštećenja (Skibo 2013: 47-51).

Eksperimenti i analize pokazali su da posude za kuhanje koje imaju tretiranu vanjsku i unutrašnju stranu imaju veću otpornost na termalne šokove. S druge strane, teksturirane površine negativno utječu na sposobnost zagrijavanja u slučajevima kada posude imaju visoku propustljivost (Young & Stone 1990). Unutrašnjost posude najčešće se glača, dok se vanjska strana tretira težim teksturama, poput barbotina. Najčešći oblik tretiranja površine je glačanje ili djelomično glačanje kako bi se zatvorile pore na površini, a posuda postala manje porozna. Ova tehnika se izvodi trljanjem čvrstog alata (najčešće oblutka) o keramičku površinu u stanju kada je glina postigla tvrdoću kože, pri čemu posuda dobiva visoki sjaj (Velde & Druc 1999: 85). Glačanjem se minerali približavaju jedni drugima, orijentirajući se paraleleno sa stijenkom posude što zaustavlja širenje pukotina kroz tijelo posude. Posude s tretmanom unutrašnje strane posude postaju vodootporne, imaju veći efekt zagrijavanja i veću otpornost na termalne šokove pa i ne čudi što su posude za kuhanje tretirane na ovakav način na svim geografskim prostorima i u vremenskim razdobljima (Skibo 2013: 52). Posude za kuhanje u pravilu su pečene na nižim temperaturama te će one posude koje nemaju tretiranu unutrašnju stranu biti vodopropusne i imati smanjeni efekt zagrijavanja, što ne odgovara namjeni za koju je posuda predviđena.

Kod prapovijesne keramike jedan od također uobičajenijih načina tretiranja površine je tehnika barbotina, odnosno „ogrubljivanja“ površine. Tehnika barbotina izvodi se tako da se prije pečenja površina predmeta premaže glinom razrijeđenom u vodi ili glinom u polutekućem stanju te se ravnomjerno razmaže po površini stisnutim ili rastvorenim prstima. Zbog takvog oblikovanja na površini nastaju različiti visoki „grebeni“ ovisno o debljini nanesene polutekuće gline. Tretiranje posude barbotinom zapravo ima više funkcionalni nego dekorativni karakter, što dovodi u pitanje njezino tradicionalno kategoriziranje u tehnike ukrašavanja.

Već smo u prethodnom poglavlju napomenuli da tretiranje vanjske strane jačom teksturom, poput barbotina, povećava otpornost posude na termalna pucanja i lomove, te mehanička oštećenja (Schiffer et al. 1994; Skibo & Schiffer 1995). Ovaj podatak išao bi u prilog činjenici što je na većini posuda vučedolske kulture obrađenih u ovoj knjizi, a koje spadaju u kategoriju lonaca (posuda koje su služile za termičku obradu hrane) tijelo tretirano barbotinom. Zbog svoje „reljefne“ površine ovakve posude lakše su za prenošenje jer prsti prilikom nošenja lakše prijanjaju u grebene koje ostavlja gruba, neravna vanjska površina nakon pečenja.

Uobičajeno je da ova vrsta posuda kod arheologa ne izaziva „oduševljenje“ jer se smatra ružnom, nezgrapnom i apsolutno nezanimljivom. Međutim, upravo ovakve posude pokazuju tehnološko umijeće lončara ili kako je naglasio J. M. Skibo (1995; 2013) „tehnološku sofisticiranost“. Posude za kuhanje, kao što je već i naglašeno, iziskuju puno više truda, znanja, vještine, vremena i tehnološkog znanja nego ostale posude koje su možda estetski oku ugodnije. Može se reći da je poseban interes za posude za kuhanje, odnosno one „ružnije“ keramičke ulomke, zapravo ključna veza među onim arheolozima koji nastoje rekonstruirati keramičku proizvodnju proučavajući neke druge aspekte, a ne samo tradicionalne tipološko-kronološke okvire.

Razne vrste premaza (slipova) također su dio tretmana površine prije pečenja. Slip je tekuća suspenzija gline (i/ili drugih materijala) u vodi koja se prije pečenja u tankom sloju nanosi na čitavu površinu posude čime se smanjuje propusnost stijenki (Rice 1987: 149).

Razne vrste dekorativnog ukrašavanja također su dio tretiranja površine prije završnog procesa pečenja. Tehnike ukrašavanja mogu imati više funkcija, osim estetske mogu imati i praktičnu uporabnu funkciju, pa tako neke tehnike mogu više utjecati na modifikaciju oblika, a manje na površinu posude (Rice 1987: 144). Različite tehnike zahtijevaju različito stanje gline (meka, polutvrda, tvrda). Tehnike koje se koriste na sirovoj, nepečenoj površini su: *urezivanje, utiskivanje, apliciranje, modeliranje, inkrustiranje i slikanje.* Tehnika urezivanja može se podijeliti na još nekoliko varijanti, a to su žlijebljenje, kaneliranje, pravilno urezivanje, metličasto urezivanje, brazdasto urezivanje, rovašenje (duboko urezivanje) i ubadanje. Ove tehnike međusobno se razlikuju po vrsti i obliku alata (okrugli, šiljasti, uglati), pritisku na tretiranu površinu (pod pravim ili oštrim kutom), stanju gline (meka, polutvrda, tvrda) te iskustvu i afinitetu majstora (Horvat 1999: 29-30). Ovdje će biti nabrojane samo one tehnike koje su korištene na obrađenom materijalu u drugom dijelu knjige.

Tehnike urezivanja:

Pravilno urezivanje - radi se alatom oštrog vrha koji se pod oštrim ili pravim kutom snažno pritiskuje, tako da reže površinu gline. Presjek urezanih linija ima oblik pravilnog ili asimetričnog slova „V". Efekti dobiveni urezivanjem znatno se razlikuju s obzirom na stadij sušenja. Tako izdignuti i nepravilni rubovi ukazuju na mokru površinu, čiste linije znače da je urezivanje napravljeno na polutvrdoj površini (eng. *leather-hard*), a tanke i vrlo plitke linije ukazuju na vrlo suhu površinu (*Slika 9*).

Brazdasto urezivanje – kombinacija je tehnike urezivanja i utiskivanja. Tupim vrhom šila urezuju se u polutvrdu površinu kratke linije, a nakon toga se po istoj liniji šilo povlači natrag u kraćim razmacima. Na kraju se na keramici ne vide tragovi urezivanja nego linije s plitkim ili dubokim otiscima (udubljenjima) u koje se najčešće stavlja inkrustacija. Zbog toga se ova tehnika većinom stavlja u varijante tehnike utiskivanja.

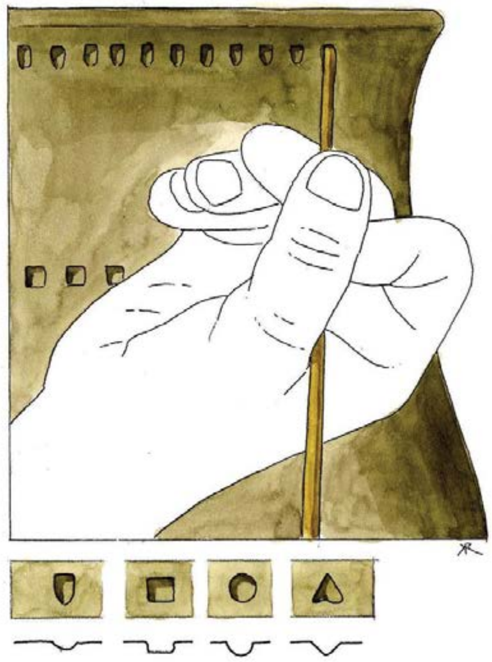
Žlijebljenje – radi se alatom tupog kraja pod oštrim ili pravim kutom. Presjek urezanih linija ima oblik pravilnog ili asimetričnog slova „U". Žlijebljene linije su uglavnom duboke i široke, iako mogu biti plitke i uske.

Rovašenje – ova tehnika odgovara osnovnim kriterijima tehnike urezivanja. Uskim alatom zareže se površina predmeta, a nakon toga se izdubi, odnosno izreže okolna površina motiva. Ta se površina potom izravna, zagladi ili ispuni inkrustacijom. Ovom tehnikom odstranjuje se glinasta masa s predmeta (*Slika 10*).

Ubadanje – ubodi se utiskuju u polutvrdu glinu alatom tupog kraja koji ostavlja različite motive po površini keramike. Motivi se razlikuju ovisno o vrsti i obliku alata te kutu i jačini pritiska na tretiranu površinu. Najčešći motivi koji se dobiju tehnikom ubadanja su: duguljasti, četvrtasti, okrugli i trokutasti (*Slika 11*).

Slika 9 – tehnika urezivanja
Fig. 9 – Incision technique

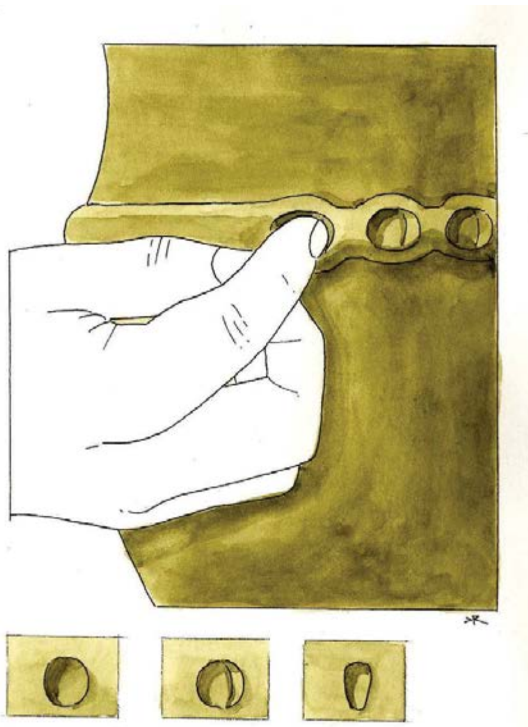
Slika 10 – Tehnika rovašenja
Fig. 10 – Notching technique



Slika 11 – Tehnika ubadanja
Fig. 11 – Puncturing technique

Tehnika utiskivanja:

Utiskivanjem se intervenira u površinu predmeta, tako da je ostala površina posude izdignuta i reljefna. Alatom se utiskuje u polutvrdu glinu na kojoj ostaje negativ motiva koji zovemo otisak. Utiskivanje može biti izvedeno i na apliciranoj traci. Izbor alata za utiskivanje je velik, od onih lako dostupnih poput prsta, nokta, školjke, sjemenki, stabljike do posebnih instrumenata koji su napravljeni za izradu motiva (*Slika 12*).



Slika 12 –Tehnika utiskivanja
Fig. 12 – Impression technique

Tehnika apliciranja:

Tehnika apliciranja radi se na polutvrdim površinama na koje se stavljaju polutvrde aplikacije. Na rubovima ili površini oko aplikacije (na području dodira aplikacije i površine predmeta) često se pojavljuju deformacije kao što je razmazana glina.

Tehnika apliciranja može imati funkcionalnu i dekorativnu karakteristiku. Postoji više vrsta aplika, od raznih izbočina, traka, ušica, gredastih izbočenja koje se apliciraju na određene dijelove posude, a mogu se izvlačiti iz tijela posude ili izrađivati u kalupu te naknadno dodavati na posudu (Horvat 1999: 37-38). Eksperimenti su pokazali da lončari brončanodobne Virovitičke grupe konične bradavičaste aplikacije izvode iz kalupa direktno na stijenku posude ostavljajući pravilan okrugli urezani trag (žlijeb oko bradavice) (Kudelić 2015). Razne vrste aplika na stijenkama posude svoju funkcionalnost imaju u smislu pridržavanja i lakšeg rukovanja posudom.

Tehnika modeliranja:

Modeliranje se odnosi na dodavanje gline na već postojeći oblik posude kako bi se oblikovala u trodimenzionalnu dekoraciju. Glina se dodaje na polutvrdu površinu i oblikuje se prstima ili određenom vrstom alata. Površina posude počinje se modelirati zajedno s oblikovanjem iste posude. Plastične aplikacije imaju razne varijante geometrijskih oblika te antropomorfnih i zoomorfnih figura (Rye 1988: 94; Horvat 1999: 39). Tehnika modeliranja primjenjuje se i za razne vrste drški.

Tehnika inkrustiranja:

Ova tehnika ne koristi se samostalno već u kombinaciji s tehnikom brazdastog urezivanja i rovašenja, gdje se u izdubljenu ili urezanu površinu stavlja inkrustacija načinjena od različitih materijala (*Slika 56*). Bijela inkrustacija dobivala se od smrvljenih školjki, vapnenačkih stijena ili životinjskih kostiju, dok su se za crvenu boju koristile smjese bogate metalnim oksidima (npr. hematit). Arheometrijske analize provedene na bijeloj inkrustaciji kostolačke, vučedolske i panonske inkrustirane keramike pokazale su da je bijela boja dobivena od praha jelenskog roga i ljuštura slatkovodnog školjkaša iz roda unionida (*Unio Sp.)* (Kos et al. 2013).

Tehnika slikanja:

Slikanje se može raditi na pečenoj i nepečenoj posudi. Za boje se koriste spojevi željeznog oksida koji pri oksidaciji daju različite boje nakon pečenja, npr. hematit će dati crvenu boju, manganovi spojevi smeđu, a u kombinaciji s grafitom crnu boju (Horvat 1999: 41-42).

PEČENJE

Pečenje je završni proces izrade keramičke posude o kojem su u velikoj mjeri ovisne karakteristike predmeta. S obzirom na to da je ovaj segment neponovljiv za lončara on predstavlja najvažniji korak u proizvodnom procesu. Tijekom pečenja događaju se razne fizičko-kemijske promjene na materijalu koje utječu na konačni izgled i svojstva posude. Dva su glavna čimbenika koja određuju završna mikrostrukturalna obilježja posude: glinena smjesa i način pečenja (Albero 2014: 87).

Svrha pečenja je da se keramika izloži dovoljno visokoj temperaturi na isto tako dovoljno vremena kako bi se osiguralo potpuno uništenje minerala u glini. Pri visokim temperaturama predmeti dobivaju na tvrdoći, boji i kvaliteti. Minimalna temperatura varira za različite minerale, najniža počinje od 500°C, a najviša od oko 800°C. Kada se zagrijava iznad ovih temperatura glina poprima karakteristike keramike, a to su čvrstoća, poroznost i otpornost na razne kemijske i fizičke promjene (Rye 1988: 96).

Promjene, koje se događaju za vrijeme pečenja, ovisne su o:

- *vremenu*, odnosno dužini stupnja zagrijavanja koji je potreban za kemijske reakcije
- *temperaturi* – kemijske reakcije uslijedit će pri točno određenoj temperaturi, a prekoračenje optimalne temperature može izazvati deformacije i lomove na posudi

- *atmosferi* (pri zagrijavanju i hlađenju) – nju određuje količina dostupnog zraka pri pečenju koja je potrebna za izgaranje određene količine goriva (Horvat 1999: 46)

Različite gline i glineni minerali ponašaju se drugačije kada su izloženi određenom stupnju zagrijavanja, što ovisi o njihovu kemijskom sastavu, kao i o atmosferi, vremenu i načinu pečenja. Unatoč tim razlikama moguće je izdvojiti neke općenite karakteristike koje se odnose na promjene i reakcije u strukturi posude kada je izložena zagrijavanju:

- zagrijavanje do 200°C - u početnoj fazi pečenja keramike, kada se zagrijavanje odvija od sobne temperature do 200°C, iz glinene mase se izlučuje voda u obliku vodene pare. U ovoj fazi uglavnom ne dolazi do sakupljanja posude.

- zagrijavanje od 200 do 400°C - na ovim temperaturama dolazi do oksidacije organskih tvari prisutnih u glinenoj masi. Ugljik iz organskih tvari u kombinaciji s kisikom tvori ugljični dioksid koji se oslobađa u atmosferu. Kao rezultat oksidacije prostor koji je prije pečenja bio popunjen organskim tvarima ostaje prazan, a keramika porozna.

- zagrijavanje od 450 do 600°C - dehidracijska faza. U ovoj fazi dolazi do isparavanja vode iz gline. Na temperaturama između 500-600°C mnogi materijali koji se prirodno ili sekundarno nalaze u glini nestaju u obliku plinova: karbon, soli, karbonati, sulfidi. To će prouzročiti skupljanje posude tijekom postupnog sušenja, a posuda može izgubiti više od 15% svoje originalne mase prije pečenja.

- zagrijavanje od 430 do 850°C – ovo je faza termičkog raspada glinenih minerala i sinteriranja u kojoj se pri povišenim temperaturama čestice u glini počinju mijenjati, topiti i međusobno spajati. Pri temperaturama višim od 900°C glineni minerali potpuno gube svoju strukturu i tvore nove silikatne minerale. Temperatura mora prijeći granicu pri kojoj počinje proces sinteriranja, a isto tako mora proći i dovoljno vremena da se taj proces završi. Konačni rezultat sinteriranja je tvrđa, gušća i manje propusna stijenka. Svi proizvodi od gline koji su nastali na ovim temperaturama mogu se smatrati keramičkim proizvodima. Kod analize približne temperature pečenja „arheološke" keramike pomažu nam saznanja o određenim mineralima koji se primarno ili sekundarno nalaze u glini, a koji na točno određenoj temperaturi mijenjaju svoj oblik: kvarc (prolazi kroz tri strukturne promjene na 573°C, 867°C i 1250°C); kalcit (740-800°C); kaolin (585°C); halozit (558°C); montmorilonit (678°C).

- zagrijavanje od 750 do 850°C – u ovoj fazi većina organskog materijala prisutnog u glini potpuno će izgorjeti. Na temperaturama iznad 700°C za većinu glina se može reći da su pečene, a u ovoj fazi proces pečenja završava za mnoge tipove posuda.

- 950°C – na temperaturama višim od 900 do 950°C dolazi do početka topljenja – vitrifikacije, koja se dešava samo kod visokih temperatura. Silikatni minerali i kisik dovoljno su zagrijani da se počinju topiti u tekuću smjesu, stvarajući staklenu strukturu. Nakon vitrifikacije pečena glina postaje manje porozna i kompaktnija, a nakon hlađenja postiže izrazitu čvrstoću. Ovaj proces rijetko započinje ispod 900°C stoga ga nije moguće ustanoviti na prapovijesnoj keramici. Na temperaturama do 900°C izgorjet će sav ugljik, osim grafita, koji može izdržati zagrijavanje do 1200°C.

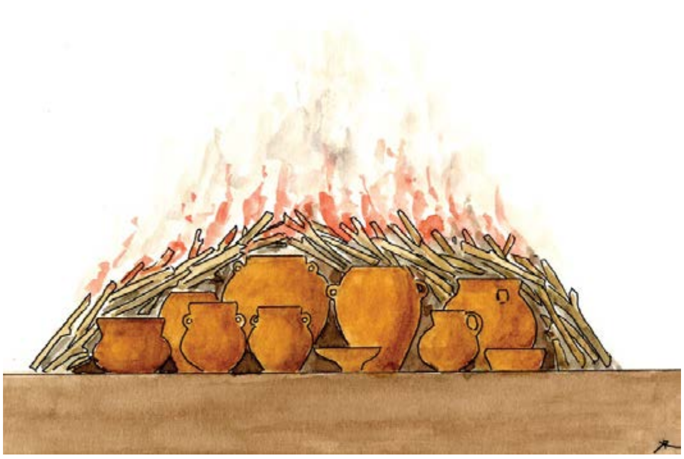
- zagrijavanje od 1050 do 1200°C – na ovim temperaturama feldspat se počinje topiti. Pore na keramici se zatvaraju i poroznost se naglo smanjuje.

- proces pečenja je završen u trenutku kada se prestaje dodavati novo gorivo ili kada ono izgori (Rice 1987: 102-104; Sinopoli 1991: 27-33; Horvat 1999: 50-52; Goffer 2007: 241-243).

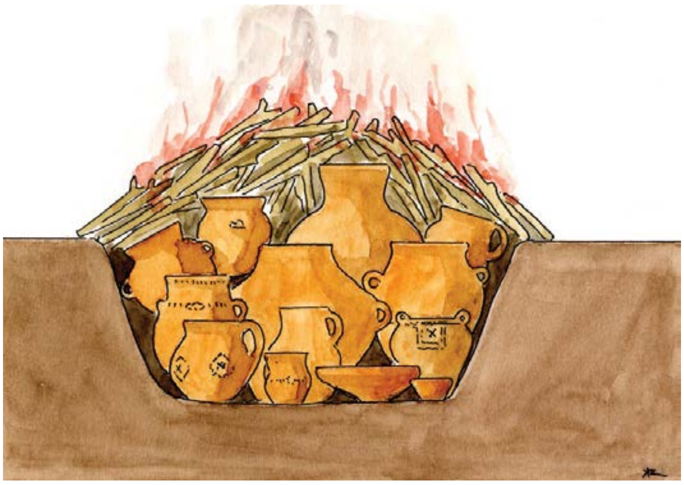
Hlađenje posuda vrlo je bitan korak u konačnom procesu izrade posude jer ono može izazvati pucanje posude te promjenu boje. Kod pečenja na otvorenoj vatri posude se mogu hladiti na dva načina: postupnim hlađenjem koje podrazumijeva ostavljanje posuda na vatri dok se ona u potpunosti ne ugasi. Drugi način je vađenje posude iz vatre i hlađenje na zraku, ali u neposrednoj blizini jame ili ognjišta za pečenje. Kod ovakvog postupka mijenja se boja radi kontakta sa zrakom pa na površini posude ostaju crvene i/ili smeđe mrlje.

Tehnologija pečenja keramike može se podijeliti u dvije kategorije:

1. Pečenje na otvorenom bez izgrađene strukture (na otvorenom ognjištu ili u jami), zajedno s gorivom (*Slika 13, 14*). Ova tehnika zahtijeva veliku vještinu kako bi bila učinkovita. Karakteristike ovakvog načina pečenja su ograničena maksimalna temperatura do 900°C (obično između 500-900°C). Tako će npr. keramika koja u sebi ima primjese školjki ili kalcita, znatno izgubiti na kvaliteti na temperaturi iznad 800°C. Kada krene pečenje kontrola atmosfere je nemoguća, maksimalna temperatura postiže se vrlo brzo, za manje od pola sata, međutim, temperaturni vrhunac kratko traje (Tite 2008: 219; Albero 2014: 105-107).



Slika 13 – Pečenje na otvorenom ognjištu
Fig. 13 – Open firing



Slika 14 – Pečenje u jami
Fig. 14 – Pit firing

Položaj goriva i posuda prije pečenja može utjecati na protok zraka, ali je vrlo teško zadržati pravu oksidacijsku atmosferu tijekom cijelog procesa pečenja. Zbog neuravnotežene i stihijske atmosfere keramički predmeti pečeni su slabije i postanu pougljenjeniji. Dok gorivo izgara, posude su izložene zraku. Naglo hlađenje može izazvati pucanje ruba na posudama sa širokim otvorom, zbog toga se one najčešće stavljaju naopako. U takvom položaju rub se sporije zagrijava, a ujedno je izoliran pepelom i žarom za vrijeme hlađenja. Pečenje u jami pogodno je za izradu crne keramike zbog nedostatka zraka, a oksidacija se može postići izlaganjem posude dok je njezina temperatura još uvijek visoka (Rye 1988: 98). Posude koje u sebi imaju veću količinu organskog materijala mogu u ovakvim uvjetima postići redukcijsku atmosferu unutar stijenki (Albero 2014: 107).

Gledano s praktične strane, pečenje na otvorenom ima svoje prednosti. Peći su statične, uvijek na istom mjestu, dok se pečenje na otvorenom može premještati ovisno o vremenskim i prostornim okolnostima. Za razliku od pečenja u pećima, koje spada u prostorno ograničene aktivnosti, pečenje na otvorenom je prostorno fleksibilna ativnost i omogućuju lončaru da premjesti mjesto pečenja posuda, na što su uglavnom i primorani kako bi poboljšali uvjete pečenja (Arnold III

1990). Razlog tome su stalne i brze promjene u smjeru vjetra koji uzrokuje nejednaku temepraturu pečenja te shodno tome pucanje posuda (Rye 1981; Rice 1987). Promjena mjesta pečenja nije moguća jedino u slučaju ograničenog prostora u naselju i veće potražnje za proizvodima, što utječe jednim dijelom i na samu organizaciju proizvodnje. Iz tog je razloga odabir mjesta za pečenje na otvorenom, kao i njegova lokacijska fleksibilnost uvjetovana vremenskim i prostornim karakteristikama, a manje tehnološkim (Arnold III 1990: 928).

2. Pečenje u zatvorenom (u pećima), odvojeno od goriva. Prednosti pečenja u pećima su: mogućnost postizanja temperature u rasponu od 1000° do 1300°C, kontrolirana atmosfera i kontrolirano vrijeme rasta temperature. Maksimalna temperatura postiže se do sat vremena, nekada i duže. Međutim, njezino održavanje traje duže, do pola sata (Tite 2008: 219-220). Izgradnjom zaštitnih konstrukcija i zidanih svodova iznad ložišta razvile su se prve peći. Na taj se način zadržavala temperatura i izolirala od hladnog zraka. Kasnije se ognjište odvaja od prostora za pečenje, a dodavanjem dimnjaka, odvodnih kanala te rešetkastih pregrada poboljšava se odvod dima iz prostora za pečenje, čime se postiže potpuna oksidacijska ili redukcijska atmosfera (Horvat 1999: 47-50).

Razne arheometrijske analize omogućuju nam da utvrdimo način i temperaturu pečenja na temelju strukturnih promjena minerala na određenim temepraturama te raspada ostalih prirodnih ili namjerno dodanih primjesa (karbonati, glineni minerali, organske tvari itd.). U ovom segmentu eksperimentalna arheologija svakako je značajan doprinos.

TRETMANI POSUDE NAKON PEČENJA

Ova završna faza u izradi keramičke posude uključuje slikanje za koje su se koristili prirodni materijali iz okolice poput minerala nastalih raspadanjem željeznog oksida (hematit, magnetit). Ovamo bi također spadali razni premazi poput voska, smola ili biljnih sokova kojima se dodatno premazuje posuda kako bi bila manje propusna, o čemu je bilo riječi u prethodnom poglavlju.

Zanimljiv primjer zabilježen je u Slavoniji, gdje su lončari u Novom Selu kraj Požege nakon pečenja pokljuka[1] uranjali ih još vruće u tekućinu koja je napravljena od vruće vode, čađe i pšeničnog brašna. Nakon što bi je izvadili, dodatno su je premazivali krpom koja je namočena u čađu da bi posuda dobila visoki sjaj i da bi se pokrila neujednačena boja posude. Međutim, ovaj postupak osim što se nazivao *farbanje*, također je zabilježen i kao *kalaisanje*, a kako se kaljena posuda smatra čvršćom (Lechner 2000: 316-317) vjerojatno je ovaj postupak tradicijski bio vezan i za poboljšanje kvalitete, a ne samo za efekt sjajne površine.

Kao što smo vidjeli, različiti tehnološki izbori ovisit će i o namjeni, odnosno funkciji posude te njezinim mehaničkim i termalnim svojstvima, a ovisno o tome hoće li buduća posuda služiti za skladištenje, kuhanje, serviranje ili transport. Različiti kriteriji utjecat će pritom na veličinu posude, debljinu stijenki, oblik ili količinu i vrstu dodavanih primjesa.

Važno je na kraju naglasiti da je u cijelom lancu operacija najbitniji lončar koji svojim tehnološkim izborom oblikuje keramičku posudu. Njegovo znanje, iskustvo te pojam o tome što je tehnološki izvedivo i društveno prihvatljivo oblikuje tehnologiju, ovisno o geografskim karakteristikama krajolika i društvenom kontekstu (Sillar & Tite 2000; Tite 2008).

[1] Pokljuke su zemljani poklopci koji su služili za pečenje kruha i mesa iznad ognjišta, a koje se još nazivaju peka, pekva, cripnja, crepulja, sač (Lechner 2000: 304).

Pri tom postoji razlika između individualnog i društvenog izbora (Sillar & Tite 2000: 9-10). Individualni izbor svakog lončara ovisi o njegovoj društvenoj pozadini, percepciji, naučenom znanju i stečenim vještinama. Međutim, i inovacija zahtijeva razumijevanje i poznavanje prethodnih tehnoloških procesa, a ovisit će o lonačerovoj vještini da usvojeno znanje primijeni u praksi.

Uvijek je bilo i bit će lošijih i boljih lončara, a vještina izrade ovisit će koliko o samom lončaru toliko i o posudi. Neke posude zahtijevaju više uloženog znanja, vještine i radne energije od drugih (ovisno o kompleksnosti posude), a tzv. tehnološki potpisi, odnosno tehnološko znanje koje ima svaki lončar ostavit će traga u zapisu posude.

Naravno da je teško zamisliti lončara kako po cijele dane mjeri, eksperimentira i „vodi zabilješke“ o određenoj vrsti gline, omjeru dodanih primjesa i veličini zrnaca dok ne dođe do idealne smjese. Međutim, sigurno je da su se loša iskustva s određenim glinama i primjesama događala te da su tehnološkim izborom lončari pokušavali doći do recepture koja je dovoljno kvalitetna za određnu vrstu posude i njezinu funkciju. Kao što je vidljivo iz arheoloških i etnoarheoloških primjera tehnološki izbor ovisio je o puno međusobno povezanih faktora: okolišnom, ekonomskom, društvenom, političkom, ideološkom i tradicijskom kontekstu proizvodnje.

7. PARAMETRI ZA OBRADU I TIPOLOŠKU KLASIFIKACIJU KERAMIČKIH NALAZA

U stručnoj literaturi postoji više pristupa obradi keramičkih nalaza ovisno o prirodi samog lokaliteta ili o fokusiranju na određenu metodu koja će zadovoljiti neke zadane parametre. Pritom je vrlo bitno prvo izabrati relevantne podatke za proučavanje koji će nam odgovoriti na specifična pitanja te odabrati varijable koje će nam to omogućiti. Neke od njih su veličina, tekstura, oblik, tvrdoća, tehnika oblikovanja, tretiranje površine, način pečenja, dekorativni elementi, upotreba, kontekst odlaganja itd. Sljedeći korak pri obradi keramičkog materijala je odabir najprikladnije metode za analizu određene varijable, npr. hoćemo li oblik promatrati i analizirati kroz prizmu morfoloških ili funkcionalnih osobina. Kao konačni cilj, a uzimajući u obzir da su prethodni parametri međusobno povezani, bitno je što želimo saznati od određenih keramičkih nalaza i na koja pitanja tražimo odgovore (Knappett 2005: 673-674).

Naravno da će naša saznanja i dostupna dokumentacija o pojedinom lokalitetu u većini slučajeva odlučiti o odabiru same metode, kao i o parametrima koje želimo postaviti. Konačni rezultat dat će relevantne informacije koje će nam omogućiti odgovor na pitanje koje smo postavili na početku obrade. Razni pristupi analizi keramike još uvijek zaostaju za onima koji se bave analizom tipova pojedinih oblika posude. Zajedno s drugim relevantnim informacijama, o kojima je bilo riječi u prethodnim poglavljima, ovaj pristup usmjeren je na postavljanje sekvenci koje nam omogućuju da sortiramo podatke koje smo skupili. Postoji više pristupa izradi tipologije keramike, ali je nekoliko aspekata koji se svakako ne smiju zanemariti. Neki od njih predstavljeni su u sljedećim poglavljima.

ZAŠTO RADIMO TIPOLOGIJU?

Taj je instrument osmišljen za rekonstrukciju kulturne povijesti u vremenu i prostoru. To je početak, a ne kraj zadaće arheologa.
(Ford & Steward 1954: 52)

Podnaslov ovog poglavlja je jedno uobičajeno pitanje koje mi studenti svake godine postavljaju tijekom predavanja. Pitanje zapravo odražava krivo shvaćanje tipologije koje je odraz tradicionalnog poimanja obrade keramičkog materijala, gdje tipologija služi određivanju isključivo krono-kulturoloških sekvenci. Gledanje na tipologiju kao na zastarjelu metodu ima za posljedicu gubitak kritičkog razmišljanja i razumijevanja o predmetima koji su dio materijalne kulture. Dvije su povezane dimenzije bitne kod svake tipologije: vrijeme i promjene. Kako se tipologije u suštini bave promjenama, to znači da se bave i vremenom (Sørensen 2015: 90). U današnje vrijeme niza dostupnih analiza tipologija više nije alat kojim samo stavljamo keramičke nalaze u relativan vremenski slijed, ona je puno više od indikatora vremena. U ovom trenutku vjerojatno postoji na tisuće praktičnih tipologija koje arheolozi svakodnevno koriste jer svaki nalaz treba staviti u vremensku i prostornu mrežu prije nego te podatke iskoristimo za neku drugu svrhu (Adams & Adams 1991: 9).

Tipologija je arheološki alat koji nema svoj vijek trajanja, ona se radila, radi se i radit će se i u budućnosti iz jednog vrlo jednostavnog razloga – jer je jedan od osnovnih alata koje koristimo za kreiranje i uvođenja reda i smjernica unutar arheoloških podataka (Sørensen 1997: 179). Međutim, ako je tipologija nasumična i nije povezana s predmetom (njegovom proizvodnjom, značenjem itd.) onda to uvođenje reda nema gotovo nikakvo značenje (Sørensen 2015: 91). Zbog toga je tipologija prvi korak u obradi keramičkog materijala, a ono što je razlikuje od tipologija koje su se radile prije nekoliko desetljeća jest da taj korak nikako nije posljednji već je zapravo početak!

Arheolozi će uvijek trebati tipologiju kako bi skupili sve podatke o keramičkim ulomcima te ih stavili u kategorije koje su kreirali, a sve u svrhu obrade podataka koji će nam pomoći pročitati sve one skrivene informacije koje krije keramička posuda. Da bismo informacije obradili, prvo ih moramo sažeti, staviti u zadane okvire prema parametrima koje smo sami kreirali i jasno definirali. Tako napravljen sustav podataka, koji je intuitivan koliko i racionalan, zapravo tvori tipologiju.

Naglasak interpretacije tu ne staje na opisu keramičkih ulomaka ili stavljanja artefakata u relativan kronološki slijed već na odgovore koji uključuju socijalni život ljudi koji su te predmete radili, njihov položaj u zajednici, organizaciju proizvodnje, distribuciju proizvoda, tehnološki izbor i prilagodbu na okoliš, tradicijske elemente, religioznost zajednice itd. Pitanja se mogu postaviti iz različitih perspektiva, ovisno o afinitetu onoga koji izrađuje tipologiju, zato je bitno na početku svake tipologije odrediti njezinu svrhu, odnosno postaviti pitanja na koja želimo dobiti odgovore.

U praksi, tipologija je u svojim počecima uvijek intuitivna, uvjetovana već pročitanom i usvojenom literaturom o keramičkom materijalu određenog razdoblja i našim prvim susretom s keramikom u procesu obrade. Postupno se naš koncept svjesno ili nesvjesno mijenja kako sustavno razlikujemo tipove unutar keramičke građe i stavljamo ih u okvire koje smo kreirali. Stjecanjem iskustva u obradi keramičkog materijala naš koncept će se sve više i više mijenjati, što rezultira kontinuiranim povratnim informacijama između keramičkog predmeta i našim idejama o njemu. Ovaj proces nikada neće završiti sve dok imamo keramičkog materijala koji treba obraditi (Adams & Adams 1991: 19).

Pristup tipološkoj klasifikaciji keramičkog materijala zato je uvijek drugačiji, a to bi i trebao biti, u prvome redu zbog različitih afiniteta samih znanstvenika, vrste i fizičkih karakteristika materijala, različite metodologije te ostalih tehničkih i dokumentacijskih mogućnosti. Naše perceptivne sposobnosti, interes, naša socijalna, ekonomska i kulturna pozadina utječu na odabir pitanja i na dobivene odgovore, tako da nikada dva arheologa neće doći do iste interpretacije bilo kojeg arheološkog fenomena. Umjesto toga, svaka arheološka interpretacija jednostavno postaje „meta“ za druge arheologe da je ponovo procijene ili odbace (Banning 2000: 8).

Objava podataka kod arheologa još uvijek predstavlja problem koji se manifestira nizanjem svih skupljenih podataka, što rezultira nepreglednim brojem stranica koje zapravo interpretacijski nemaju nikakvu vrijednost. Ovdje dolazimo do pitanja tipologije i njezine svrhe. Tipološka analiza keramičkog materijala trebala bi ispunjavati minimalno četiri zahtjeva. Prva dva kriterija već je u svojim radovima donijela Carla Sinopoli (1991), a to su *provjerljivost* - da se u svakom trenutku podaci mogu statistički provjeriti i *ponovljivost* - da se podaci mogu replicirati, odnosno da bilo tko po istim kriterijima može doći do istih rezultata. Druga dva zahtjeva trebala bi biti *dosljednost* i *razumljivost*. Dosljednost podrazumijeva da onaj koji radi tipologiju, treba jasno definirati svoje parametre, odnosno varijable i atribute, bez obzira koji način tipološke klasifikacije odabrao, i treba biti dosljedan u atribuiranju keramičke građe unutar zadanih kriterija. Razumljivost je možda najvažniji i najteži kriterij svake tipologije, a to znači da bi svaka tipologija trebala biti jasna, jednostavna, prilagodljiva i otvorena za daljnje analize. Ako tipologija ne služi nikakvoj svrsi to znači da je tipolog zanemario specificirati koja je njezina svrha (Gardin 1980: 81), ali je gotovo nemoguće da se dogodi da tipologija ima značenje samo onome tko je tipologiju napravio. To samo znači da tipolog nije shvatio svrhu svoje tipologije.

Postoje različite svrhe klasifikacija kod izrade tipologije. Adams & Adams (1991: 157-168) navode tri osnovne kategorije: opću, instrumentalnu i višenamjensku svrhu, a koje se mogu podijeliti u nekoliko podgrupa. Opća klasifikacija dijeli se na deskriptivnu, komparativnu i analitičku, a potonja još i na unutarnju, interpretativnu i povijesnu. Deskriptivne tipologije su većinom morfološke i zatvorenog tipa. Komparativne služe uspoređivanju s drugim lokalitetima, razdobljima i regijama i moraju biti otvorenog tipa. Svrha unutarnje klasifikacije napravljena je za arheologe čiji je primarni interes predmet, a ne čovjek koji je taj predmet izradio i koristio. Više je usmjerena na karakteristike predmeta, a ne na socijalni i ekonomski kontekst u kojima su ti predmeti napravljeni. Interpretativna svrha najviše se koristi kada je riječ o prapovijesnoj arheologiji, a njezin interes su ljudi koji su predmet napravili i koristili, podaci o tehnologiji (tehnikama oblikovanja, pečenja itd.), ekonomiji i društvenoj organizaciji. Povijesna ima za cilj proučavanje razvoja i promjena kroz prostor i vrijeme. Instrumentalna svrha tipologije većinom svoj interes usmjerava na relativno datiranje nalaza, etničku identifikaciju i rekonstrukciju društvene organizacije. Višenamjenska svrha, kao što i sama riječ kaže, napravljena je da služi nekolicini svrha, a može se napraviti namjerno ili slučajno. Naime, vrlo često se dogodi da arheolog sekundarnu svrhu tipologije uoči tijekom ili pred kraj obrade nalaza. S druge strane, moguće je već na početku izrade tipologije postaviti više svrha na koje se želi odgovoriti. Ovakav pristup dovodi do problema kod izrade tipologije, a jedno od rješenja je taksonomija, o kojoj će više biti riječi u narednim poglavljima.

Svrha tipologije prvi je i najbitniji u nizu koraka koji definira način na koji su tipovi napravljeni. Zato bi početak svake praktične tipologije trebao imati razumljivu svrhu kako napravljena tipologija ne bi sama sebi ostala svrhom.

Općenito se smatra da su tipologije subjektivna kreacija arheologa više nego rekonstrukcija kategorija koje su bile važne onima koji su ih radili ili koristili (Trigger 1989). Ovaj problem vidljiv je kod tradicionalne tipologije koja se i danas koristi, gdje kreiranje tipova ostaje jedini oblik analize i interpretacije, a keramički ulomci ne proučavaju se kao predmeti koji su aktivno uključeni u društveni život ljudi, već kao pasivni komadi pečene gline. Svaka posuda napravljena je s razlogom, da služi nekoj svrsi, i svaka u sebi nosi svoju priču. Srećom, tragovi na posudi mogu se prepoznati na razne načine (makroskopski i mikroskopski) od načina oblikovanja, tragova upotrebe do konačnog odbacivanja, a mi smo tu da rekonstruiramo njezin životni vijek (Skibo 2013). Tipologija je tu da nam pomogne klasificirati setove podataka o keramičkoj građi, da ih strukturiramo tako da oni imaju određenu svrhu. Braun je još 1983. napisao jednu od citiranijih izjava: *„pots as tools“*, koja u sebi sadržava sukus onoga što bismo trebali imati na umu kada obrađujemo keramički materijal.

POVIJESNI PREGLED TIPLOŠKE KLASIFIKACIJE KERAMIČKOG MATERIJALA

Tipološka faza obrade materijala počela je oko 1880. godine, kada je Pitt-Rivers razvio tipološki pristup obrade otkopane građe sa svojih iskopavanja. U isto vrijeme Flinders Petrie osmislio je vlastiti model serijacije i kronološkog redoslijeda otkopanih grobova na iskopavanjima u Egiptu (Petrie 1904; Orton et al. 1993: 8-13; Renfrew & Bahn 2004: 27-36). Dvadesetih i tridesetih godina prošlog stoljeća dolazi do pojave velikog broja tipologija različitog materijala, a većina tipologija koja se koristi danas vjerojatno su formulirane tijekom toga razdoblja. U razdoblju između 1920.-1950. uslijedilo je mnogo teoretskih rasprava i debata na ovu temu (za pregled vidi: Adams & Adams 1991). Glavni ciljevi početka ove tipološko-kronološke faze bili su usmjereni na vertikalnu (kronološku) i regionalnu distribuciju keramičkih nalaza. Metodološki pristup temeljio se na serijaciji i stvaranju kulturne kronologije na temelju kvantitativih podataka nastalih jednostavnom metodom prebrojavanja keramičkih ulomaka. Tek će u kontekstualnoj fazi doći do sazrijevanja ideje o nekim drugim mjerenjima koja mogu biti indikator količine keramičkog materijala (težina, kapacitet posude itd.). Kronološke sekvence nastajale su na osnovi tipova koje je sredinom prošlog stoljeća Gifford (1960) opisao kao „specifičnu vrstu posude koja spaja jedinstvenu kombinaciju prepoznatljivih atributa". Tijekom vremena bilo je jasno da ovakva jednoslojna podjela nije dovoljna pa je uskoro podjela na tipove i varijante tipova bila široko prihvaćena.

Mnogo je članaka i znanstvenih debata posvećeno ovom „fenomenu" i njegovoj upotrebi prilikom obrade i analize keramičke građe (Phillips 1958; Wheat et al. 1958; Smith et al. 1960; Ford 1961; Sabloff & Smith 1969; Smith 1979). Šezdesete godine prošloga stoljeća slijedom nekoliko okolnosti donijele su novi znanstveni zamah u arheologiji pa tako i u tipologiji.

Kontekstualnu fazu, koja je započela oko 1960. godine, obilježio je rad Anne O. Shepard što je ujedno značilo i prekretnicu u analizi keramičkog materijala i stvaranje temelja za mnoge praktične i teoretske analize. Njezin rad iz 1956. godine usmjeren je na sve aspekte analize keramike – kronologiju (identifikacija tipova), distribuciju (identifikacija sirovine i izvora trgovine) i tehnološki razvoj (fizičke karakteristike posude). Može se reći da je nakon njezina rada analiza keramike krenula u svim mogućim smjerovima. Jedan od njih bila je i integracija etnografskih studija, znanstvenih metoda i tehnoloških analiza.

Znanstvene metode koje su se u analizi keramičkog materijala u većoj mjeri počele koristiti od 60-ih godina prošlog stoljeća imale su tri važna utjecaja na analizu keramičkog materijala – datiranje, porijeklo sirovine i proučavanje funkcije posude. Isto tako njihov doprinos išao je i u smjeru proučavanja tehnologije i izrade same posude te proučavanja formacijskih procesa. Autori koji se bave tehnološkim aspektom keramike svoja su istraživanja usmjerili u dva smjera. Jedan od njih je proučavanje tehnologije kao indikatora socijalnog progresa (za pregled vidi: Loney 2000), dok drugi uključuje kemijske i fizičke analize keramike sagledavajući ih pod utjecajem etnografije.

Tipologija i klasifikacija keramičkog materijala razvijala se i nadopunjavala novim saznanjima i pristupima počevši od kraja 19. stoljeća pa sve do danas. Upotreba računala i raznih statističkih metoda s vremenom je olakšala preglednost, transparentnost i manipulaciju podacima. Tipološka analiza keramičkog pa tako i bilo kojeg arheološkog materijala, ovisi prije svega o samom repertoaru, odnosno o reprezentativnosti podataka. Način na koji je materijal prikupljen (stratigrafsko iskopavanje, terenski pregled ili obrada materijala iz fundusa muzejskih zbirki) imat će veliku ulogu prilikom interpretacije obrađene građe (Sinopoli 1991: 47).

Mnogo je radova napisano o definiciji tipa posude i pristupima tipološkoj analizi, što je rezultiralo brojnim konstruktivnim raspravama među raznim znanstvenicima koji su uključeni u obradu i tipološku analizu keramičkog materijala. Tipološka analiza keramičkog materijala tako je uključila znanstvenike raznih interesnih skupina od filozofije, matematike, antropologije, etnologije, informacijskih znanosti, biologije do lingvistike. Kada ovdje pribrojimo i znanstvene discipline koje su uključene u analizu sastava i izvora gline kao sirovinskog materijala te metode datiranja, može se reći da je analiza keramičkog materijala najbolji primjer interdisciplinarnosti, bez koje danas ne možemo zamisliti arheologiju kao znanstvenu disciplinu.

KLASIFIKACIJA KERAMIKE

Klasifikacija keramike u tipove prvi je neophodan korak korištenja podataka o keramici za daljnju detaljniju analizu. Koliko informacija ćemo skupiti i prezentirati za tipološku klasifikaciju još uvijek je otvoreno pitanje koje je predmet mnogih rasprava među arheolozima.

Nema formule, matematičke jednadžbe ili standardizirane metode kojom ćemo izabrati prave ili točne informacije iz nepreglednog broja podataka koje nam pruža posuda. To će ovisiti ponajprije o materijalu s određenog lokaliteta i njegovim općim karakteristikama. Npr. ako je sva keramika koju obrađujemo crne boje, sigurno je da boja neće biti koristan i relevantan parametar za stvaranje podtipova ili grupa unutar keramičkog inventara. S druge strane, ako je boja različita na zdjelama i loncima, te varira od crne do svijetlosive, onda će ona biti koristan parametar za stvaranje niza varijabli kojima možemo odrediti učestalost i značenje ovakve pojave (Sinopoli 1991: 43-44). U tom smjeru ići će i naše određivanje varijabli koje možemo zabilježiti o određenom keramičkom ulomku. Neke će nam biti korisnije i važnije od drugih, ovisno o vrsti interesa. Zato je kod interpretacije podataka najvažnije na početku analize postaviti pretpostavku koja se može testirati i potom odabrati mjerenja i podatke koji će nas dovesti do vjerodostojnih zaključaka (Kingery 1981: 463). Ovakav pristup zahtijeva poznavanje keramičkog inventara prije početka obrade i definiranja određenih varijabli.

Određivanje tipova posude ima dva pristupa. Jedan se odnosi na bilježenje objektivnih činjenica o obliku posude na osnovi keramičkih ulomaka, dok je drugi temeljen na nagađanju, tj. već utvrđenom znanju o posudama i njihovim oblicima koji pripadaju određenom razdoblju ili kulturi (Orton et al. 1993: 77-78).

Prije postavljanja temelja za tipološku klasifikaciju vrlo je bitan način na koji ćemo odrediti koje i kakve uzorke ćemo skupljati za analizu, odnosno koje podatke želimo skupljati. Općenito gledajući postoje dvije tehnike, a to su slučajno (eng. *random sampling*) i namjerno uzorkovanje (eng. *judgment sampling*). Kada govorimo o keramičkim ulomcima, kod slučajnog uzorkovanja bilo koji ulomak ima istu vjerojatnost da bude odabran za analizu i ne ovisi o odabiru ostalih ulomaka iz keramičkog inventara. Namjerno odabiranje keramičkih ulomaka temelji se na znanju i iskustvu arheologa koji potom odabire i selektira relevantne keramičke ulomke za analizu, ovisno o području interesa. Ovakav odabir je puno jednostavniji, međutim, neki relevantni podaci mogu se propustiti prilikom konačne interpretacije (Sinopoli 1991: 46-49). Koji ćemo način uzorkovanja odabrati ovisi o nizu parametara (stratigrafija lokaliteta, dokumentacija, vrsta i količina raspoloživog materijala itd.).

Nakon što smo odredili koju ćemo metodu koristiti prilikom sortiranja keramičkog materijala, sljedeći korak u analizi je klasifikacija. Postoje tri vrste tipološke klasifikacije materijala*:* intuitivna ili tradicionalna tipologija; tipologija tipova i varijanti; kvantitativna ili statistička tipologija.

Prije nego pojasnimo svaku od navedenih klasifikacija, treba naglasiti razliku između tipologije i klasifikacije, varijabli i atributa. Tipologija je zapravo posebna vrsta klasifikacije, ona nije napravljena za kategoriziranje i označavanje stvari nego za njihovo razdvajanje u manje grupe koje korespondiraju s našim klasifikacijskim kategorijama i oznakama. Taj se proces zove sortiranje, a grupe kategorija u koje su predmeti sortirani zovu se tipovi. Ukratko, tipologija je posebna vrsta klasifikacije napravljena za sortiranje subjekata, odnosno predmeta. Za razliku od mnogih ostalih klasifikacija, tipologija je uvijek u nekom opsegu eksperimentalna, barem u svojoj razvojnoj fazi. Tip, za razliku od drugih vrsta klasa, također spada u kategoriju sortiranja. Stoga klasifciranje spada u čin kreiranja kategorija, a sortiranje je čin stavljanja stvari u kategorije nakon što su kreirane. Jedan je proces definicije, a drugi atribucije (Adams & Adams 1991).

Tipovi su napravljeni da služe nekoj svrsi koja mora nekome koristiti. Prema tome, u tipologiji je subjektivnost neizbježna i mora biti prisutna. Cilj onoga koji klasificira jest da diktira izbor varijabli i atributa koji će biti uzeti u obzir u tipologiji i da taj izbor određuje prirodu tipova i rezultata.

Atribut je opredjeljiv aspekt svake određene varijable i dok su varijable konceptualno samostalne, atributi to nisu. U svakom tipu može biti samo jedan atribut po varijabli, npr. varijabla bi bila boja posude, a atribut crvena boja. Svaki atribut ima ekskluzivnost što znači da jedan isključuje drugi. Tako određeni ulomak ne može imati tanke i debele stijenke ili uvučeni i izvučeni rub. Varijable su stoga kriterij značenja, a atributi kriterij identiteta. Varijable se mogu okarakterizirati kao dimenzije varijabilnosti. One određuju osobine koje se manifestiraju na svim tipovima u tipologiji, ali ne uvijek na isti način. Npr. svaka posuda ima osobine kao što su oblik, težina, boja, tekstura, ali te se osobine mogu manifestirati na različite načine.

Generalno gledajući postoje četiri stupnja odluke na kojima temeljimo formuliranje i upotrebu naše tipologije. To su odabir varijabli i atributa za formuliranje tipova, označavanje i imenovanje tipova i razvrstavanje subjekata. Najveća količina materijala s kojim se susrećemo kod analize i obrade keramičkog materijala zapravo su ulomci pa su slijedom toga naši subjekti ulomci, a ne cijele keramičke posude. Međutim, naši tipovi nisu tipovi ulomaka nego tipovi cijelih posuda. Stoga je vrlo važno kod sortiranja usporediti što više mogućih atributa, a ne samo dijagnostičke ulomke koje sa sigurnošću možemo pripisati određenom tipu jer tip nije definiran jednim atributom već kombinacijom atributa (Adams & Adams 1991).

VRSTE TIPOLOGIJA

Kada govorimo o vrstama tipologije treba početi s najranijom i najjednostavnijom, a to je *tradicionalna tipologija.* Ona podrazumijeva razvrstavanje ulomaka i sortiranje u grupe s manje-više sličnim ulomcima. Ova vrsta tipologije vrlo je uspješna kada arheolog koji obrađuje materijal ima dosta iskustva s keramičkim materijalom. Međutim, ovakav način tipološke obrade ovisi isključivo o našoj percepciji, odnosno sposobnostima da uočimo obrasce iako nismo uvijek sigurni koji su faktori presudni za percepciju određenih obrazaca (Sinopoli 1991: 50).

Tradicionalna tipologija s vremenom je sazrijevala i napredovala kako se povećavao broj arheoloških iskopavanja, keramičkog inventara i znanstvenog interesa. Robert Whallon (1972) pokušao se odmaknuti od tradicionalne tipologije primjenjujući hijerarhijski način procjenjivanja atributa, od kojih su neki primarni i važniji od drugih u konačnom svrstavanju posuda u grupe. Na taj način za definiranje tipa posude bila je potrebna jedna varijabla koja je određena sa dvije različite karakteristike (atributa). Tradicionalna tipologija ima svoja ograničenja i teško da je ponovljiva, pogodna je za određena pitanja vezana za relativno kronološke promjene, međutim nikako nije zadovoljavajuća za interpretaciju tehnologije, stila ili proizvodnje (Sinopoli 1991: 49-52).

Klasifikacija keramičkog materijala po sistemu *tip-varijanta* (eng. *type-variety method*) najraširenija je vrsta tipologije koja se razvila 60-ih godina prošlog stoljeća kao odgovor na veliku količinu keramičkog materijala s područja Američkog jugozapada (Wheat et al. 1958). U počecima izrade ove tipologije njezini začetnici nisu se toliko zamarali time što je zapravo tip i kako se on definira. Njegovo definiranje napravljeno je na osnovu vrlo malog broja dijagnostičkih tragova, pri čemu je tip određen vremenskim razdobljem i područjem na kojem se pojavljuje. Kasnijim razvojem ovakvog načina izrade tipologije klasifikacija materijala išla je u smjeru rješavanja konkretnih pitanja i problema.

Orton, Tyers & Vince (1993: 76-79) razlikuju dva načina razvrstavnja tipova u skupine (eng. *type-series*) pri čemu svaki tip predstavlja grupu posuda za koje se podrazumijeva da su manje-više sličnog oblika. Nestrukturirani način podrazumijeva odvajanje jednog ulomka iz keramičke građe koji se potom nazove Tip I. Sljedeći ulomak usporedi se s njim i ako nije sličan nazove ga se Tip II. Metoda se nastavlja do cjelokupne obrade keramičkog materijala. Ovakav pristup ima prednosti zbog svoje jednostavnosti i mogućnosti širenja tipova, a omogućuje obradu vrlo male količine keramičkog materijala koja se naknadno može proširiti. Vrlo je zahvalan za obradu materijala na većim i dugotrajnijim lokalitetima.

Strukturirani pristup ide obratnim redoslijedom, što zahtijeva poznavanje cjelokupne keramičke građe prije početka klasifikacije. Cijela keramička građa prvo se podijeli u grupe na osnovi oblika posude: npr. Tip I - zdjela, Tip II - tanjur, Tip III - lonac itd. Zatim se svaka grupa podijeli na podtipove (I.A, I.B...), na osnovi oblika, stila, ukrasa, dimenzija ili nekog drugog atributa. Na kraju se mogu numerirati individualni tipovi unutar grupa (I.A.1, I.A.2...), što ovakav način tipološke klasifikacije čini preglednim i otvorenim za daljnje analize (Orton et al. 1993: 77-79). Na tipologu ostaje da kod formiranja tipova u obzir uzme i neke druge karakteristike građe, (npr. tehnološki aspekt), kako bi odredio svrhu svoje tipologije.

Kvantitativna tipologija obuhvaća stvaranje tipologije i njezinu interpretaciju s pomoću raznih statističkih metoda, pri čemu veliku ulogu ima definiranje varijabli. Flinders Petrie začetnik je serijacije kojom je utvrdio relativnu dataciju egipatskih grobova još davne 1899. godine, što je zapravo papirnata preteča statističke serijacije. U začecima arheološke statistike Albert Spaulding je 1953. godine napisao „statistika nije zamjena za razmišljanje, međutim statističke analize predstavljaju podatke koji su vrijedni razmišljanja“ (prema Lock 2003: 127). Zahvaljujući kompjutorizaciji nakon 70-ih godina prošloga stoljeća, statističke analize danas se u arheologiji koriste kao dio uobičajenih alata za sažimanje i interpretaciju podataka.

Brojanje je arheolozima uobičajen dio posla. Brojimo keramičke ulomke, kamen, kosti, slojeve, uzorke i sve što dolazi u arheološki zapis. Iako arheologija spada u humanističke znanosti, arheolozi često moraju koristiti razne statističke metode. Ne zato što to žele, već da bi kvantificirali podatke koje su skupili. Statističke metode tu su da nam pomognu i olakšaju filtrirati mnoštvo prikupljenih podataka koje smo, naravno, opet izmjerili (visina posude, debljina stijenki, promjer ruba, debljina dna itd.). Kreirajući bazu podataka u koju unosimo kvantitativne podatke otvaraju nam se mogućnosti usporedbe i uočavanja obrazaca koje prilikom obrade mnoštva keramičkih ulomaka ne možemo percipirati. U tom smislu statistika nam otvara pregršt novih pitanja koja možemo testirati. Jedan dio arheologa zazire od statistike, smatrajući je dosadnom i nerazumljivom, dok drugi dio koristi statististiku za tablično ili grafičko prikazivanje podataka, međutim nikada zapravo niti ne mjereći standardnu devijaciju, srednju vrijednost ili odnose među atributima ili varijablama.

Kao i kod stvaranja tipologije, statistika i kvantifikacija nisu kraj procesa obrade keramičkih nalaza već početak. Ovi alati nam pomažu da lakše uočimo, filtriramo, testiramo i transparentno prikažemo sličnosti, razlike i obrasce na obrađenom setu podataka (VanPool & Leonard 2001), u našem slučaju keramičkih ulomaka. Kvantitativne metode i statistike primjenjuju se na podatke, a podaci su naša zapažanja i mjerenja o pojedinom keramičkom ulomku, kamenoj alatki ili kosti

(Drennan 1996; Shennan 2001; VanPool & Leonard 2001). Ono što oblikuje podatke jesu naša teoretska i istraživačka pitanja te parametri koje smo na početku naše obrade jasno postavili.

Kao što je već napisano, nema pravila niti matematičke formule na koji način i u kojem obujmu ćemo skupljati podatke. Podaci su jednostavno onakvi kakve ih mi odredimo! Jasno je da svaki arheolog ima određenu razinu predznanja o problemu koji obrađuje i da je vjerojatno da će u svoju obradu uključiti ona zapažanja koja su ključna za interpretaciju određenog problema ili pitanja. Prvi korak je postaviti varijable za naše podatke, a varijabla je svaka kvaliteta opažanja. Odabrane varijable mogu uključivati različite vrste mjerenja, ovisno o području interesa onoga koji obrađuje keramičku građu. Tako će tehnološke varijable podrazumijevati one parametre koji su vezani za sirovinski materijal (glinu), izradu i način pečenja te mehaničke promjene na posudi. Varijable koje omogućuju mjerenja veličine i oblika keramičke posude međusobno su povezene, a uključuju mjerenje promjera otvora posude, veličinu, maksimalan promjer posude, promjer dna, debljinu stijenki itd. Posude se podijele u oblikovne grupe (zdjela, vrč, tanjur, lonac...), a dodatnim mjerenjima može se doći do još detaljnije podjele unutar tih grupa. Ovakav način može nam koristiti za identifikaciju kronoloških i stilskih promjena. Varijable vezane za dekorativne karakteristike i tretiranje površine uključuju već navedene tehnike ukrašavanja keramičkog posuđa i definiranje boje. Bilježenje ukrasa na posudi odnosi se na njihov smještaj (rub, vrat, trbuh) i način na koji su izvedeni (ubadanje, urezivanje, utiskivanje itd.) (Sinopoli 1991: 53-67). Cilj ove metode je statističkim analizama dobiti podatke koji se mogu na razne načine formirati, grupirati i pregledavati.

U arheološkim analizama najčešće se koristi deskriptivna statistika koja omogućuje sažimanje podataka u numeričkoj ili grafičkoj formi. Numeričke vrijednosti uključuju tipične i glavne karakteristike prikupljenih podataka te zbroj prosječnih ili srednjih vrijednosti. Grafički prikazi omogućuju nam vizualno prikazivanje skupljenih podataka u formi tabli, histograma i ostalih varijanti grafikona (Drennan 1996). U konačnici mi ni približno ne selektiramo podatke iz nepreglednog broja informacija koje smo prikupili ili koji se mogu prikupiti, već ih slažemo na osnovi našeg isključivo subjektivnog zapažanja, onako kako ih mi vidimo i kako ćemo ih kategorizirati (Banning 2000: 7-34). Uvijek ostaju otvorena pitanja, jesmo li prikupili dovoljno podataka?; jesmo li napravili pravilan odabir za selekciju?; koje podatke ćemo prezentirati prilikom interpretacije? To su sve pitanja koja su dio cjelokupnog procesa obrade keramičke građe. Vjerojatno ne postoji arheolog koji sebi ne postavlja takva pitanja prilikom obrade keramičke građe. Odgovor se nalazi u odluci na kojem stupnju obrade, analize ili mjerenja treba stati, a to se posebno odnosi na sažimanje podataka i konačnu interpretaciju. Svi podaci filtrirani su kroz subjektivnu prizmu onoga koji obrađuje keramičku građu. Skupljanje većeg broja podataka, odnosno mjerenje niza varijabli na keramičkom materijalu može dovesti do prikazivanja gomile podataka koji nemaju interpretativnu vrijednost ako ti podaci u konačnoj fazi nisu filtrirani na pravi način. To ne znači da sve te podatke ne treba uzimati i mjeriti, samo ih treba znati vrednovati.

Bitno je naglasiti da keramička građa koja je otkopana i skupljena s određenog lokaliteta nikada nije potpuni pokazatelj slike naseljavanja pojedinog naselja ili razdoblja. Pravilan odabir uzimanja uzoraka (odnosno keramičkih ulomaka) bilo slučajnom ili namjernom tehnikom, bit će reprezentativan u smislu općenitog raspona keramičke građe nađene na određenom lokalitetu.

Koji god način i metodu odabrali za analizu keramičkog materijala, bitno je da ona bude postavljena na već unaprijed zadanim parametrima koji će dati odgovore na unaprijed postavljena pitanja. Tek tada će naši odgovori biti relevantni pokazatelji onoga što želimo saznati iz brojnih varijabli koje nudi keramička građa.

MORFOLOGIJA KERAMIČKIH POSUDA

Morfologija keramičke posude može biti opisana i klasificirana na mnogo načina, a na arheologu je da izabere odgovarajući način na koji će analizirati svoj keramički materijal.

P. Rice (1987: 224-226) ističe četiri glavne karakteristike koje su povezane s morfologijom keramičke posude: kapacitet, stabilnost, dostupnost (sadržaju posude) i prenosivost (transport). Iako postoji još karakteristika koje su vezane za funkciju posude navedena obilježja isključivo su vezana za morfologiju posude.

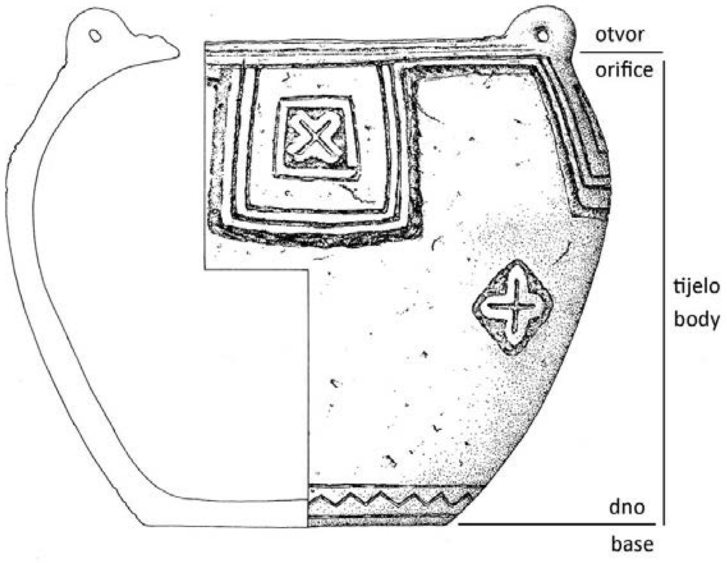
Prije određivanja parametara za tipološku klasifikaciju keramike vrlo je bitno poznavati anatomiju same posude. Anatomija keramičke posude prihvaćena je i upotrebljavana u cijelom svijetu, a njezini osnovni oblikovni dijelovi referiraju se na dijelove ljudskoga tijela. Svaka posuda može biti opisana i okarakterizirana na mnogo načina, usmjerena na određene dijelove i njihove proporcije. Pojednostavljeno, posuda ima tri primarna dijela: otvor, tijelo i dno (*Slika 15*). Ove komponente su bitne za konstrukciju posude, njezinu funkcionalnost, moguće dekorativne elemente, a njihove proporcije odredit će oblik posude (Rice 1987: 212). Sekundarni oblikovni atributi na posudi su razne varijante ručki, držaka, izljevi i noge koji su dodani na već izrađenu posudu (Horvat 1999: 80). Primarni i sekundarni dijelovi posude čine morfologiju posude koja je polazna točka pri klasifikaciji i analizi osnovnih oblika posude.

PRIMARNI DIJELOVI POSUDE

Otvor – glavna karakteristika otvora posude je njezin odnos s maksimalnim promjerom posude. Ova komponenta najviše se veže za funkciju posude i bitna je za dostupnost sadržaju.

Tijelo – definirano je kao dio između otvora i dna posude koji uključuje maksimalni promjer ili dio najvećeg volumena posude. O veličini tijela ovisi i visina posude, odnosno komponenta koja je vezana za kapacitet.

Dno – predstavlja krajnji dio posude i odgovoran je za njezinu stabilnost (*Slika 15*).



Slika 15 - Primarni dijelovi posude
Fig. 15 – Primary parts of the vessel

Nemaju sve posude ovako jednostavan oblik, uglavnom su mnogo kompleksnije u izradi, stoga se njihova struktura može raščlaniti na još nekoliko dijelova (Horvat 1999) (*Slika 16*):

USTA/RUB USTA - *OTVOR POSUDE*

VRAT

RAME } *TIJELO*

TRBUH } *POSUDE*

DNO

NOGA

Usta: predstavljaju gornju krajnju točku posude, a prijelaz prema vratu nije prekinut već je vertikalan. Ta orijentiranost može biti i profilirana prema unutrašnjoj ili vanjskoj strani posude.

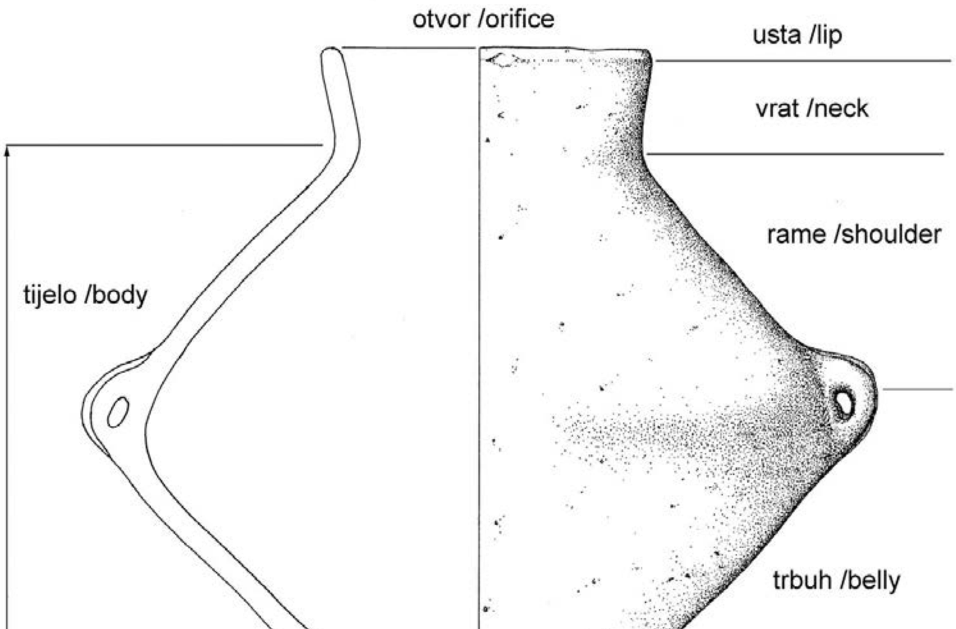
Rub usta: je dio na otvoru posude koji je posebno dorađen ili oblikovan, a dodir sa stijenkom posude je odsječen ili jako odrezan. Usta i rub usta zajedno čine otvor posude. Neki autori za ovaj dio posude koriste samo termin rub, bez dodatne podjele, što je također uobičajeno pri klasifikaciji osnovnih dijelova posude.

Vrat: je dio koji omeđuje otvor posude, a prelazi u gornji dio tijela (rame).

Rame: predstavlja gornji dio tijela posude, ispod vrata.

Trbuh: označava donji dio tijela posude, a prelazi u dno (bazu/nogu). Rame i trbuh zajedno tvore tijelo posude.

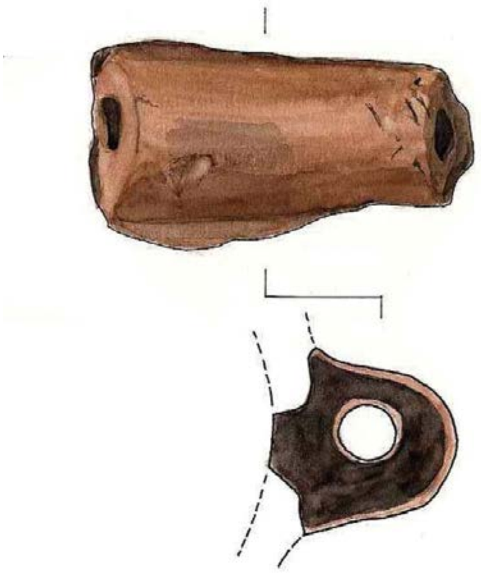
Noga: obično je naknadno dodana ili aplicirana na već oblikovanu posudu, odnosno na bazu ili dno posude. Manje nožice mogu biti oblikovane zajedno s posudom, odnosno izvučene iz tijela posude, kao npr. kod zdjela na četiri čepaste nožice te zdjela na križnoj, prstenastoj i cilindričnoj nozi (T. 11, 12, 17, 18).



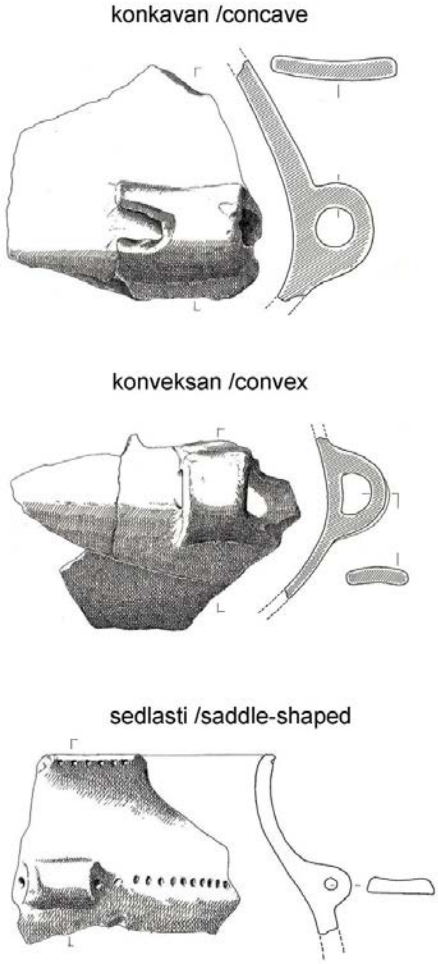
Slika 16 - Struktura posude
Fig. 16 – The vessel's structure

SEKUNDARNI DIJELOVI POSUDE – RUČKE I DRŠCI

Vrste ručki i držaka te tehnike izrade razmatrani su samo u okviru obrađenog vučedolskog materijala, a ne kroz sve prapovijesne kulture. Ručke imaju isključivo funkcionalnu namjenu, a služe za lakše podizanje i prenašanje posude. Ručke su naknadno dodane na vanjsku stijenku posude, koja može biti i posebno pripremljena za njezino postavljanje. Takav oblik pripreme zahtijeva dubljenje stijenke kako bi čepasti nastavak ručke mogao što bolje prionuti uz posudu. Krajevi ručki dodatno se razmazuju uz stijenku posude kako bi se dobila bolja čvrstoća (*Slika 17*). Ručka može biti i samo prilijepljena na stijenku posude uz dodatno razmazivanje i dorađivanje. Osim načina postavljanja ručki, pri osnovnoj podjeli bitan je njezin smještaj na tijelu posude, oblik, presjek, orijentacija i obris (Horvat 1999: 100-101).



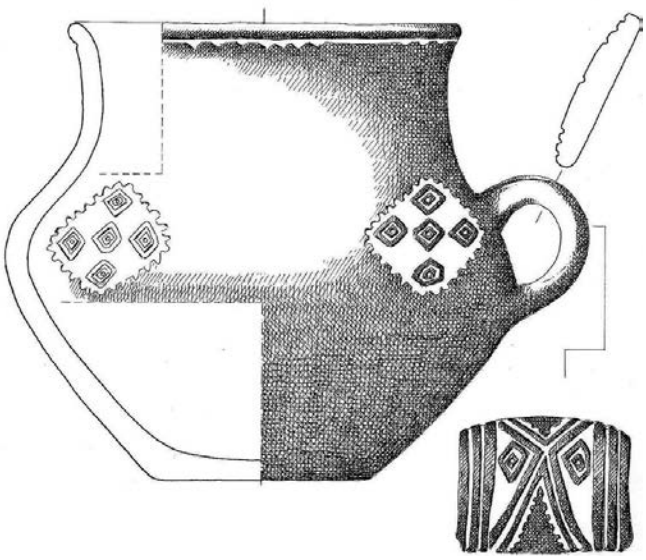
Slika 17 - Čepasti nastavak na tunelastoj ručki
Fig. 17 – Lug end on a tunnel handle



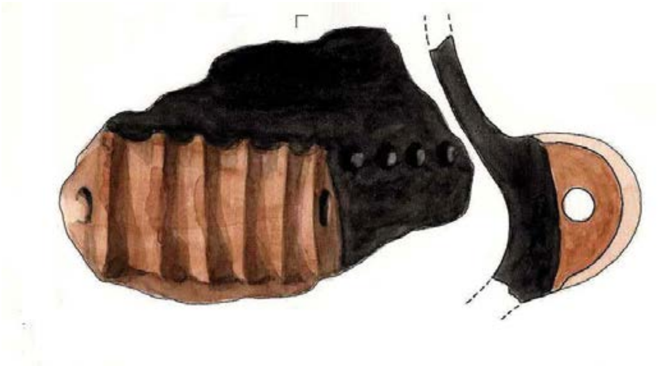
Slika 18 - Konkavan, konveksan i sedlasti presjek na tunelastim ručkama
Fig. 18 – Concave, convex and saddle-shaped cross-sections of tunnel handles

S obzirom na smještaj ručke mogu biti tunelaste ili trakaste. Tunelasta ručka postavljena je horizontalno u odnosu na stijenku posude i može imati konkavan, konveksan, sedlasti (*Slika 18*) ili elipsasti presjek (*Slika 19*).

Ručke većih dimenzija i debljih stijenki smještene su uglavnom na prijelazu ramena u trbuh, dok one manjih dimenzija mogu biti postavljene i na prijelazu vrata u rame posude. Ovaj oblik ručke javlja se najvećim dijelom na loncima koji zbog svojih dimenzija zahtijevaju veće i deblje ručke kako bi rukovanje posudom bilo što lakše. Najčešće se radi o loncima koji su služili za kuhanje hrane, pa su ručke neophodan dio morfologije takvih posuda kako bi se omogućilo dizanje i stavljanje na vatru. Velika količina keramičkih kuka za vješanje posuda iznad vatre zabilježena je na gotovo svim vučedolskim lokalitetima, pa tako i na obrađenim lokalitetima na Ervenici i Damića gradini (*Slika 26*).



Slika 19 - Elipsasti presjek na tunelastoj ručki
Fig. 19 – Elliptical cross-section of a tunnel handle

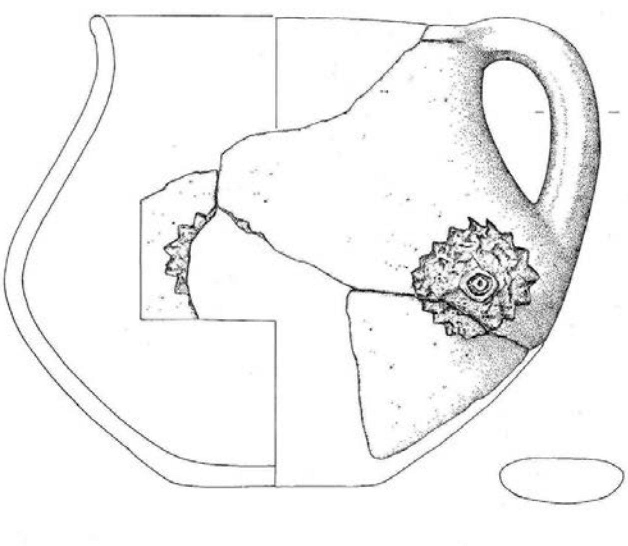


Slika 20 - Žlijebljena tunelasta ručka
Fig. 20 – Grooved tunnel handle

Slika 21 - Lonac za skladištenje namirnica sa 2 obične i 4 žlijebljene tunelaste ručke
Fig. 21 – Storage pot with two simple and 4 grooved tunnel handles

Tunelaste ručke na loncima vrlo često su ukrašene žlijebljenjem (*Slika 20*). Ova vrsta ukrašavanja mogla je imati dvojaku funkciju, estetsku i funkcionalnu. Naime, žlijebljene tunelaste ručke možda su namjerno oblikovane na taj način kako bi se omogućilo lakše rukovanje posudom, jer žlijebljene udubine lakše prianjaju uz prste i na taj način onemogućuju da posuda isklizne iz ruke, a u pravilu se nalaze na loncima (*Slika 21*).

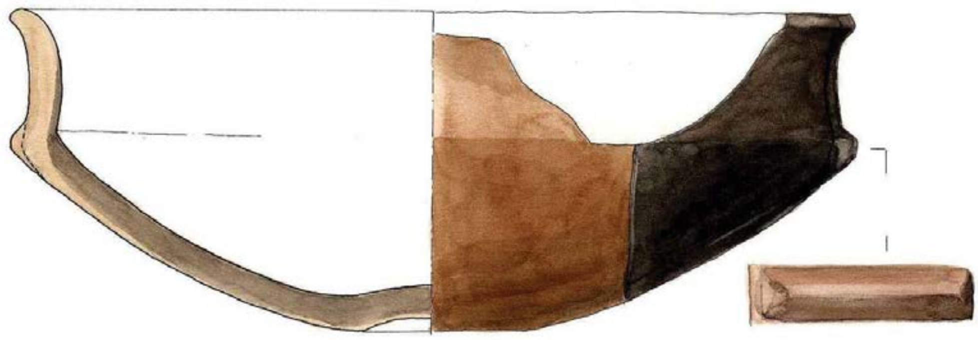
Trakaste ručke postavljene su vertikalno u odnosu na stijenku posude, a presjek im može biti elipsast, konkavan ili konveksan. Gornji dio ručke u pravilu je smješten na rubu, a donji završava na ramenu ili trbuhu posude. Ova vrsta ručki većinom se nalazi na zdjelama (*Slika 22*), vrčevima i šalicama (T. 30).



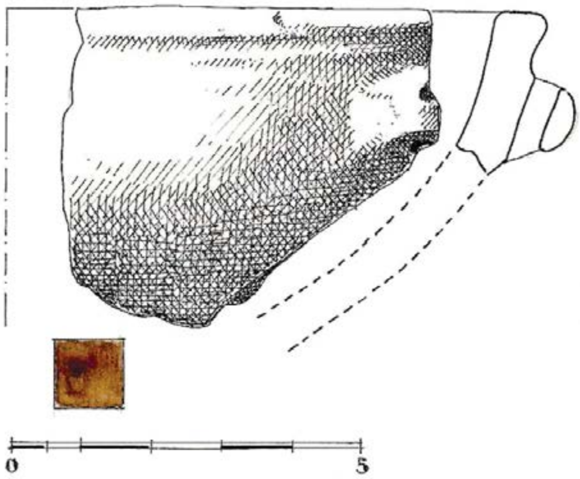
Slika 22 - Trakasta ručka na zdjeli
Fig. 22 – Strap handle on a bowl

Kao i ručke, dršci se razlikuju po svom smještaju, orijentaciji, presjeku, obrisu i tehnologiji izrade. Dršci mogu biti prilijepljeni i razmazani na stijenku posude, izvučeni iz stijenke posude ili modelirani. Njihova namjena može i ne mora imati naglašenu funkcionalnost. Držak može služiti za držanje i pridržavanje, odnosno kao vrsta oslonca koja olakšava podizanje i pomicanje posude s jednog mjesta na drugi.

Smještaj drške različit je s obzirom na tip posude. Kod niskih zdjela nalazi se odmah ispod ruba ili na najširem dijelu posude (*Slika 23*). Drške mogu imati i ušicu koja služi za vješanje posude (*Slika 24*), a vrlo često dolaze u kombinaciji s ručkama.



Slika 23 - Drška na zdjeli
Fig. 23 – Grip on a bowl



Slika 24 - Elipsasta ušica na zdjeli s vertikalno probušenom rupicom
Fig. 24 – Elliptical loop on a bowl, with a vertical hole

PROBLEM TERMINOLOGIJE

Terminologija je ključna za usvajanje specifičnih znanja o znanosti na koju se odnosi, a ovisi o količini i kvaliteti prethodno usvojenog znanja (Erdeljac & Willer Gold 2009). Nažalost, u većini stručne literature koja se bavi keramičkim nalazima nema ujednačene terminologije, što dovodi do nepreglednog broja naziva i izraza za primarne i sekundarne dijelove posude te način i stil ukrašavanja. Tako se npr. dršci terminološki još uvijek nazivaju isključivo po vizualnoj percepciji, pa imamo bradavičasate, gredaste, srcolike, šiljaste, dugmetaste, rogolike, nosolike, jezičaste, čepaste ili sedlaste drške. Vrlo često nazivaju se aplikacijama, ispupčenjima, plastičnim naljepcima, izbočinama, grbicama ili ručkama. Slična je situacija s definiranjem oblika posude (kruškoliki, polukuglasti, kuglasti, trbušasti oblici) ili primarnih dijelova posude (obod, recipijent, prijelom).

Ovakva terminologija još uvijek se oslanja na tradicijsku arheologiju šezdesetih i sedamdesetih godina 20. stoljeća. Možda najzanimljivija pojava je definicija recipijenta. Tako netko pod recipijentom podrazumijeva otvor, a netko obris posude: pa imamo okrugli, ovalni, bikonični ili zaobljeni recipijent. Prema definiciji na *Hrvatskom jezičnom portalu*[2] recipijent je onaj koji prima, usvaja; primatelj, primalac (*recipijent informacija*), bolesnik koji transfuzijom prima krv (*med.)* ili posuda za hvatanje tekućina i plinova (*kem.)*. Iz ovog vrlo ekstremnog primjera izgleda da nam je diskursivna praksa, barem kada je o ovom dijelu arheologije riječ, u krizi što je dovelo do nedostatka kritičkog promišljanja i uvođenja standarda koji su općeprihvaćeni. Iako je terminologija morfologije keramičke posude općeprihvaćena i upotrebljava se u većini stručnih tekstova koji se bave analizom keramičkog materijala, izgleda da je nama „milija“ metoda *copy-paste*. Suvremena arheološka znanost značajno je napredovala u posljednjih nekoliko desetljeća pogotovo kada je riječ o novim tehnologijama i interdisciplinarnom pristupu koji je postao dio interpretativnih alata vrednovanja i promišljanja, pa tako i u usvajanju određene terminologije i analitičkih pristupa.

2 http://hjp.novi-liber.hr/index.php?show=search

Kod terminologije i interpretacije keramičke građe uočavaju se dva ključna problema. Kao što je već naglašeno, keramička građa još se uvijek većinom gleda kao „koristan alat“ za rekonstrukciju tipološko-kronoloških sekvenci bez dodatne analitičke dimenzije koja uključuje rekonstrukciju socijalno-ekonomskih pitanja, tehnoloških promjena i inovacija, iskorištavanja resursa itd. Drugi problem predstavlja značenje, odnosno terminologija koja se odnosi na oblike keramičkih posuda, tehnike ukrašavanja i tretiranja površine, dijelove keramičkih posuda itd.

Vrlo je interesantno slijediti pisane tragove pojedinih naziva za tehniku ukrašavanja ili oblik posude kako bi se došlo do pojašnjenja u vidu slike ili nacrtane table. Zanimljivo je da su razne varijante jezičnih konstrukcija ili riječi, koje danas nisu u duhu hrvatskog jezika, preživjele taj dalek pisani put i postale glavna spona u diseminaciji znanja. Neki termini povlače se po znanstvenim člancima i kataloškim jedinicama poput duhova prošlosti, a njihovo stvarno značenje rijetki znaju opisati ili objasniti (npr. subkutane ušice). Kao da je riječ o običajnom pravu koji se ne smije pogaziti. Mislim da neću pogriješiti ako napišem da arheolozi koji su uveli spomenute izraze nisu niti slutili koliko će strahopoštovanja oni izazvati, a vjerojatno nisu niti mislili da će ostati zapisani odsad pa zauvijek. Čitanje znanstvenih tekstova, odnosno pisane riječi kojom upijamo i prenosimo nove znanstvene ideje i spoznaje, kritički promišljamo znanstvenu problematiku, stvaramo nove teoretske okvire i metode, trebala bi nas poticati na dodatna promišljanja, a ne nas u tome sputavati.

8. METODOLOGIJA OBRADE KERAMIČKIH NALAZA

Brojni su radovi posvećeni tipološkoj klasifikaciji keramike, posebno usmjereni na određivanje tipa posude. Jedan od najznačajnijih je već spomenuta knjiga A. Shepard (1985) koja je svoje prvo izdanje doživjela još 1956. godine, a koja je i danas mnogim arheolozima polazna točka u deskripciji keramike i rad na koji se referiraju svi oni koji se bave analizom keramike. U definiranju pojedinih oblika posude postoji nekoliko varijanti, a A. Shepard navodi tri osnovna pristupa: *funkcionalni, estetski i taksonomski*.

FUNKCIONALNA KOMPONENTA

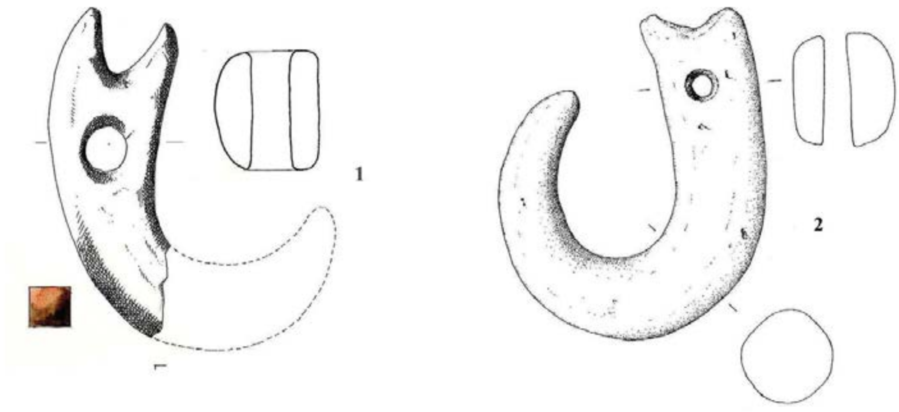
Funkcija posude oduvijek je privlačila istraživački interes jer namjena posude može ukazivati na običaje i aktivnosti određene zajednice. Međutim, veza između oblika i upotrebe nije uvijek jedinstvena. Naime, isti oblik mogao je biti upotrebljavan za različite namjene, a isto tako različiti oblici posuda koristili su se u istu svrhu.

Određivanje funkcije posude ima dva smjera, ili bolje rečeno pristupa, koji su u interesnom fokusu arheologa koji se bave analizom funkcionalne komponente. Jedan je usmjeren na oblik posude koju je lončar odabrao da bi zadovoljio određenu svrhu. Npr. posuda koja je služila za kuhanje mora biti otporna na termalne šokove povezane s naglim hlađenjem i zagrijavanjem. Nadalje, mora biti dovoljno velika i imati široki otvor za dodavanje i vađenje hrane te ručke ili drške kako bi se lakše podizala s vatre. Kao što smo vidjeli u prethodnim poglavljima, tretiranje vanjske površine težim teksturama poput barbotina te uglačana unutrašnja površina osigurat će posudi nepropusnost i čvstoću (*Slika 25*).

Drugi pristup je fokusiran na pronalaženje tragova na posudi koji bi ukazivali na njezinu stvarnu uporabu jer je na najjednostavnijoj razini primarna utilitarna funkcija posude upravo njezin sadržaj. Uzimajući za primjer ponovo posudu koja je služila za kuhanje, mnogi tragovi mogu se

Slika 25 – Restaurirani lonac s Damića gradine. Tijelo je tretirano barbotinom, vrat je uglačan, a 4 drške nalaze se na prijelazu vrata u rame posude
Fig. 25 – Restored pot from Damića Gradina. The body has been treated with barbotine, the neck is polished and there are four grips where the neck turns into the vessel's shoulder.

prepoznati i analizirati po njezinim vanjskim i unutrašnjim promjenama. Dno posude može biti oksidirano na dijelu koji je bio direktno izložen vatri, mogu se prepoznati ostaci hrane u unutrašnjosti posude ili kemijski tragovi hrane koji su apsorbirani u stijenku posude (Banning 2000: 179-180). Oksidacijske mrlje na vanjskoj strani posude pokazuju da je posuda bila direktno izložena vatri, međutim, ovakvi tragovi mogu ukazivati i na poziciju posude u odnosu na izvor vatre. Također, kod posuda za kuhanje vrlo često su vidljivi tragovi taloga čađe na dnu posude kao posljedica izlaganja vatri ili se mogu naći u unutrašnjoj strani posude kao ostaci hrane. Međutim, izostanak oksidacijskih mrlja s čađave površine ukazuje da posuda nije bila u direktnom kontaktu s vatrom već je visila iznad nje (Hally 1983). Ovome u prilog išle bi, već spomenute, keramičke kuke za vješanje posuda koje su u velikom broju nađene na lokalitetima vučedolske kulture (*Slika 26*).



Slika 26 - Keramičke kuke za vješanje posuda iznad vatre s lokaliteta na Ervenici (1) i Damića gradini (2)
Fig. 26 – Pottery hooks for hanging vessels above the fire, from the sites of Ervenica (1) and Damića Gradina (2)

Keramičke posude zapravo su vrlo zahvalne za analizu jer ostavljaju na sebi veliki broj fizičkih i kemijskih tragova koji upućuju na njihovu stvarnu uporabu. Jedan od pristupa analizi funkcije uključuje i tragove korištenja (eng. *use-alteration analysis*) te tragove trošenja/oštećenja na posudi (eng. *use-wear analysis*). Prvi radovi i analize na ovu temu pojavili su se još u 70-im godinama 20. stoljeća (za pregled vidi: Vieugué 2014) te intenzivno nastavili u 80-ima (Hally 1983; Schiffer & Skibo 1989; Skibo 1992).

Tragovi na posudi javljaju se na dva načina: kao posljedica mehaničkog kontakta između posude i alata koji se koristio tijekom pripreme hrane (miješanje, mljevenje, struganje), čišćenja posude ili skladištenja, a uzrokuje ogrebotine i razne deformacije na posudi. Drugi je vidljiv zbog tragova koji nastaju usljed kemijskih reakcija hrane u posudi (fermentacija, isparavanje vode, kristalizacija soli) koja ulazi u pore i stvara ljuštenje (Skibo 1992; 2013; Arthur 2002; 2003). U stručnoj literaturi poznatiji su kao abrazivni i neabrazivni procesi. Svojstva keramičke posude u velikoj mjeri utječu na ove procese, pogotovo čvrstoća, prisutnost pora, primjese (veličina, vrsta, količina, distribucija, orijentacija), oblik posude i tretman površine. Tako će glačane površine imati veću otpornost na abrazije od onih s teškim teksturama i porama. Organski materijal koji izgara tijekom pečenja stvara pore na keramici i veliku poroznost pa su shodno tome takve posude osjetljivije na struganje (Skibo 2013: 120-121). Međutim, vidjeli smo da će organske primjese, ako su krupnije i manje zastupljene, osigurati posudi otpornost na lomljenja i mehaničke udarce (Skibo et al. 1989).

Analize tragova upotrebe na posudi posebno su važne:

a) zbog mnogo preciznijeg određivanja upotrebne funkcije;

b) jer primarna upotreba uvijek ne odgovara stvarnoj upotrebi posude;

c) radi određivanja sekundarne upotrebe posude (Skibo & Schiffer 1995).

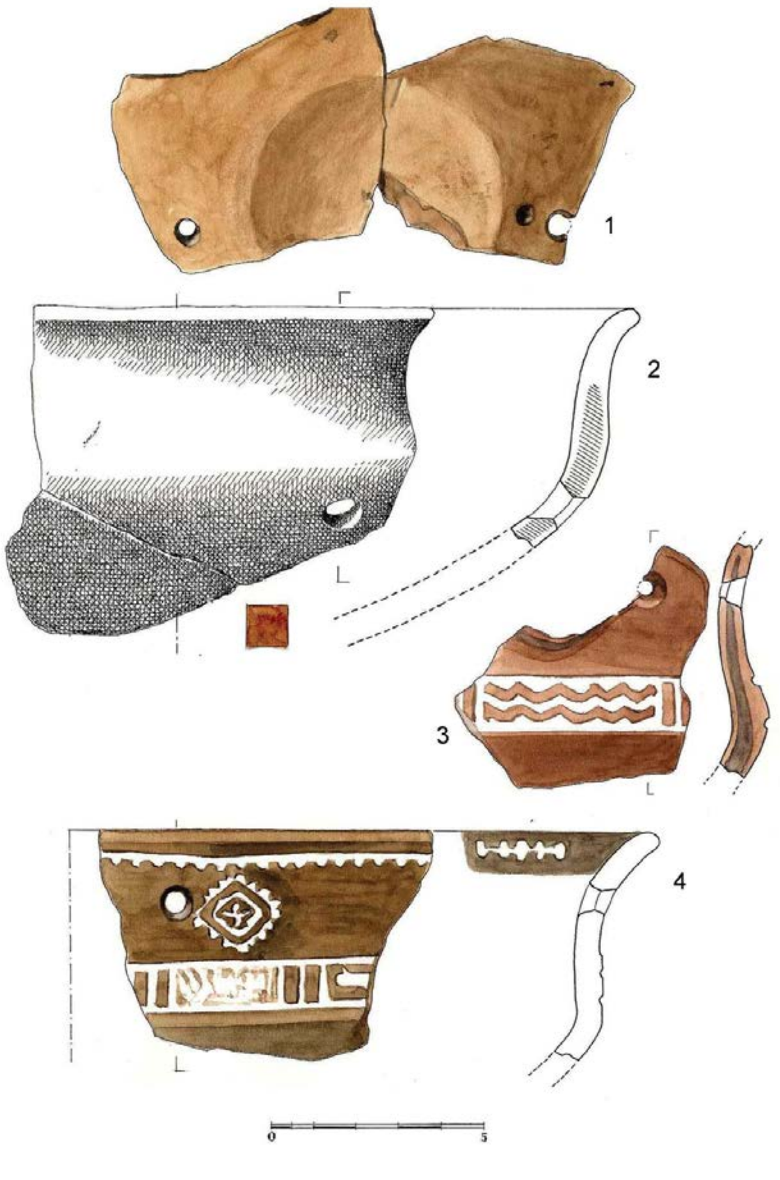
Prilikom definiranja uporabne funkcije keramičke posude svakako je bitno naglasiti da se svi navedeni parametri trebaju sagledati zajedno jer sami za sebe mogu navesti na krive interpretacije. Jedan od razloga je što je posuda mogla biti multifunkcionalna, odnosno služiti za nekoliko svrha, što nije neuobičajena pojava. Tako je posuda u kojoj se kuhalo meso ili povrće tijekom dana, navečer mogla služiti za obavljanje ritualnih ili nekih drugih simboličkih radnji (Skibo 2013). Takvi se tragovi također mogu prepoznati na posudi. S druge strane, neke posude imaju ekskluzivnost u uporabnom smislu i namijenjene su za pripravljanje samo jedne vrste namirnica.

Etnoarheološka istraživanja zajednice Kalinga na Filipinima pokazuju da se riža kuhala u posebnoj vrsti posuda, dok su se jela od mesa i povrća pripremala u sasvim drugoj vrsti posuda (Skibo 2013). Isto vrijedi i za posude za kuhanje mlijeka o čemu svjedoči tradicija iz Dalmatinske zagore. Mlijeko se kuhalo u posebnoj vrsti zdjele sa širokim otvorom, koja se nazivala „lopuža", a koja nije bila u direktnom kontaktu s vatrom već je visila iznad ognjišta (komina). Nakon određenog ciklusa kuhanja posuda bi se čistila grebanjem žlicom te struganjem ostataka skorenog mlijeka u unutrašnjosti posude, bez pranja (*Slika 27*).

Slika 27 - Posuda za kuhanje mlijeka („lopuža"). Sredina prošlog stoljeća, Blato na Cetini
Fig. 27 – Milk-cooking vessel ('lopuža'). Mid-20th c., Blato na Cetini

Također treba imati na umu da su neke posude upotrijebljene za sekundarnu svrhu ili su reciklirane. U okviru arheologije i antropologije ovaj segment razvio se u poseban smjer koji se intenzivno razvija u posljednjih nekoliko desetljeća, a naziva se *fragmentacija* (Chapman 2000; Chapman & Gaydarska 2007). Arheolozi vrlo često gledaju na razbijene materijalne ostatke kao rezultat isključivo slučajnog procesa, radnji koje se nisu namjerno dogodile (Chapman & Gaydarska 2007). Naša percepcija pritom ostaje ograničena na pasivnu ulogu predmeta, umjesto na njegovu aktivnu ulogu u društvu. U ovom smislu fragmentacija kao poseban znanstveni smjer nastoji proširiti naše spoznaje o predmetu tako da se on ne gleda kao izolirani nalaz ili ulomak, već u širem kontekstu društvenih veza, ritualnih radnji ili simboličkog značenja.

Sekundarna upotreba posuda vrlo je uobičajena u današnjim tradicijskim zajednicama isto kao što je vjerojatno bila u prapovijesnim društvima. Nakon što posuda odradi svoju primarnu funkciju, može se upotrijebiti za neku drugu svrhu kako bi se maksimalno iskoristio njezin životni vijek. Npr. kada posuda za kuhanje postane vodopropusna ona se može iskoristiti za skladištenje namirnica (Skibo 2013). Kako posude za kuhanje imaju najkraći vijek trajanja, između nekoliko mjeseci do godine dana prema nekim etnoarheološkim istraživanjima (Longacre 1985; Tani & Longacre 1999), one su većinom završavale u sekundarnoj funkciji prije nego bi ušle u arheološki kontekst. Recikliranje posuda ima dugi tradicijski zapis, a prema etnoarheološkim istraživanjima sekundarna upotreba i recikliranje vrlo su česta pojava u tradicionalnim društvima (Hally 1983a; Hayden & Cannon 1983; Deal & Hagstrum 1995; Senior 1995; Deal 1998; Wilson & Rodning 2002; Skibo 2013). Na keramičkim ulomcima sekundarna upotreba posude najvidljiva je po popravcima, odnosno namjerno probušenim rupama na mjestima gjde su se dogodili lomovi. Rupe



Slika 28 - Primjeri sekundarne upotrebe posuda - popravci na zdjelama s lokaliteta na Ervenici (1) i Damića gradini (2, 3, 4)
Fig. 28 – Examples of secondary use of vessels – repairs on bowls from the sites of Ervenica (1) and Damića Gradina (2, 3, 4)

su bile povezane nekom vrstom organskog materijala kojeg, s obzirom na prirodu materijala, u arheološkom okruženju ne nalazimo. Etnoarheološka istraživanja pokazala su da se uglavnom radi o trakama kože ili biljnim nitima (Senior 1995: 101). Ovakve posude u svojoj sekundarnoj funkciji mogle su poslužiti za skladištenje i čuvanje krutih namirnica poput žitarica, sjemenki ili začina (*Slika 28*).

Kao što je već rečeno, jedno od „najpoznatijih" recikliranja je usitnjavanje razbijenih posuda u grog koji se koristio kao primjesa. Ostale vrste reciklaže uključuju izradu raznih alata od razbijenih ulomaka (strugala za obradu keramike ili drugog materijala, žlice), pršljenaka za vretena te utega za mreže, što je vrlo česta pojava na prapovijesnim nalazištima. Recikliranje keramičkih ulomaka zabilježeno je i u građevinskim zahvatima, kao npr. kod popločanja keramičkih peći (Balen 2005) ili peći za pečenje kruha (Đuričić 2014; Vuković 2015). Razbijene posude također su se koristile kao kalupi za izradu posuda (Rice 1987) ili kao podloge za pečenje (Wilson & Rodning 2002).

Razna etnoarheološka istraživanja životnog vijeka posude (eng. *ceramic uselife*) započela su još 60-ih godina prošloga stoljeća kada je etnograf G. M. Foster (1960) shvatio potencijal podataka o životnom vijeku posude za arheološku interpretaciju. U početku su ova istraživanja bila u formi intervjua s lončarima, a već u 70-ima su izvršena metodološki sistematiziranija istraživanja koja su uključivala životni vijek svake posude u domaćinstvu te se na taj način dobila srednja vrijednost funkcionalnih klasa (David 1972; DeBoer 1974). Danas je istraživanje životnog vijeka posude predmet mnogih znanstvenih članaka i analiza koje se proučava kroz funkciju posude, učestalost upotrebe, mehaničku čvrstoću posude itd. (Longacre 1985; Tani & Longacre 1999; Sullivan 2008).

Iz ovog pregleda jasno je da određivanje funkcije posude zahtijeva niz analiza i komparativnih metoda:

a) arheološki kontekst nalaza (kuće, grobovi, otpadna mjesta, religijski kontekst);
b) oblik posude koji uključuje stabilnost, kapacitet, dostupnost sadržaju posude i mogućnost transporta;
c) tretman površine (posebno važan kod vodopropusnosti i mehaničkih oštećenja);
d) tragovi korištenja i oštećenja na posudi (čađa, oksidacijske mrlje, abrazivni i neabrazivni procesi);
e) organski ostaci u stijenkama posude (lipidi biljnog i životinjskog porijekla);
f) ukrasi (uloga posude u društveno-političkom životu zajednice ili ritualnom kontekstu).

A. Shepard još je 1956. prva ukazala na važnost analize metričkih vrijednosti u definiranju oblika posude, naglašavajući da nam upotreba posude govori o aktivnostima i običajima zajednice koja ju je koristila. Rice (1987: 207) također naglašava da su „morfološke karakteristike, atributi oblika i tehnologije, usko povezani s njezinom podobnošću za određene aktivnosti".

Općenito gledajući posude za svakodnevnu upotrebu služile su za pripremu hrane, skladištenje i transport (Rice 1987: 208-210). Tehnološki izbor, između ostalog, uljučivao je veličinu i oblik posude kako bi posuda zadovoljila uvjete svoje namjene. Promjer otvora vrlo je bitan za određivanje oblika posude. Ako je otvor posude isti ili približno jednak maksimalnom dijametru posude, onda se on karakterizira kao neograničen otvor, a u ovu kategoriju spadale bi najvećim dijelom zdjele. Ako je otvor manji od maksimalnog dijametra posude, onda se radi o ograničenom otvoru koji je karakterističan za lonce (Rice 1987). Tako će npr. posuda za skladištenje tekućine imati ograničen otvor radi izbjegavanja prolijevanja, dok će posuda za kuhanje imati neograničen otvor radi lakšeg miješanja, vađenja i stavljanja namirnica u posudu.

Teško je odrediti upotrebu određene posude u prapovijesti, međutim, bitno je napomenuti da se svi pokazatelji moraju uzeti u obzir prilikom konačne interpretacije. Nije dovoljno analizirati samo oblik ili ostatke organskih ostataka u posudi jer kao što smo vidjeli, posuda može biti multifunkcionalna ili sekundarno upotrijebljena. Isto se odnosi na samostalno proučavanje tragova na posudi ili nekog drugog segmenta. Arheolozi vrlo često interpretiraju određenu funkciju keramičke posude koja je proizišla isključivo iz subjektivnih zapažanja, usvojenih termina i usporedbi s modernim, povijesnim i etnološkim primjerima.

Vrlo je važno gledati na funkciju posude kao na kompleksan parametar koji nije tako lako čitljiv kako se nama na prvi pogled čini. Ono što je važno da u interpretacijskom smislu treba biti vrlo oprezan, pritom uzimajući u obzir sve relevantne i dostupne analize koje smo proveli: arheološki kontekst nalaza, arheometrijske analize, tragove upotrebe na posudi, organske ostatke, morfologiju posude te ostale dokaze ljudske aktivnosti u istom okruženju.

ESTETSKA KOMPONENTA

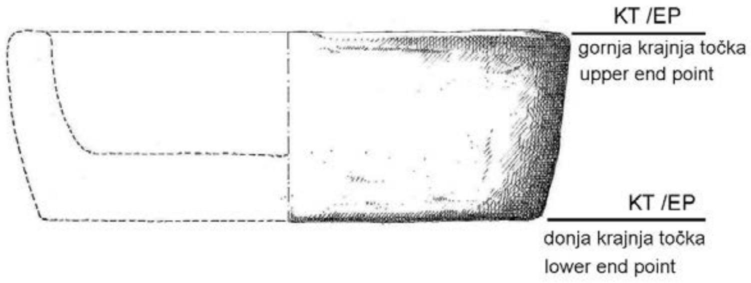
Estetska komponenta je vezana za oblik posude i njezine proporcije, a analizom stilskih obilježja možemo utvrditi socijalnu, ekonomsku, religijsku i umjetničku komponentu, kao i relativnu dataciju.

TAKSONOMSKA KOMPONENTA

Taksonomska komponenta odnosi se na proporcije, odnosno mjere u svrhu deskripcije keramičkih oblika. To rezultira stvaranjem klasifikacije i terminologije pojedinih oblika, kao što su zdjela, vrč, tanjur itd. (Shepard 1985: 224-225). Taksonomijom se može klasificirati gotovo sve, a u arheologiji ovaj pojam koristimo za klasifikacijski sustav koji ima hijerarhijsku strukturu, odnosno sustav u kojem su osnovni oblici grupirani u veće grupe ili su podijeljeni u manje ili oboje (Adams & Adams 1991: 202). Keramičke analize vrlo često započinju i završavaju s taksonomskim podacima koji su dizajnirani da organiziraju veliku količinu arheološkog materijala i usporede je s drugim objavljenim materijalom. Analiza tipova i varijanti jedna je od dominantnih taksonomskih tehnika (Neff 1993: 24-25).

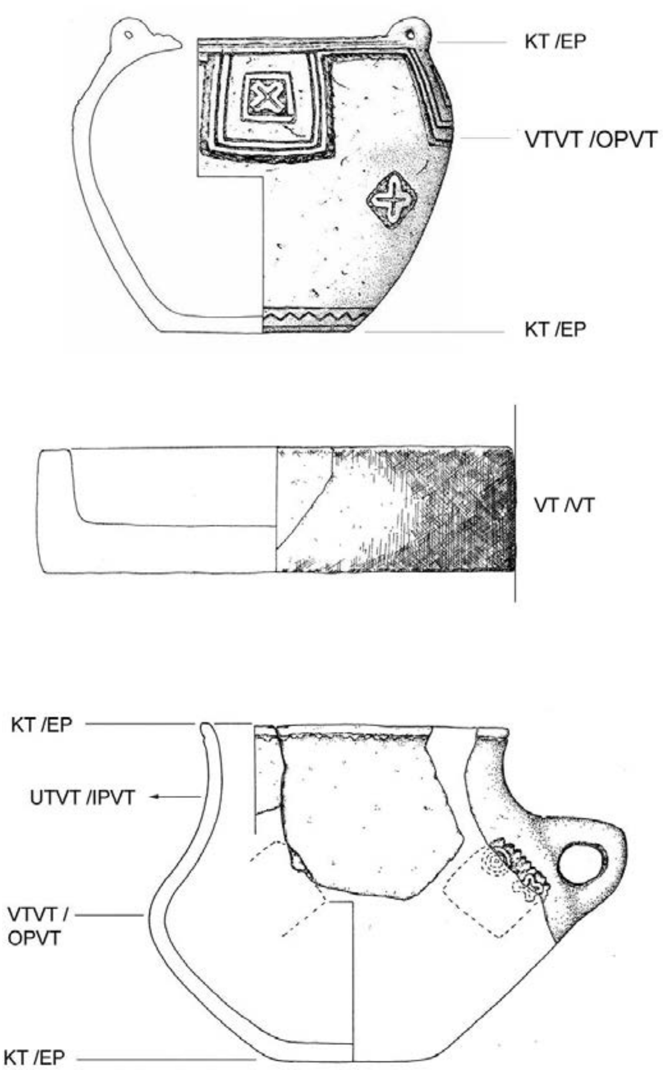
Da bi se izbjeglo stvaranje iskrivljenih grupa podataka pri analizi keramičkog materijala, jedan od pristupa je izdvajanje oblika na osnovi geometrijskih parametara. Za opće prihvaćanje ovog pristupa zaslužna je A. Shepard koja zastupa geometrijski kriterij pri analizi oblika posude i njezinoj klasifikaciji jer su naša opažanja direktno usmjerena na proporciju i konture, odnosno obris posude. Ovakav pristup koristi se u većini literature koja se bavi analizom keramičkih tipova, a koristio se pri klasifikaciji keramičkog materijala čiji su rezultati prikazani u drugom dijelu knjige. Proporcije se lako daju izračunati, dok je s konturama malo teže, a postoje dva pristupa koja se koriste: analiza općih karakteristika obrisa i usporedba oblika s geometrijskim tijelima. Osnovni koncept analiziranja posude koji je uveo Birkhoff 1933. godine (Shepard 1985: 226) koristan je u crtanju oblika posude te u deskripciji i klasifikaciji. On je uzeo u obzir točke obrisa posude na kojima počiva naše oko. Postoje četiri tipa takvih karakterističnih točaka:

1. *Krajnje točke krivulje na dnu i rubu* (KT) – predstavljaju krajnje točke na otvoru i dnu posude (*Slika 29*)



Slika 29 - Primjer krajnjih točki na posudi (KT)
Fig. 29 – Examples of end points on vessels (EP)

2. *Točke vertikalne tangente* (VT). Postoje dvije vrste tangentnih točaka – vanjska točka vertikalne tangente (VTVT) koja određuje najveći promjer na okruglom obliku, i unutrašnja točka vertikalne tangente (UTVT) koja određuje minimalni promjer na hiperboličnom obliku posude (*Slika 30*).

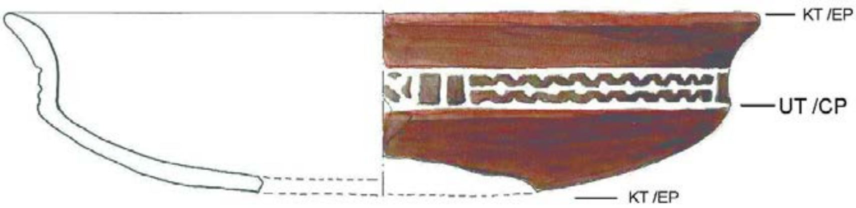


Slika 30 - Primjer vertikalnih tangentnih točaka na posudi (VT, UTVT, VTVT)
Fig. 30 – Examples of points of vertical tangent on vessels (VT, IPVT, OPVT)

3. *Točke infleksije* - gdje se krivulja mijenja iz konkavne u konveksnu i obrnuto (TI). Oblici s točkom infleksije uglavnom su S-profilirani oblici (*Slika 31*).

Slika 31 -Primjer točke infleksije, zajedno s točkama vertikalne tangente (TI)
Fig. 31 – Example of a point of inflection, together with points of vertical tangent (IP)

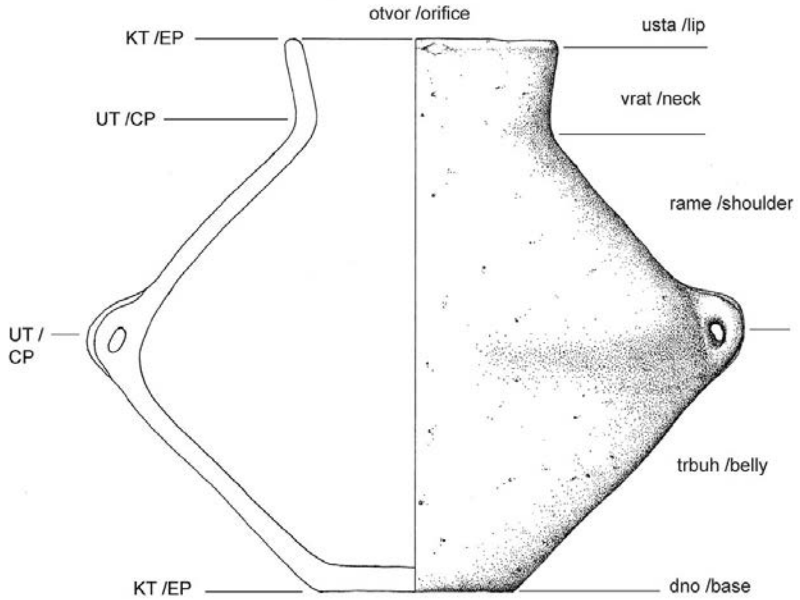
4. *Ugaone točke* - gdje se smjer tangente naglo mijenja, s oštrim promjenama u obrisu (UT). Ugaona točka na keramičkom obliku tipična je za posude bikonične profilacije (*Slika 32*).



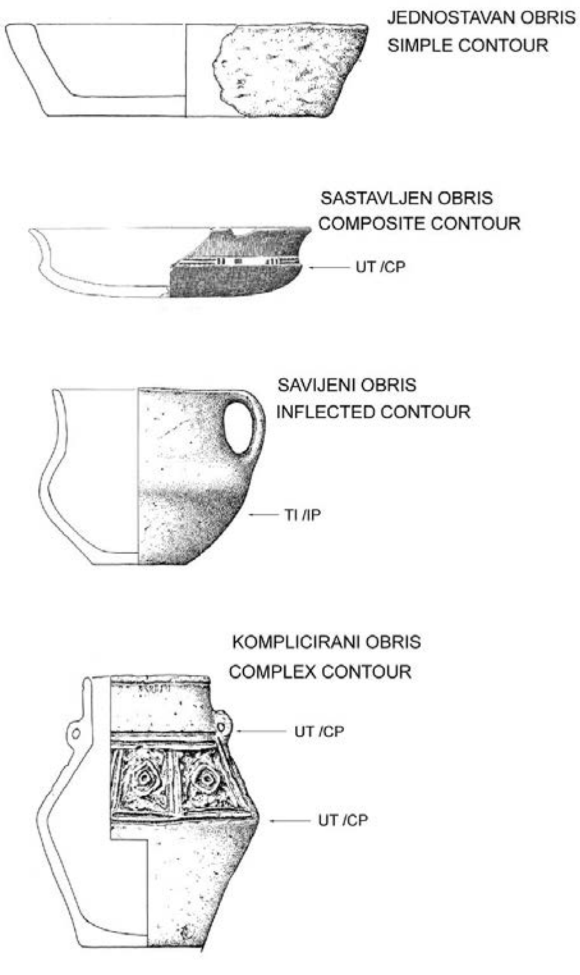
Slika 32 - Primjer ugaone točke zajedno s ostalim karakterističnim točkama (UT)
Fig. 32 – Example of a corner point together with other characteristic points (CP)

S pomoću karakterističnih točaka lako možemo izračunati dimenzije posude, odrediti tip obrisa i stupanj njegove zastupljenosti. Svaka od tih točaka određuje osnovni oblikovni razred (Horvat 1999: 58). Po karakterističnim obrisima možemo odrediti i dijelove posude, tako da se primjer primarnih dijelova posude može prikazati i opisati unutar karakterističnih obrisa posude (*Slika 33*).

Geometrijski pristup temelji se na sličnosti pojedinih tipova posude s geometrijskim tijelima. Tako razlikujemo kuglaste, valjkaste, elipsoidne, hiperbolične oblike, koji se nadalje dijele na jednostavne, komplicirane, sastavljene i savijene oblike posude (Shepard 1985; Horvat 1999: 74-79). Jednostavni oblici imaju ravne ili zaobljene stijenke posude, a njihov obris karakterizira nedostatak točke infleksije i ugaone točke. Sastavljen obris imaju one posude koje imaju jednu ugaonu točku. Savijeni obris imaju oni oblici posuda koji imaju samo jednu točku infleksije. Komplicirani obrisi su oni sa dvije ili više točki infleksije ili ugaonih točki (Horvat 1999: 190). U klasifikaciji



Slika 33 - Primjer primarnih dijelova posude uspoređenih s karakterističnim obrisima posude
Fig. 33 – Example of a vessel's primary parts compared with its characteristic contours



Slika 34 - Tipovi obrisa posude
Fig. 34 – Types of vessel contours

keramike koja se koristi u našoj stručnoj literaturi, jednostavnim oblicima pripadali bi konični i zaobljeni oblici, sastavljeni oblici odnosili bi se na bikoničnu profilaciju, savijeni na S-profilirane oblike, a komplicirani oblici pripadali bi bikoničnim ili S-profiliranim oblicima ponešto razvijene profilacije (*Slika 34*).

Šira klasifikacija osnovnih keramičkih oblika koju donosi A. Shepard (1985), a koju su prihvatili i drugi autori, odnosi se na nekoliko parametara koje treba izabrati prema njihovim karakteristikama i važnostima (Shepard 1985: 224-247; Horvat 1999: 57-79). To su:

Simetrija	pri definiciji osnovnih oblika posude simetriju ne tretiramo posebno, već se polazi od pretpostavke da su oblici posude simetrični
Točke na obrisu	ovdje treba uzeti u obzir siluetu obrisa, promjenjivosti na liniji obrisa i točke na obrisu
Struktura	za strukturu posude važna je raspoređenost dijelova posude i njihov međusobni odnos
Tip obrisa	ugaona točka i točka infleksije pružaju osnovu za klasifikaciju obrisa posude koji može biti jednostavan, sastavljen, kompliciran ili savijen
Sličnost s geometrijskim oblicima	oblik posude možemo usporediti s nekim geometrijskim tijelom ili kombinacijom različitih geometrijskih oblika. Točke tangente i ugaone točke na obrisu označuju dio gdje se spajaju dva dijela posude, pri čemu je svaki dio usporediv s nekim geometrijskim oblikom ili njegovim dijelom
Proporcionalnost	stabilnost posude ovisna je o njezinoj proporcionalnosti, koja je povezana s funkcijom i obrisom
Određivanje osnovnih oblika, podskupina i oblikovnih skupina	određivanje keramičkih oblika na osnovne skupine prema njihovim oblikovnim karakteristikama i proporcionalnim omjerima

Sagledavajući veliki raspon mogućnosti i informacija koje nam pruža keramički materijal možemo se referirati na izjavu Flindersa Petriea kako je „keramika najveći izvor informacija arheologa“ (Petrie 1904: 15-16). Količina keramičkog materijala na arheološkim lokalitetima, kao i njezina neuništivost i otpornost, pruža nam nebrojene i pritom vrlo važne indikatore o kulturnim, socijalnim, ekonomskim, religioznim i tehnološkim postignućima određene zajednice i razdoblju u kojem je nastala. Tu ne smijemo zanemariti i kronološku opredijeljenost unutar relativne ili apsolutne datacije.

Pokušavajući sažeti osnovne parametre pri analizi keramičkog materijala, treba naglasiti da je odabir podataka koje želimo analizirati i dobiti od keramičkog materijala prvi i najbitniji korak pri uspostavi analitičke metode. Pouzdanost naših podataka ovisit će upravo o izboru tih svojstava. Parametre za analizu treba odabrati unutar ovdje prikazanih brojnih varijabli koje pruža keramički materijal – oblik, veličina, tekstura, tvrdoća, čvrstoća, boja, ukrašavanje i tretiranje površine, izbor materijala, tehnika oblikovanja, atmosfera i način pečenja, stratigrafski kontekst. Tu su još razne arheometrijske analize koje se odnose na sastav gline i primjesa te porijeklo sirovine. Naravno da će izbor parametara ovisiti o prirodi lokaliteta i keramičkom repertoaru, a isto tako i o našim afinitetima. Ako je naš interes usmjeren na razmjenu i kulturne kontakte, tada će i odabir parametara za analizu uključivati izvor gline i njezin sastav. Fizičke karakteristike bit će osnovni parametar pri analizi tehnoloških dostignuća, dok stilskom analizom možemo dobiti indirektne kronološke dokaze kao i socijalnu, ideološku ili religioznu komponentu. Parametri koje ćemo odabrati ako želimo doznati funkciju posude dijelom su vezani za fizičke karakteristike, kao i one koji su usmjereni na razne analize koje nam pružaju tragovi na keramičkoj posudi.

Bitno je napomenuti da odabir metode i parametara za analizu nije uvijek u korelaciji s onim što bismo mi kao arheolozi htjeli i željeli doznati od keramičke građe. Nepotpuna dokumentacija s lokaliteta koja uključuje nepoznavanje stratigrafskog konteksta ili manjak uzoraka potrebnih za analizu u velikoj će mjeri ograničiti naše mogućnosti. Kod lokaliteta s nepoznatom stratigrafskom slikom bit će mnogo teže odrediti redoslijed kojim su različiti tipovi posuda bili odlagani. Isto tako, mnogo je lakše odrediva uporabna namjena posude ako je određena stratigrafskim kontekstom. Međutim, i bez poznavanja konteksta odlaganja keramičkih posuda one nam i dalje mogu biti izvor informacija, o čemu će biti više riječi u drugom dijelu knjige.

Za kraj ovog poglavlja bitno je naglasiti da je naša zadaća kao arheologa prepoznati razliku između onoga što znamo i onoga što možemo zamisliti o keramičkoj posudi, što naravno vrijedi i za sve ostale predmete koji su dio materijalne kulture čovjeka u prošlosti.

DRUGI DIO

9. OBRADA I ANALIZA KERAMIČKOG MATERIJALA S LOKALITETA NA ERVENICI I DAMIĆA GRADINI

PRISTUP I METODOLOGIJA

Tipološka klasifikacija keramičkog materijala s lokaliteta na Ervenici u Vinkovcima i Damića gradini u Starim Mikanovcima temeljena je na prikupljanju kvantitativnih i kvalitativnih podataka iz cjelokupnog uzorka pri čemu su podaci obrađeni s pomoću deskriptivne statistike u *SPSS* programu (*Statistical Package for the Social Sciences*). Osnovna podjela napravljena je kreiranjem tipova prema morfološkim podacima. Na taj način dobiveni su osnovni funkcionalni oblici: A - zdjela, B - lonac, C - šalica i D - vrč koji su definirani na oba lokaliteta, dok su na Damića gradini izdvojena još tri posebna oblika: E - cjedilo, F - boca i G - poklopac (*Slika 35, 36, 37).*

Iako određivanje osnovnih oblika i tipova posude ovisi o keramičkom materijalu koji se analizira, odnosno vrsti lokaliteta i razdoblju kojemu pripada, klasifikacija oblika uvijek se temelji na visini i maksimalnom dijametru posude te vrsti i veličini otvora (Rice 1987: 215).

Postoji nekoliko klasifikacija koje određuju oblik posude, od kojih su najpoznatije njemačka i francuska klasifikacija. Prilikom obrade vučedolskog materijala za određivanje oblika posude uzeta je kombinacija obje klasifikacije. Zdjela je definirana kao posuda koja uglavnom nema vrat, iako to nije pravilo, a visina joj varira od 1/3 pa sve do jednakog maksimalnog promjera posude. Lonac je posuda s vratom ili bez njega, ima ograničen otvor, a visina mu je uglavnom veća od maksimalnog promjera posude. Šalice su posude s ručkom čiji je promjer otvora uglavnom jednak visini posude. Vrč je posuda s vratom i ručkom s visinom većom od maksimalnog promjera posude (Rice 1987: 216; Horvat 1999: 86).

Prilikom razdvajanja tipova u grupe primijenjen je strukturirani pristup koji omogućuje neograničeno proširivanje i nadopunjavanje tipologije, a koji je detaljno prikazan u Poglavlju 7. Novi oblici koji se mogu pojaviti na nekom drugom vučedolskom lokalitetu mogu se uvrstiti u postojeću tipologiju njezinim proširivanjem, a oblici koji su isti usporediti s već postojećima. Unutar svakog tipa kojeg čine posve različite karakteristike (npr. Tip A – zdjele), napravljena je dodatna podjela na podtipove (Tip A 1) kojima su obilježja vrlo slična, a koji su izdvojeni i klasificirani prema četiri karakteristične točke na obrisu posude (npr. Tip A 1 obuhvaća sve zdjele koje u svom obrisu imaju dvije krajnje točke na rubu i na dnu). Ovakav način razdvajanja podtipova čini tipologiju manje subjektivnom, a podjela u podgrupe manje je podložna greškama onoga koji kreira i definira tipologiju. Unutar svakog podtipa numerirani su i izdvojeni individualni tipovi (Tip A 1a) na osnovi međusobno povezanih varijabli koje omogućavaju mjerenje veličine i oblika keramičke posude (polumjer ruba, dna, visina posude, debljina stijenki).

Prilikom obrade uzimana je veća količina podataka koji su podijeljeni u nekoliko kategorija. Morfološki podaci uključivali su određivanje tipa, podtipa i varijante, vrstu ruba, dna, ručke i drška; metrički podaci obuhvatili su mjerenje polumjera ruba, dna, visinu posude i debljinu stijenke; kod ukrašavanja posude uzimani su podaci o tehnici, motivu i položaju na posudi; tehnološki podaci bilježeni su određivanjem vanjske i unutarnje boje ulomka te boje presjeka prema kojoj je određena atmosfera pečenja, kao i tretiranje vanjske i unutrašnje površine posude.

Radi specifičnosti obrađenih lokaliteta na Ervenici je primijenjeno slučajno uzorkovanje, dok je na lokalitetu na Damića gradini korišteno namjerno uzorkovanje. Nekoliko je razloga zašto je primijenjen različit način uzorkovanja, a koji potkrijepljuju već spomenutu činjenicu da svaki lokalitet zahtijeva drugačiji pristup obradi materijala. U ovom slučaju radi se o ograničenim mogućnostima koje su uvjetovane nepotpunim stratigrafskim kontekstom materijala. To nikako ne znači da se takvi lokaliteti ne bi trebali obrađivati, jer keramičkom građom možemo rekonstruirati neke druge procese, poput tehnoloških, ekonomskih ili simboličkih te modela kojima možemo utvrditi tragove društvene organizacije ili specijalizacije.

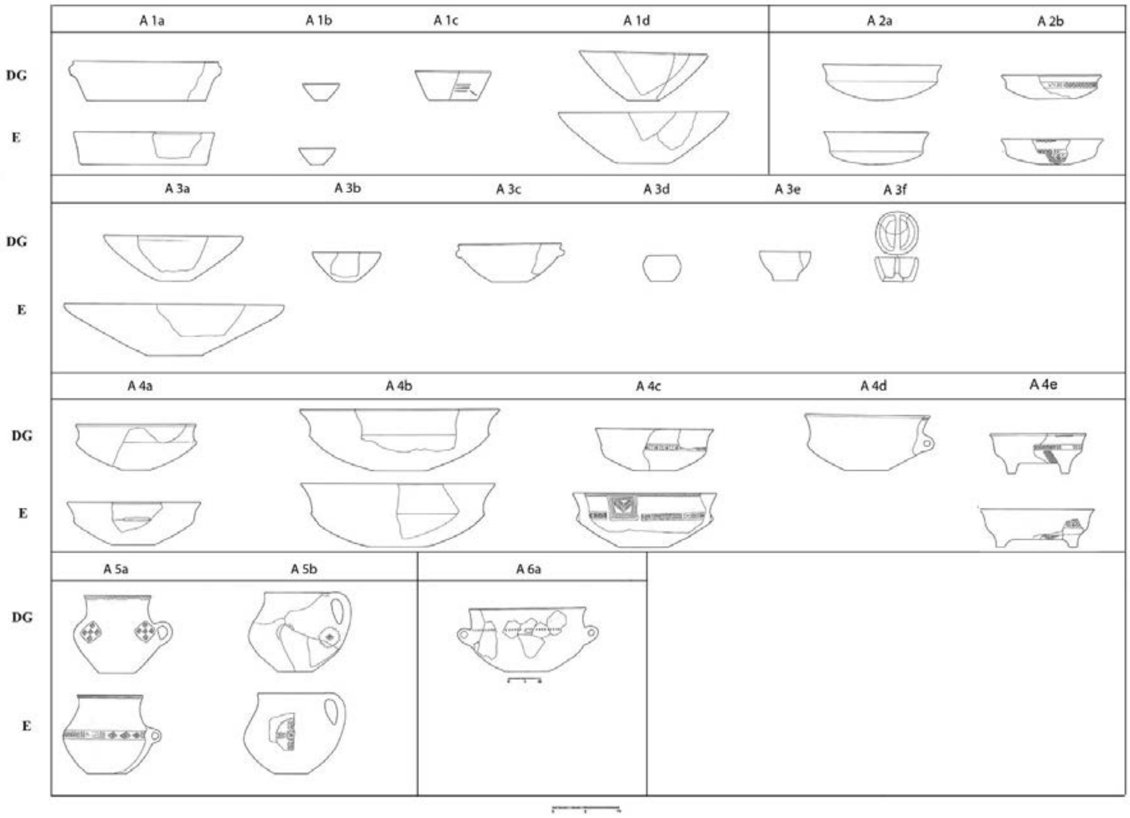
Iako su oba lokaliteta istražena u okviru zaštitnih arheoloških iskopavanja, lokalitet na Ervenici istražen je 2007., a na Damića gradini 1980. godine. Metodologija i dokumentacija arheološkog iskopavanja, kao najbitniji segmenti struke, napredovale su tijekom vremena stoga je nemoguće uspoređivati iskopavanja koja se provode danas, kada nam dostupnost tehnologije i podataka omogućava bržu, bolju i precizniju obradu lokaliteta, s iskopavanjima koja su se provodila prije 30 i više godina. Tu se ne radi o kvaliteti iskopavanja, već o kvaliteti prikupljanja podataka. Lokalitet na Damića gradini istraživan je prije 35 godina i prije svega je bio ograničen iskopnom površinom gdje je smještaj nalaza i slojeva određen temeljima i trakama širine 2 i 4 m, koji su kopani za potrebe osnovne škole (*Slika 42, 43*), što je onemogućilo dobivanje horizontalne stratigrafije u cijelosti.

S obzirom na to da je stratigrafski kontekst poremećen samom otkopnom površinom, obrada materijala zahtijevala je višestruko pregledavanje kako bi se pojedini ulomci pripojili istoj posudi. Dodatnu otežavajuću okolnost predstavlja i činjenica da se na Damića gradini naseljavanje može pratiti od sopotske, badenske, vučedolske, vinkovačke i bosutske kulture do mlađe faze srednjolatenskog razdoblja. Razlikovanje posuda grublje fakture između vučedolske i vinkovačke kulture (posebno one tretirane barbotinom na tijelu posude) gotovo je nemoguće bez poznavanja stratigrafskog konteksta. Stoga su, radi dobivanja što točnije i pouzdanije kronološko-kulturološke odredbe keramičkog materijala, u obzir uzeti samo oni ulomci koji se sa sigurnošću mogu pripisati vučedolskoj kulturi, što je odredilo i način uzorkovanja.

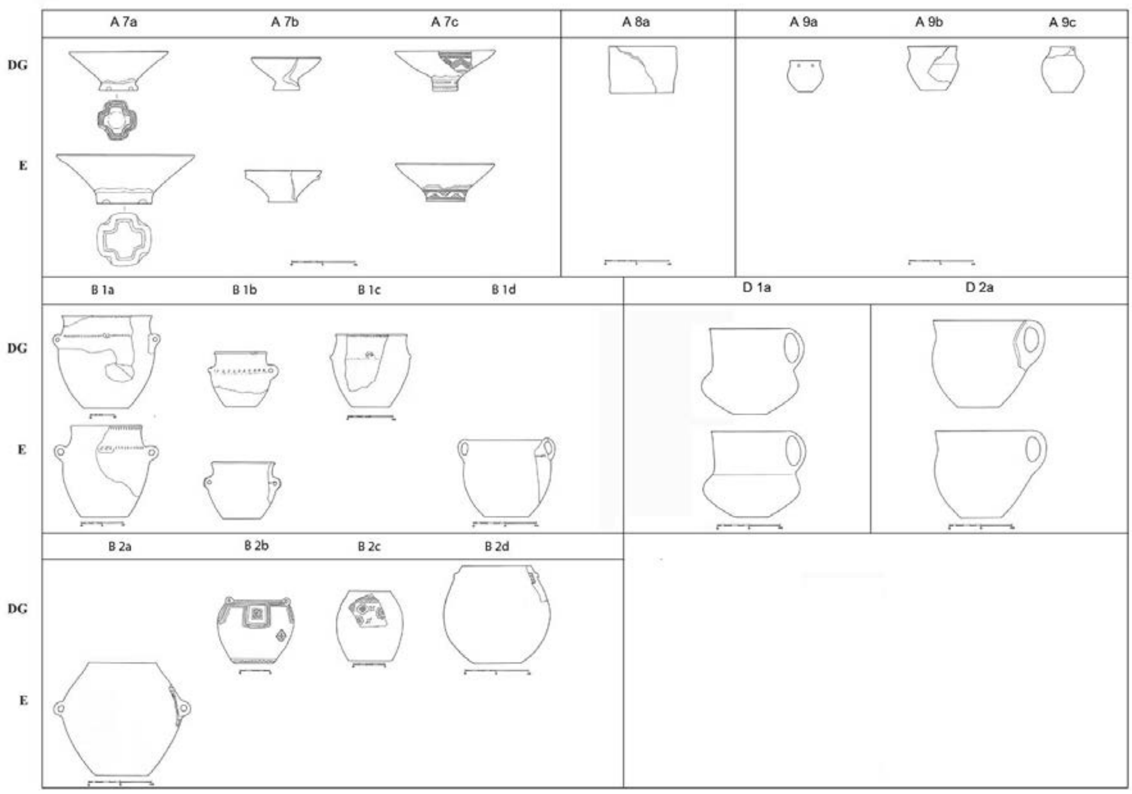
Iako se posude pokušalo rekonstruirati što je više moguće, ovakav pristup određivanja minimalnog broja posuda u konačnoj interpretaciji dao bi iskrivljenu i nepouzdanu sliku keramičke građe. Stoga je pregledavanjem keramičke građe s oba lokaliteta te spajanjem ulomaka koji pripadaju istoj posudi na Ervenici bilo moguće odrediti minimalan broj posuda (MNV-*minimum number of vessels*) uz primjenu slučajnog uzorkovanja, dok na Damića gradini to nije bilo moguće te je dobiven maksimalan broj posuda namjernim uzorkovanjem.

Nakon definiranja klasifikacije, koja je deskriptivna, te analitičke svrhe koja je interpretativna, dobiveni su osnovni preduvjeti i smjernice koji su omogućili rekonstrukciju aktivnosti vučedolskog društva na osnovi obrađenog keramičkog materijala.

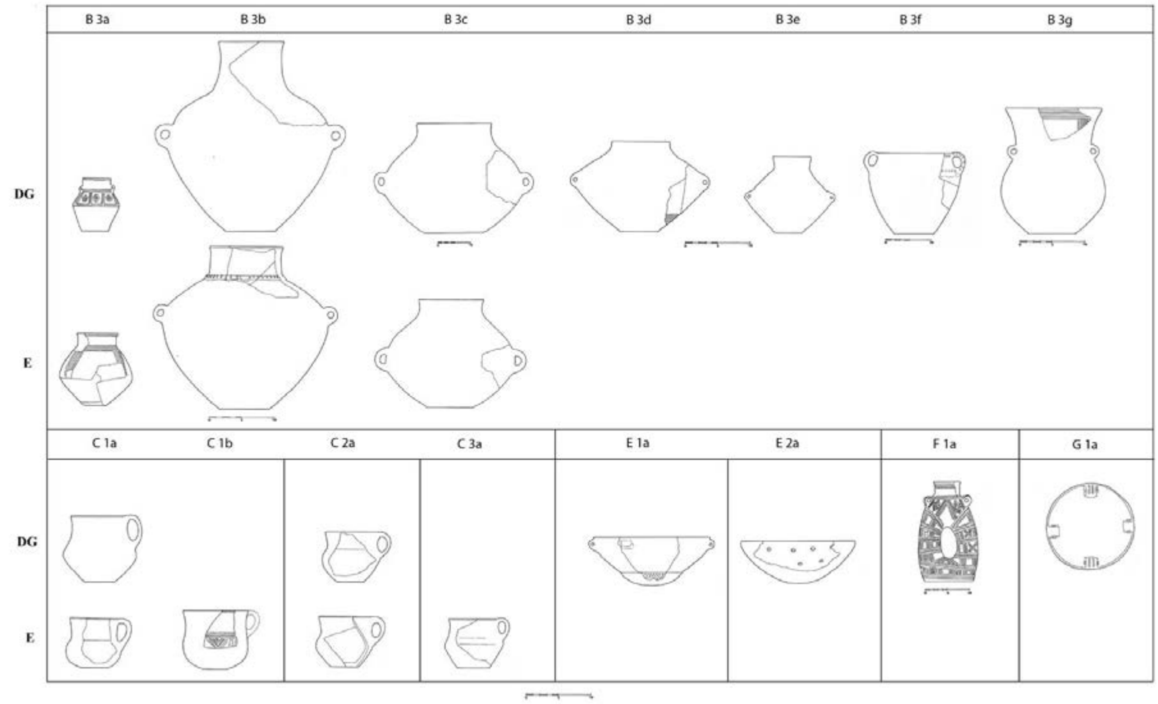
U sljedećim poglavljima bit će predstavljeni rezultati provedenih analiza, a prije toga upoznat ćemo se s geološkim i geografskim karakteristikama krajolika, smještajem i karakteristikama obrađenih lokaliteta te općim pokazateljima vučedolske kulture.



Slika 35 – Tipologija obrađenog materijala s lokaliteta na Damića gradini (DG) i Ervenici (E)
Fig. 35 – Typology of the pottery excavated at the sites of Damića Gradina (DG) and Ervenica (E)



Slika 36 – Tipologija obrađenog materijala s lokaliteta na Damića gradini (DG) i Ervenici (E)
Fig. 36 – Typology of the pottery excavated at the sites of Damića Gradina (DG) and Ervenica (E)



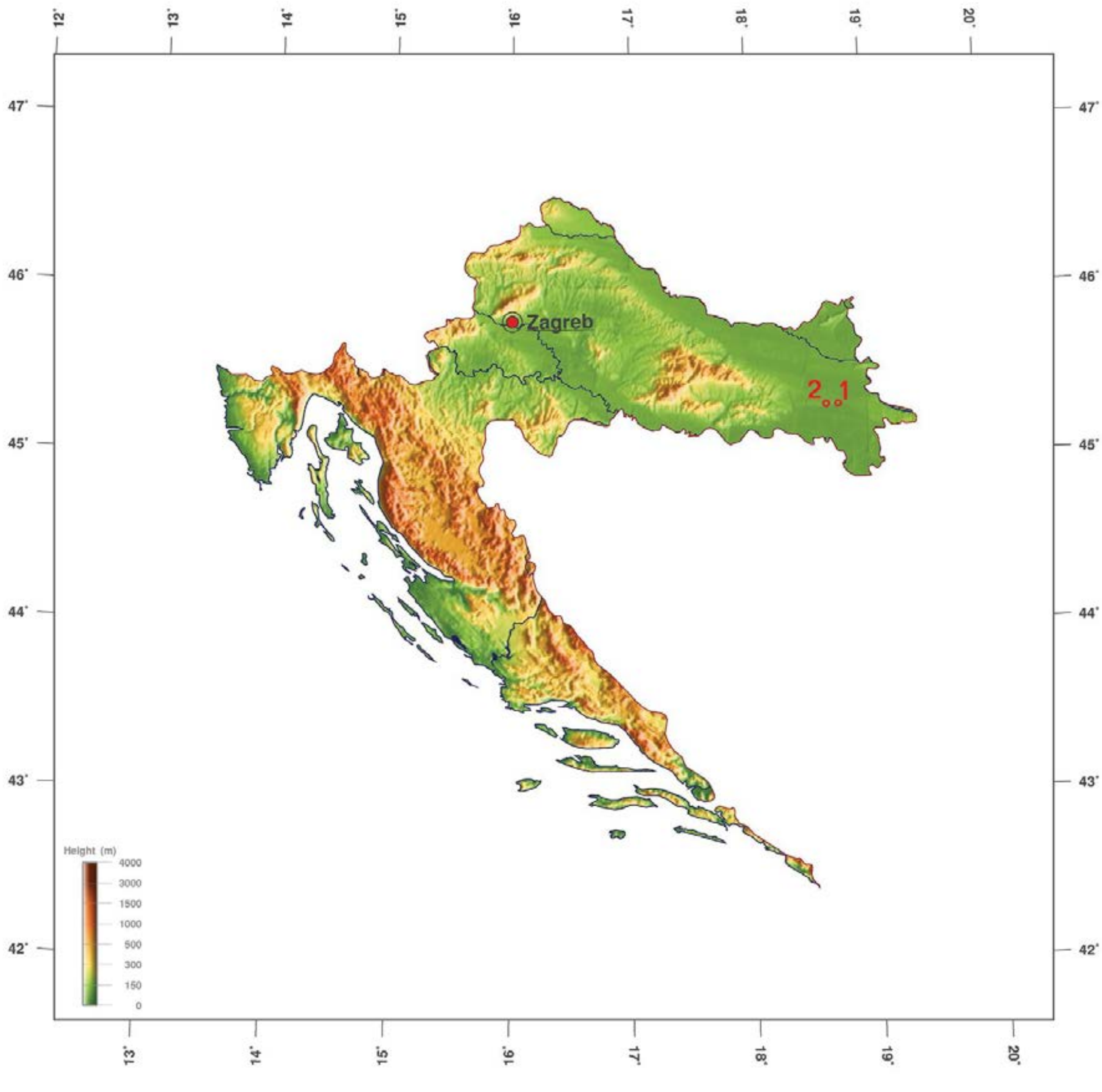
Slika 37 – Tipologija obrađenog materijala s lokaliteta na Damića gradini (DG) i Ervenici (E)
Fig. 37 – Typology of the pottery excavated at the sites of Damića Gradina (DG) and Ervenica (E)

10. GEOGRAFSKE I GEOLOŠKE ZNAČAJKE KRAJOLIKA

GEOGRAFSKE KARAKTERISTIKE

Prostor istočne Hrvatske prepoznatljiv je po svojim geografskim posebnostima koje su i razlog regionalne podjele na Istočnohrvatsku ravnicu i Slavonsku Posavinu s Požeškom kotlinom. To je otvoren ravničarski kraj, najvećim dijelom sastavljen od mlađih riječnih naplavina i praporastih sedimenata (Sić 1975: 123-125).

Detaljnijom geografskom podjelom Istočnohrvatske ravnice na šest geografskih cjelina, Vinkovci i Stari Mikanovci smjestili su se unutar geografskog područja Bosutske nizine koja je prirodno dobro omeđen i izdvojen dio istočno-hrvatske ravnice (*Slika 38*). Na sjeveru je zatvaraju istaknuti rubovi Đakovačkog i Vukovarskog prapornog ravnjaka, a na jugu rijeka Sava. Zapadni dio omeđen je srednjom Posavinom s uskom prisavskom ravnicom i gorskim zaleđem, a istočni ravničarskim dijelom fruškogorskog Srijema.



Slika 38 – Geografski smještaj Vinkovaca (1) i Starih Mikanovaca (2) na prostoru Istočnohrvatske ravnice
Fig. 38 – Geographical position of Vinkovci (1) and Stari Mikanovci (2) in the East-Croatian plain

Prostor Bosutske nizine ima površinu od 2355 km^2 i predstavlja cjelovitu i, s obzirom na strukturu pejzaža, homogenu jedinicu. To je izrazito nizinski kraj, prošaran močvarama i znatnim dijelom prekriven šumom. Takav šumsko-močvarni pejzaž ima izolacijsku funkciju te je ograničio život na rubne dijelove ravnjaka. U velikoj mreži tekućica najvažniju ulogu ima Bosut, koji s najvećim pritokom Biđom ima dužinu od 186 km i porječje od 3025 km^2, što znatno prelazi površinu nizine. Direktna povezanost između Posavine (sliva Bosuta) i dravsko-dunavske nizine (sliva Vuke) odvijala se preko potoka Ervenice (Barice) (Bognar 1994: 25-48). Biđ-Bosut te ostali važniji tokovi imaju vrlo mali pad, vijugav i plitak tok, što je pogodovalo njihovu izlijevanju za vrijeme visokih voda i stvaranju prirodnih rastoka. Takav je slučaj bio poznat s račvanjem Bosuta i Vuke preko potoka Ervenice, koji je mlađim radovima zasut.

Veliko značenje voda odrazilo se na obilježja biljnog pokrova i tla, a ekološke prilike utjecale su na razvoj i veliko širenje vlažnih nizinskih šuma hrasta lužnjaka u Bosutskoj nizini. Općenito se smatra da se u tom prostoru nalazi najveći areal takvih šuma u Hrvatskoj, a vjerojatno i u Europi (Sić 1975: 175-180).

Specifična geografska osnova bila je izvorno negostoljubiv prostor zbog močvarnog zemljišta i čestih poplava. Danas je slika Bosutske nizine, kao i uostalom cjelokupnog krajolika koji nas okružuje, bitno drugačija nego što je bila u prapovijesno vrijeme. To se posebno odnosi na modernu infrastrukturu, ceste i prometnice, ravnice i šume te močvarna područja koja su bila teško prohodna prije današnjih melioracija. Geografske karte Hrvatske iz 18. i 19. st. koje je napravila Austro-Ugarska i na kojima je ucrtan svaki detalj poput putova, mostova, potoka, ravnica, močvara ili šuma mogu nam barem kroz nekoliko stoljeća unazad dati sliku krajolika kakav je nekada bio. Udaljenost je na tim kartama prikazana u satima ili koracima, tako je za 6000 koraka potreban 1 sat hoda (Buczynski et al. 1999: 7-8). Za Vinkovce piše da su udaljeni dva i četvrt sata od Ivankova, tričetvrt sata od Mirkovaca, sat od Cerića i Nuštra, sat i četvrt od Jarmine, dva i pol sata od Privlake. Preko Bosuta nalazio se drveni most, a rijeka koja je na tom mjestu zavijala bila je široka 80 do 90 koraka i samo se na nekim mjestima ljeti mogla pregaziti. Potok *Erbenica* spuštao se kroz šumu i ulazio u Bosut. Pored grada, gdje obale postaju više, bio je širok 50-85 koraka. U blizini grada dubina mu je bila 5-6 stopa, a u ostalim područjima 2-3 stope. Gotovo cijelom duljinom imao je muljevito dno i nije bio prohodan, osim preko dva drvena mosta.

Drugi potok koji utječe u Bosut je *Nijerkuša*, a dolazi iz močvare *Ivankovački rit*. Nije bio prohodan i također je imao muljevito dno. Voda iz Bosuta i ova dva potoka bila je dobra samo za napajanje stoke (Buczynski et al. 1999: 110-111, Sekcija 17). Vinkovci su bili okruženi šumom, a još nekoliko šumovitih predjela nalazilo se u njihovoj neposrednoj blizini (*Topolovica* i *Crni gaj*). Bare oko Ivankovačkog rita, koji se prostire sve do vinkovačkog područja, ponekad bi presušile pa bi bile prohodne, ali močvara nikad nije bila prohodna.

Za Stare Mikanovce stoji da su udaljeni pola sata od Novih Mikanovaca, dva i četvrt sata od Đakova te isto toliko do Ivankova. Različiti potočići teku ovim područjem u smjeru juga i obližnjih bara *Jelas*, *Grajensko* i *Kaluđer*. Potoci su premošćeni mostovima, a za uobičajena vodostaja mogli su se prijeći na više mjesta. Te bare vodom su punile mnogobrojne duboke blatne grabe koje presijecaju veliku šumu, a uviru u rijeku *Biđ* koja teče tom šumom. Skupa s Biđem one su znale prouzrokovati velike poplave kroz cijelu šumu za vrijeme kišnog vremena te u proljeće kada se otapa snijeg (Buczynski et al. 1999: 104-105, Sekcija 16). Prema izračunu u satima Stari Mikanovci su od Vinkovaca bili udaljeni 4 sata hoda.

GEOLOŠKE KARAKTERISTIKE

Geološki sastav ovog područja zasigurno je imao veliku ulogu pri odabiru mjesta za podizanje naselja kroz cijelo prapovijesno razdoblje. U sastavu reljefne strukture prevladavaju riječne naplavine (pijesak, šljunak, glina i ilovača) te akumulacije prapora ili lesa i prapornih sedimenata (Roglić 1975: 18). Upravo su naslage prapora karakteristične u pokrovu jugoistočnog dijela panonske ravnice (Roglić 1975: 18), a prapor i njegovi derivati prekrivaju 35,7% hrvatskog teritorija (Galović et al. 2009). Tijekom oledbi u srednjem i mlađem pleistocenu jaki sjeverozapadni vjetrovi donosili su prašinu s alpskih prostora. Prašina je odlagana u obliku prapora (lesa) na jezerske i riječne terase stvarajući praporne zaravni, koje su glavno obilježje istočnog dijela Hrvatske (Hećimović 2009).

Za vrijeme holocena počinje zatopljavanje, postupno se smanjuje količina vode i rijeke su se započele usijecati u svoj nanos tvoreći raznolike fluvijalne oblike (terase, meandre i dr.). Širi prostor Vinkovaca izgrađuju kvartarni sedimenti koji se mogu podijeliti na pleistocenske i holocenske. Pleistocenski sedimenti zastupljeni su praporom i barsko-kopnenim praporom, a holocenski uglavnom barskim sedimentima (Hećimović 2009: 98; Osnovna geološka karta L 34-98). Prapor je neslojevit, nevezan i porozan sediment, a fauna pokazuje njegovo taloženje tijekom hladne i suhe klime te klimatsku varijabilnost u posljednjem ledenom dobu (Würm). Prema veličini zrna prapor je silt s primjesama pješčane ili glinovite komponente, a njegova važna značajka je poroznost, obično 40-60%. Glavni mineralni sastojak je kvarc kojeg ima i do 70%. Osim kvarca prapor se sastoji i od feldspata (do 20%), muskovita, gline, klorita, limonita itd. (Herak 1990). Debljina prapora je različita, najčešće do 20 m, a ponegdje iznosi i do 50 m (Erdutsko brdo).

Naslage barskog prapora primarno su taložene u spuštenim predjelima terena i to najčešće na riječnim terasama. Osnovni mineralni sastojak barskog prapora je kvarc (do 60%), a udio kalcijevog-karbonata je promjenjiv (0-30%). Debljina mu doseže do 10 m, a u izrazitije spuštenim dijelovima terena i do 30 m (Hećimović 2009: 98-99). Barske naslage taložile su se tijekom holocena, a vezane su za nekadašnje sporije tokove ili stajaće vode koje su se u najnižim dijelovima terena pretvarale u močvarišta. U takvim su se uvjetima taložile pretežno gline i glinoviti siltovi obogaćeni visokim sadržajem organske tvari, debljine do 3 m. Aluvijalne naslage taložile su se u dolinama današnjih rijeka. Sastoje se od šljunaka, pijeska, siltova i glina, a debljina im je vrlo različita, iako rijetko prelazi 10 m (Hećimović 2009: 100-101).

Podizanje naselja na prapornim terasama, uz ona gradinskog tipa, karakterističan je način naseljavanja tijekom trajanja vučedolske kulture. Praporna su uzvišenja zapravo ravnjaci, a zbog svog su sastava i nešto većih visina suši, prirodno plodniji i ekološki povoljniji. Između dunavsko-dravskog i savskog pritjecajnog prostora zaostala je đakovačko-vinkovačka praporna greda koja je za 10-15 m viša od okolnog tla. Ona se širi na krajnjim dijelovima, osobito prema obroncima Fruške gore, gdje su i naslage najdeblje, čak do 20 m (Roglić 1975: 11-23). Na području Bosutske nizine pravog suhozemnog ili kopnenog prapora ima samo na nekoliko mjesta (oko Vinkovaca i Gradišta, između Otoka i Nijemaca).

11. VUČEDOLSKA KULTURA

Vučedolska kultura najzanimljivija je kasnoeneolitička pojava koja svojim prepoznatljivim keramičkim oblikovanjem i stilskim izričajem vrlo jasno odražava duh vremena u kojem je nastala. Svoje ishodište ima u slavonsko-srijemskom prostoru iz kojeg se u kasnijem razdoblju proširila na sve četiri strane svijeta. Vrijeme jedinstvene vučedolske kulture završava pred sam kraj eneolitika, a matično područje njezina nastanka polako gubi svoje značenje i otvara prostor za egzistenciju novim kulturama koje će naseljavati ovo područje početkom ranoga brončanoga doba.

Iako je riječ o vrlo prepoznatljivoj prapovijesnoj kulturi, stanje objavljenih lokaliteta ukazuje na nedovoljnu istraženost te nepoznavanje životnih uvjeta i navika, kao i naseobinskih pokazatelja. Nažalost, osim sustavnih iskopavanja na lokalitetu Vučedol, većinom je riječ o rezultatima zaštitnih arheoloških istraživanja, što onemogućuje dobivanje cjelovite stratigrafske slike vučedolskih lokaliteta te naseobinskih karakteristika. Od 63 evidentirana vučedolska položaja samo je njih 13 istraženo (19,11%), dok su ostali položaji dokumentirani rekognosciranjem ili slučajnim nalazima u muzejskim fundusima (Balen 2010). Još jedan problem, ništa manje zanemariv, je nedostatak objave pokretnog arheološkog materijala, kao najboljeg pokazatelja svakodnevnog života i društveno-ekonomskih promjena koje su se događale u vučedolskom društvu pred kraj trećeg tisućljeća pr. Kr.

Od prvih pisanih podataka o vučedolskoj kulturi prije 140 godina (Deschman 1875) mnogi autori bavili su se različitim aspektima vučedolske kulture - od njezinog porijekla, općih karakteristika naseljavanja i materijalne kulture, geografske rasprostranjenosti do kronoloških podjela na pretklasičnu, ranoklasičnu, klasičnu i kasnu fazu naseljavanja (za pregled vidi: Miloglav 2012). Možda najbitnija karakteristika vučedolske kulture jest da je u jednakoj mjeri primala utjecaje i inovacije sa strane i održavala neke stare tradicije koje je prilagođavala novom vremenu i načinu života. U njezinom se keramičkom repertoaru mogu jasno vidjeti utjecaji kostolačke i badenske kulture, a posredno preko njih sopotske i vinčanske kulture. Prihvaćajući utjecaje svojih prethodnika, vučedolska kultura će isto tako ostaviti traga u mnogim kulturama ranog brončanog doba s kojima je dolazila u kontakt. To je ujedno i vrijeme kada se njezina homogenost raspada na niz regionalnih varijanti na širokom geografskom prostoru.

Već po pregledu topografskih karakteristika nekih najvažnijih vučedolskih lokaliteta vrlo se jasno može zaključiti da je vučedolska populacija slijedila određena pravila pri podizanju svojih naselja. Jedan od sigurno najbitnijih faktora pri odabiru mjesta za naseljavanje bili su prirodno povišeni istaknuti položaji, smješteni u blizini riječnih tokova ili manjih potoka. Takvi su položaji vrlo logičan odabir, značajan u strateškom i komunikacijskom pogledu, a utvrđivanje podignutih naselja ovisilo je ponajprije o prirodnoj konfiguraciji terena i izgledu krajolika. Praporne naslage porozne su i neuslojene, vode se lako procjeđuju i otapaju vapnene sastojke. Porozni i na površini suhi prapor uvjetovao je nastajanje plodne zemlje za pašnjake, pa je ovo područje oduvijek bilo privlačno za naseljavanje (Miloglav 2012a).

Veliki broj utvrđenih naselja ukazuje na potrebu vučedolskog stanovništva za mirnijim i trajnijim životom na jednom mjestu te iskorištavanjem već ranije zaposjednutih i napuštenih položaja koji se lako mogu utvrditi. Uglavnom su naseljavali one položaje koje su prije njih nastanjivali nositelji starčevačke, sopotske, badenske ili kostolačke kulture (Vučedol, Sarvaš, Gomolava, Borinci, Damića gradina, Vinkovci). Podizanje naselja na visokim prapornim gredama uz rijeke, posebno uz Dunav, štitilo je naselje od poplava. Tako su prva prapovijesna naselja u Vinkovcima nastala na lijevoj, povišenoj strani bosutske obale čija nadmorska visina iznosi oko 88 m i znantno je viša od desne te je zahvaljujući tome bila prirodno zaštićena od čestih poplava te pogodna za naseljavanje.

Topografske odrednice imale su veliku ulogu kroz sva prapovijesna razdoblja, gdje su se naselja jednostavno prilagođavala krajoliku u ekonomskom i organizacijskom smislu. Strateška komponenta postala je bitan faktor tek u vrijeme kasnog eneolitika kada se ta ista naselja dodatno utvrđuju jarcima i palisadama, očito iz potrebe za većom zaštitom svojih naselja u novonastalim nesigurnim vremenima.

Utvrđena naselja i stalan boravak na jednom mjestu ukazuju na zemljoradničku privredu, što vučedolsku ekonomiju bitno ne razlikuje od one kakvu su poznavali nositelji badenske i kostolačke kulture. Potreba za boravkom na istom mjestu i vezivanje za isto područje način je života koji se može pratiti još od kasnog neolitika, kada se naselja grupiraju u mala sela, odnosno zaseoke. Trajnost boravka na jednom mjestu možda je najbolje arheološki dokumentirana obnavljanjem kućnih osnova i postojanjem nekoliko stambenih horizonata na istom mjestu u naselju, kao što je slučaj s Vučedolom (Dimitrijević 1979: 283; Durman 1988; Forenbaher 1995: 20; Balen 2005a: 31), Vinkovcima, Sarvašom i Borincima (Dimitrijević 1979: 283), a ista situacija potvrđena je i na lokalitetima na Ervenici i Damića gradini.

Prije pojave vučedolske kulture obrada bakra na području Karpatske kotline već je poznavala obradu elementarnog bakra kovanjem, spoznaju da se bakar tali i oblikuje kovanjem, te lijevanje bakra u jednodijelnim kalupima tehnikom *„cire perdue“* što znači da se za svaki izliveni predmet morao izraditi njegov prototip u vosku. Novost u kasnom eneolitiku je pojava dvodijelnih kalupa, što omogućuje da se jednim prototipom napravi više kalupa istovremeno. To je značilo pojavu serijske proizvodnje dvodijelnih kalupa, odnosno serijsku proizvodnju bakrenih predmeta (Durman 1983: 23-31). Velika količina bakrenih sjekira i kalupa koji su pronađeni u ostavama ili kao pojedinačni nalazi (Vinkovci, Vučedol, Sarvaš, Borinci), kao i dokazi metalurške djelatnosti koji se mogu pratiti na lokalitetima od najranije faze vučedolske kulture, svjedoče o velikoj ulozi metalurgije u vučedolskom društvu.

Razdoblje eneolitika ne znači samo poznavanje i upotrebu bakra kao nove sirovine, već novi pogled i način života. U gospodarskom smislu to je značilo prevlast stočarstva nad poljoprivredom koje brže stvara viškove i omogućuje intenzivniju razmjenu i trgovinu.

Ribolov je, uz zemljoradnju i stočarstvo, na naseljima uz rijeke sigurno imao veliku ulogu. Za razliku od vučedolskog područja, vinkovački kraj bogatiji je šumama, geološka podloga mu je ilovača, a nalazi se uz Bosut koji ni približno ne omogućuje stanovnicima koji žive u njegovoj neposrednoj okolici sve pogodnosti koje nudi Dunav. Zbog takvih uvjeta vučedolska naselja na ovom području jednostavno su se prilagodila krajoliku u ekonomskom i topografskom smislu. Analizom faune s položaja „Vinograd-Streim“ na lokalitetu Vučedol uočeno je da su za vrijeme badenske i kostolačke kulture u većoj mjeri zastupljeni školjkaši, dok u vučedolskoj kulturi dominiraju puževi. Uzrok ove promjene nije poznat, ali je sigurno da su ribe, školjkaši i puževi imali veliku ulogu u prehrani eneolitičkih kultura uz dunavsku obalu (Paunović & Lajtner 1995). To samo pokazuje da je blizina rijeka i riječnih tokova oduvijek bila prirodan i logičan izbor za podizanje naselja, kako bi se osigurala egzistencija i omogućila komunikacija.

Gospodarska strategija vučedolskog stanovništva koja je uključivala zemljoradnju, stočarstvo, lov i metalurgiju imala je za posljedicu društveno raslojavanje gdje se jedan bogatiji sloj zajednice izdvojio nad ostalima. Formiranje čvršće povezanih patrijarhalnih rodovskih i plemenskih zajednica u društvenom će pogledu prerasti neolitički način života (Težak-Gregl 1998: 111). Društvena hijerarhija najbolje se očituje u sahranjivanju pokojnika i pokazateljima unutar koncepcije stanovanja i organizacije naselja. „Grobnica bračnog para“ s položaja Gradac na Vučedolu ukazuje na pokopavanje vladajućeg sloja rodovskog plemstva i tragove društvene diferencijacije koji su vidljivi i u samom odabiru mjesta za pokop (Dimitrijević 1979).

Pokapanje na groblju izvan naselja dosad nije utvrđeno ni na jednom vučedolskom lokalitetu. Lokaliteti na Ervenici i Damića gradini u potpunosti se uklapaju u opću sliku života u kasnom eneolitiku, a o rezultatima provedenih analiza koji se odnose na gospodarski i društveni segment navedenih naselja bit će više riječi u poglavljima koja slijede.

12. NASELJA VUČEDOLSKE KULTURE U VINKOVCIMA I STARIM MIKANOVCIMA

ERVENICA U VINKOVCIMA

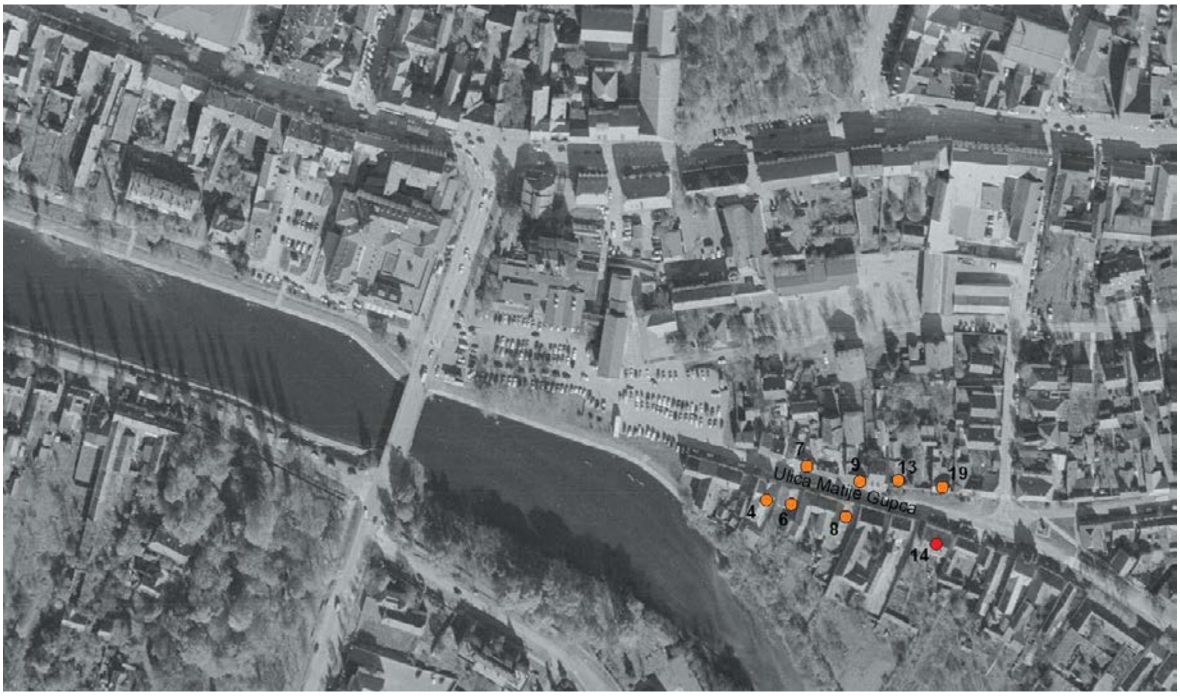
Vinkovačko područje zbog svog je povoljnog geografskog položaja bilo prostor koji je pružao idealne uvjete za naseljavanje od prapovijesti do današnjih dana. Jedno od svakako najpoznatijih nalazišta na vinkovačkom području je lokalitet u stručnoj literaturi poznat kao tel „Tržnica“ ili Vinkovci-Hotel. Lokalitet se nalazi u samom centru Vinkovaca, a njegov smještaj na lijevoj, povišenoj, obali Bosuta omogućio je idealne uvjete za naseljavanje koji se mogu pratiti još od starčevačke kulture. Prvi nalazi s ovog lokaliteta potječu još iz druge polovice 19. st. (Brunšmid 1902: 118), a veliko zaštitno iskopavanje na položaju hotela Slavonija provedeno je 1977./78. godine na površini od 2170 m^2 (Dimitrijević 1979: 267-341). Stratigrafska slika pokazala je naseljavanje tijekom starčevačke, vučedolske i vinkovačke kulture te lasinjsko-salkucanske i bodrogkeresturske nalaze. Prilikom urbanizacije Vinkovaca u drugoj polovici 70-ih godina te zaštitnim arheološkim istraživanjima, koja se na području grada intenzivno provode u posljednjih 50-ak godina, otkriveno je oko 12000 m^2 površine vučedolskog naselja, koje se rasprostiralo na dva platoa s lijeve i desne strane potoka Ervenice, dok je s južne strane naselje bilo omeđeno Bosutom (Gale 2002; Miloglav 2007; 2012a). Zahvaljujući starim vojnim kartama (Poglavlje 10) moguće je prepoznati tok potoka Ervenice koji je na području grada zasut sredinom prošlog stoljeća (*Slika 39*). Na nekadašnje postojanje potoka danas ukazuje samo prirodna depresija u Ulici Matije Gupca gdje je vidljiv povišeni plato koji se s jedne strane spušta prema Bosutu, a s druge strane prema nekadašnjem koritu potoka Ervenice.

Slika 39 – Položaj naselja na Ervenici (2) i tela „Tržnica“ (1) u odnosu na potok Ervenicu i rijeku Bosut
Fig. 39 – Position of the settlement at Ervenica (2) and the ‘Tržnica’ tell (1), in relation to the Ervenica brook and the River Bosut

Područje Ervenice nalazi se na povišenom platou jugoistočno od središnjeg gradskog trga te je odavno poznato u stručnoj literaturi. Početkom prošlog stoljeća J. Brunšmid navodi kako je donji dio ulice Ervenice (danas Ulica Matije Gupca) bio naseljen već u kameno doba (Brunšmid 1902: 120). Prva sondažna istraživanja na ovom području proveo je S. Dimitrijević 1957. godine prilikom kojih je otkriveno starčevačko, sopotsko i keltsko naselje (Dimitrijević 1966: 6, 36). Nalaze vučedolske kulture S. Dimitrijević evidentira samo na položaju "Poljski jarak", koji je služio za odvod bujica i vode s ulice, a nalazi se pri kraju istočnog dijela Ervenice. To je dio Ervenice gdje se Ulica M. Gupca spaja s Bosutom (Dimitrijević 1956: 413, T. III: 1; Dimitrijević 1979a: 138, Karta II/3).

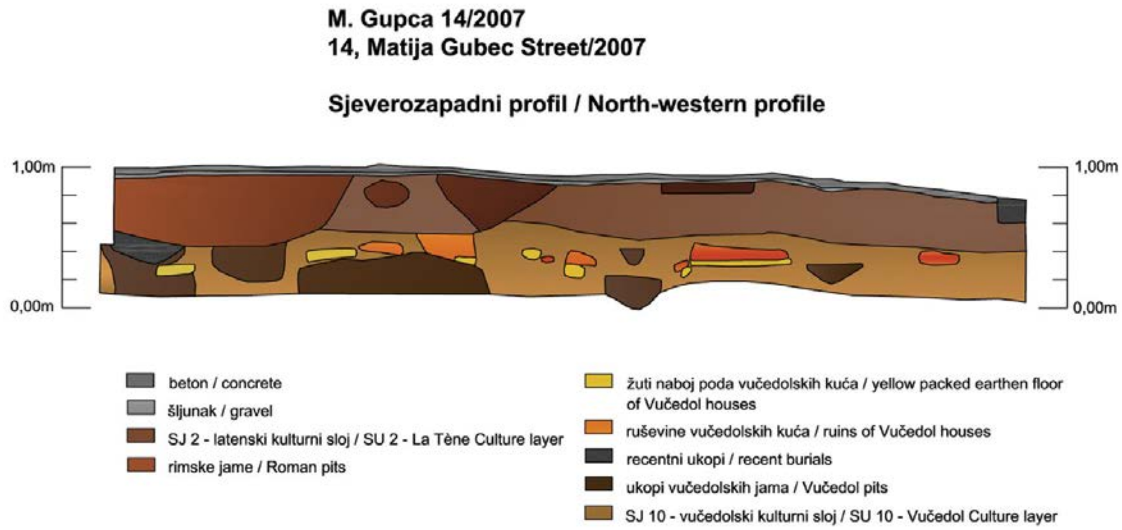
Područje Ervenice arheološki je vrlo zanimljivo, međutim moderna urbanistička izgradnja, nažalost, ne dopušta provedbu sustavnih istraživanja kako bi se do kraja upotpunila slika naseljavanja na ovom području. Manja zaštitna iskopavanja provode se već duži niz godina jer se područje Ervenice nalazi u zaštićenoj arheološkoj zoni. Takva su istraživanja uvijek kompleksna i zahtjevna jer moderna infrastruktura suvremenog grada otežava arheološka i geofizička istraživanja, a poremećena stratigrafska slika i ograničena površina istraživanja onemogućuju nam dobivanje cjelovite slike naseljavanja. S druge strane, zaštitna istraživanja jedini su način evidentiranja i dokumentiranja arheoloških nalazišta koja leže ispod današnjih suvremenih gradova te nam omogućuju da zabilježimo raster i izgled nekadašnjih naselja.

Od 90-ih godina prošlog stoljeća istraživanja na Ervenici ograničena su na manje iskopne površine prilikom izgradnje stambenih i poslovnih objekata u Ul. Matije Gupca. Tragovi vučedolskog naselja dosad su zabilježeni na kućnim brojevima od 4 do 19 (Krznarić Škrivanko 1994; Gale 2002; Miloglav 2007; 2012a) (*Slika 40).* Prema dosadašnjim istraživanjima istočnije od položaja kod k. br. 14 i 19 nisu zabilježeni tragovi naseljavanja tijekom vučedolske kulture. Dimitrijevićevi nalazi na položaju Poljski jarak zasad nam ostaju usamljeni slučajni nalazi koje ne možemo arheološki interpretirati.



Slika 40 – Istraženi položaji u Ulici M. Gupca na Ervenici u Vinkovcima
Fig. 40 – Investigated locations in Matija Gubec Street, Ervenica, in Vinkovci

Lokalitet obrađen i prikazan u ovoj knjizi istražen je 2007. godine u Ulici Matije Gupca 14 na Ervenici, a obuhvaćao je površinu od 250 m² (Krznarić Škrivanko 2008). Stratigrafska slika lokaliteta pokazala je ostatke sopotske kulture, nekoliko naseobinskih faza koje pripadaju kasnoklasičnoj vučedolskoj kulturi, tragove naseljavanja tijekom mlađeg željeznog doba te dosta uništen i poremećen rimski kulturni sloj. Iako se radi o višeslojnom lokalitetu najviše traga ostavila je upravo vučedolska kultura. Ukupno su zabilježeni ostaci 6 podnica koji su pripadali stambenim objektima, orijentacije SI-JZ, s podlogom od žute nabijene ilovače i tragovima gorenog kućnog lijepa te 14 jama i rupa za stupove. Nažalost, zbog male iskopne površine ni jedna od otkrivenih podnica nije otkopana u cijelosti jer svaka barem jednim dijelom ulazi u profil. Prema širini od oko 4,50 m odgovarale bi uobičajenoj širini kuća koje su otkopane na lokalitetu Vučedol (Forenbaher 1994). Jame su ovalnog oblika promjera od 0,5 do 2 m. Tragovi obnavljanja podnica kao i 14C datumi (*Tablica 1*) pokazuju da se radi o dvije faze naseljavanja, najvjerojatnije unutar jedne do dvije generacije (Miloglav 2012) (*Slika 41).* Slična situacija obnavljanja kućnih osnova zabilježena je i na susjednom položaju hotela Slavonija (Dimitrijević 1979: 283).



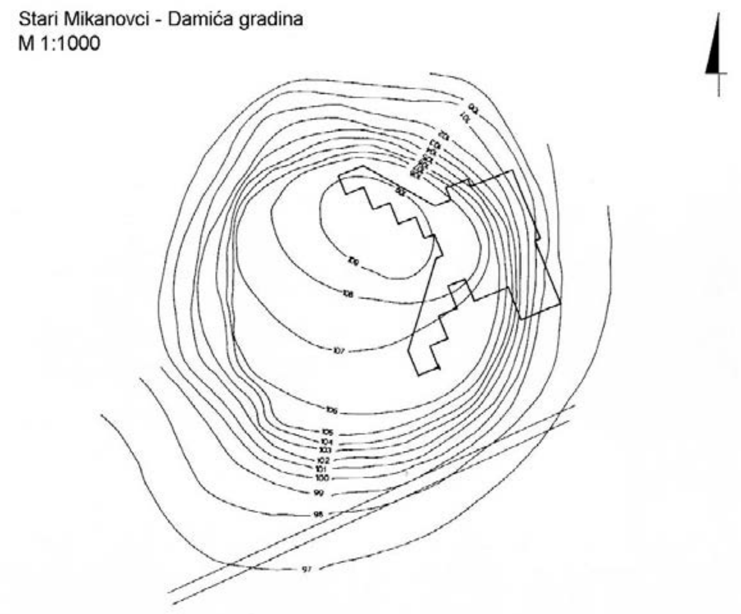
Slika 41 – Sjeverozapadni profil sonde na položaju u Ul. Matije Gupca 14 na Ervenici
Fig. 41 – North-western profile of the test pit in the position of 14 Matija Gubec Street, Ervenica.

DAMIĆA GRADINA U STARIM MIKANOVCIMA

Lokalitet Damića gradina nalazi se u samom centru Starih Mikanovaca, na južnim padinama Đakovačko-Vinkovačkog prapornog ravnjaka koji se blago spušta prema jugu i prelazi u savsku ravnicu. Gradina je dobila ime po nekadašnjim vlasnicima, obitelji Petričević koja je u selu nosila nadimak Damići. Lokalitet prvi put u literaturi spominje putopisac, grof Marsilije početkom 18. st. (Virc 1979), koji donosi crtež s tlocrtom i presjekom naselja s jasno vidljivim ostacima fortifikacijskog sustava koji se sastojao od opkopa i zemljanog bedema te položaj kasnosrednjovjekovne obrambene kule na južnom dijelu gradine. J. Korda također spominje lokalitet 1954. godine te piše da "se u centru diže "Damića gradina" gdje su utvrđeni ostaci neolita i latena (keltsko doba)" (Korda 1954: 81). Veliko zaštitno istraživanje proveli su arheolozi Gradskog muzeja Vinkovci 1980. godine prilikom gradnje temelja za osnovnu školu (Iskra-Janošić 1984) (*Slika 42*).

Slika 42 – Iskopavanje na Damića gradini 1980. godine
Fig. 42 – The 1980 excavation at Damića Gradina

Iskopavanje je pokazalo kontinuitet naseljavanja tijekom sopotske, badenske, vučedolske, vinkovačke i bosutske kulture, a život na gradini završava utvrđenim naseljem mlađe faze srednjolatenskog razdoblja u drugoj polovici 1. st. pr. Kr. (Dizdar 2001; Potrebica & Dizdar 2002). S obzirom na to da je lokacija za školu bila predviđena na istočnoj polovici gradine, na toj su strani izvršena istraživanja u pet traka širine 2 i 4 m *(Slika 43).*



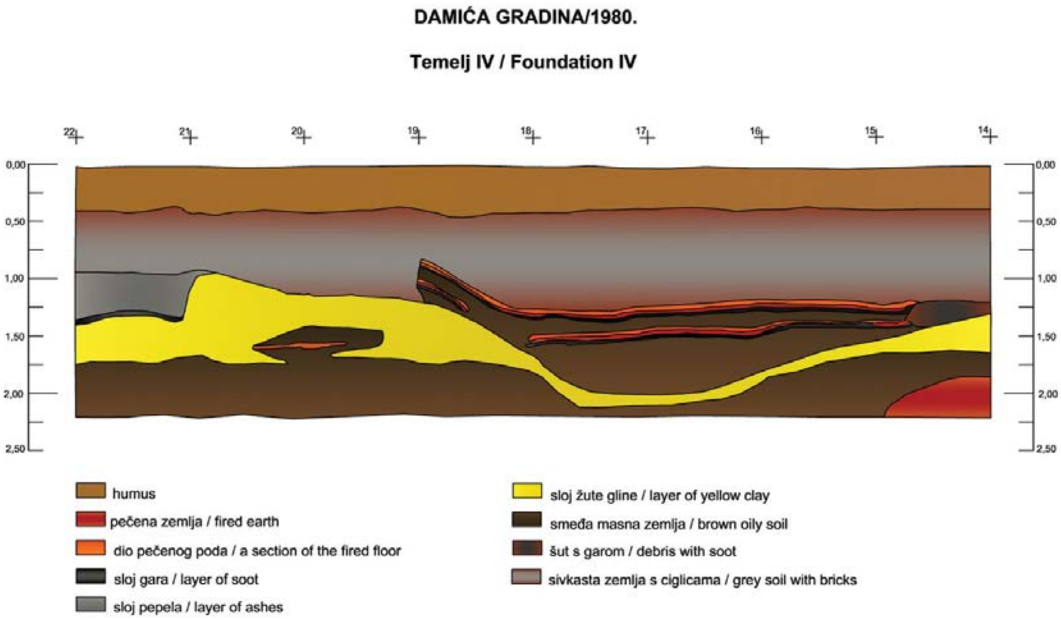
Slika 43 – Tlocrt iskopavanja za temelje Osnovne škole
Fig. 43 – Ground plan of the excavations for the foundations of the elementary school

Rezultati su pokazali da je gradina imala zemljani bedem zapečen u dva nivoa, podignut u vrijeme sopotske kulture te opkop koji je vjerojatno bio povezan s potočićem koji teče s istočne strane gradine. Plato gradine kružnog je oblika promjera 117-125 m, dok je u podnožju promjera oko 170 m. Gradina se blago spušta prema jugu, relativne visine 8 m, dok je visina u sjeveroistočnom dijelu platoa preko 9 m (Iskra-Janošić 1984: 149).

S istočne strane nalazio se potok koji je punio opkop vodom, a vidljiv je i danas sa sjeveroistočne, sjeverne i sjeverozapadne strane. Ulaz na gradinu bio je s jugoistočne, najpristupačnije strane (*Slika 44*).

Slika 44 – Damića gradina – pogled s jugozapada. Snimljeno tijekom obilaska terena 2002. godine
Fig. 44 – Damića Gradina – view from the south-west. Photographed during a field survey in 2002

Prema dokumentaciji s istraživanja, obnavljanju podnica na istom mjestu (*Slika 45*) i dobivenim 14C datumima (*Tablica 1*) vučedolsko stanovništvo je na Damića gradini također koristilo isti prostor za naseljavanje tijekom nekoliko naraštaja.



Slika 45 – Damića gradina – južni profil temelja IV
Fig. 45 – Damića Gradina – southern profile of foundation IV

Na oba obrađena lokaliteta stratigrafski su zabilježena dva horizonta naseljavanja, odnosno dva nivoa kućnih osnova. Može se pretpostaviti da su kuće obnavljane generacijski, odnosno da je na istom mjestu živjelo nekoliko naraštaja, što je uobičajeno za razdoblje eneolitika. To bi objasnilo široki raspon dobivenih datuma i keramički materijal koji ne pokazuje velike niti znatne razlike po obrađenim stratigrafskim jedinicama. Kalibracijsko koljeno u razdoblju između 2900.-2600. g. pr. Kr. pritom svakako treba uzeti u obzir.

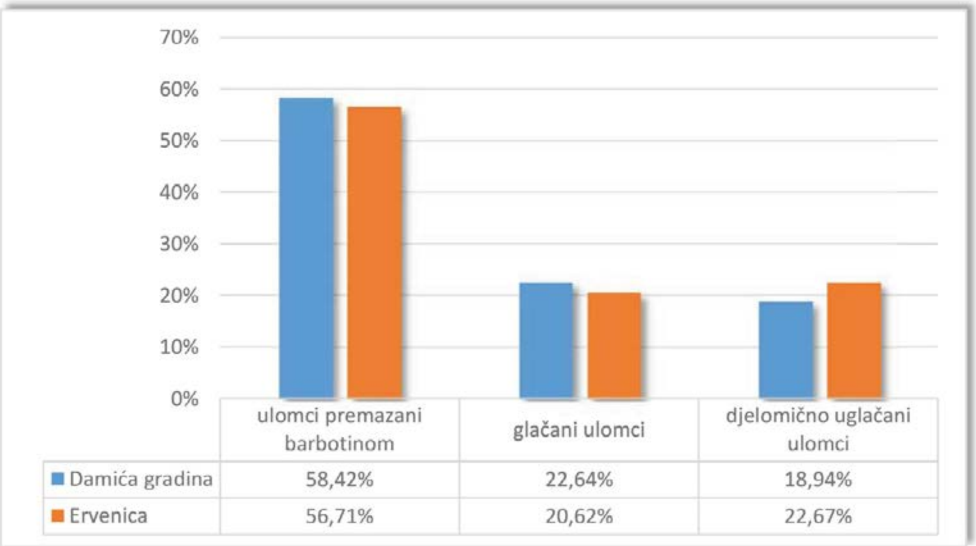
Vinkovci, Ervenica - Ul. M. Gupca 14 - vučedolska kultura Vinkovci, Ervenica – 14 Matija Gubec Street – Vučedol Culture					
Lab. Broj Lab. no.	Kontekst i materijal Context and material	δ 13 C	Datum (BP) Date (BP)	Kalibrirani datum (cal BC) Calibrated date (cal BC)	
				2 σ (95%)	1 σ (68%)
Beta-256824	jama SJ 49 - ugljen pit SU 49 – charcoal	-24.9	4160 ±40	2880-2610	2870-2840
				2600-2590	2820-2670
Beta-256822	sa podnice kuće SJ 22/23 - ugljen from the house floor SU 22/23 – charcoal	-23.9	4080 ±50	2870-2800	2840-2810
				2780-2480	2670-2570
					2510-2500
Beta-256823	jama SJ 39 - ugljen pit SU 39 – charcoal	-23.4	4070 ±50	2860-2800	2840-2820
				2760-2480	2670-2560
					2520-2500
Beta-279291	jama SJ 47 - kost pit SU 47 – bone	-20.8	4090 ±40	2860-2800	2840-2810
				2760-2560	2670-2570
				2530-2490	
Beta-279292	jama SJ 49 - kost pit SU 49 – bone	-20.2	4190 ±40	2890-2830	2880-2850
				2820-2630	2810-2750
					2720-2700
Damića gradina - Stari Mikanovci – badenska kultura Damića Gradina – Stari Mikanovci – Baden Culture					
Beta-292356	T. XIX - koštani rog Pl. XIX – antler	-21.7	4720 ±40	3630-3490	3630-3580
				3470-3370	3530-3500
					3430-3380
vučedolska kultura Vučedol Culture					
Beta-292357	T. XLVIII - životinjski zub Pl. XLVIII – animal tooth	-20.8	4090 ±40	2860-2800	2840-2810
				2760-2560	2670-2570
				2530-2490	
Beta-290815	T. XLI - kost Pl. XLI – bone	0	4020 ±40	2630-2470	2580-2480
vinkovačka kultura Vinkovci Culture					
Beta-292358	T. III - koštani rog Pl. III – antler	-21.2	3850 ±40	2460-2200	2440-2420
					2400-2380
					2350-2280
					2250-2220

Tablica 1 – 14C datumi s lokaliteta na položaju M. Gupca 14 na Ervenici i Damića gradini (Uzorci drvenog ugljena i kostiju s oba lokaliteta analizirani su u laboratoriju Beta Analythic inc., Miami, Florida)
Table 1 – Radiocarbon dates from the sites at 14 Matija Gubec Street in Ervenica and at Damića Gradina. (The charcoal and bone samples from both sites have been analysed in the laboratory of Beta Analytic inc., Miami, Florida.)

13. TIPOLOŠKO-STATISTIČKA ANALIZA

REZULTATI TIPOLOŠKO-STATISTIČKE ANALIZE

U Poglavlju 9 detaljno je opisana metodologija obrade keramičkog materijala stoga će u ovom biti prikazani samo tipološko-statistički rezultati s oba lokaliteta. Kreiranje tipova napravljeno je prema određivanju karakterističnih točaka na obrisu posude kako bi se smanjila subjektivnost prilikom klasifikacije materijala. Kao što je već napisano primijenjen je različit načina uzorkovanja prilikom obrade te se na lokalitetu na Ervenici dobio minimalan broj posuda, a na Damića gradini maksimalan. Ulomci kojima se nije mogao odrediti funkcionalni oblik niti tip posude prebrojani su i razvrstani u tri kategorije prema tehnološkom kriteriju, odnosno načinu obrade vanjske površine. Velika zastupljenost ulomaka tretiranih barbotinom na oba obrađena lokaliteta nije iznenađujuća jer većinom pripadaju velikim loncima čija je fragmentiranost daleko brojnija zbog veličine posude (*Slika 46*). Uglačani i djelomično uglačani ulomci uglavnom pripadaju zdjelama i šalicama.



Slika 46 - ukupna zastupljenost tipološki neodredivih ulomaka prema tretiranju površine na cjelokupnom uzorku s oba lokaliteta

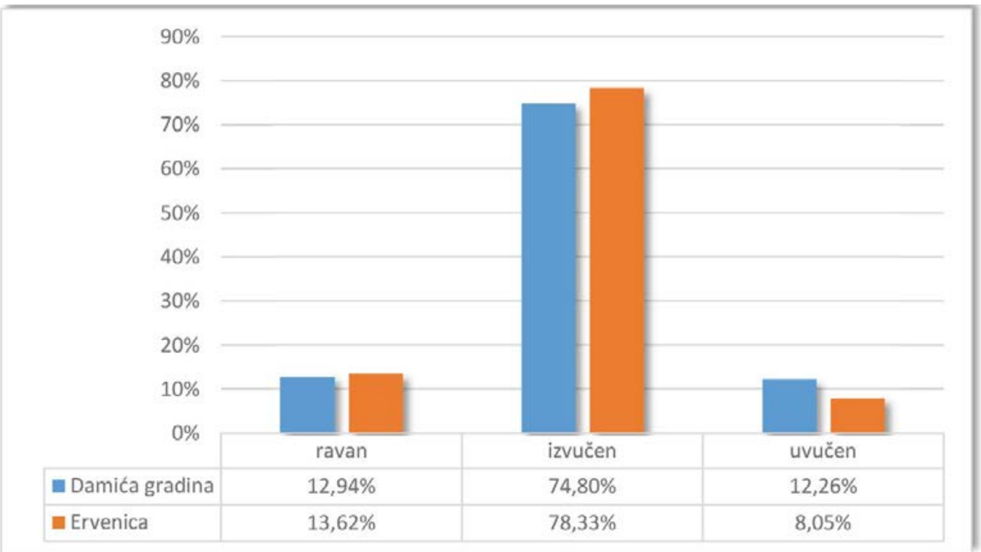
Sveukupno je obrađeno 37,95% dijagnostičkih ulomaka na Ervenici i 31,80% na Damića gradini od cjelokupnog uzorka (rub, dno, ručka, ukras). Od toga, 43,17% ulomaka s Ervenice i 37,87% s Damića gradine nije bilo moguće funkcionalno odrediti zbog malog broja relevantnih parametara. Uglavnom se radi o manjim ulomcima ruba, ukrašenog tijela posude, dijelovima dna ili ručki. Ti su ulomci obrađeni, ali nisu uzeti u obzir prilikom prikazivanja statističkih izračuna. Ista je situacija s ulomcima kojima se mogao odrediti samo tip (A, B, C itd), ali ne i varijanta. Takvi su ulomci obrađeni prema nekoliko parametra koji ih smještaju u određenu kategoriju. To su debljina stijenke, polumjer ruba i dna, visina i obrada površine. Kod statističkog računanja zastupljenosti pojedinih tipova u obzir je uzeta ukupna količina funkcionalno odredivih tipova s obzirom na to da se za ostale ne može pouzdano reći o kojem se tipu radi. Na Ervenici ona iznosi 15,77%, a na Damića gradini 13,39% od cjelokupnog uzorka (*Tablica 2*).

	Ukupan broj obrađenih ulomaka	Tipološki neodredivi ulomci	Dijagnostički ulomci	Ulomci kojima se mogao odrediti samo tip	Zastupljenost tipova i varijanti
Damića gradina	5780	3944	1838	1142	**774**
%	100,00%	68,24%	31,80%	19,76%	**13,39%**
Ervenica	1813	1125	688	105	**286**
%	100,00%	62,05%	37,95%	5,79%	**15,77%**

Tablica 2 - statistički prikaz obrađenih ulomaka

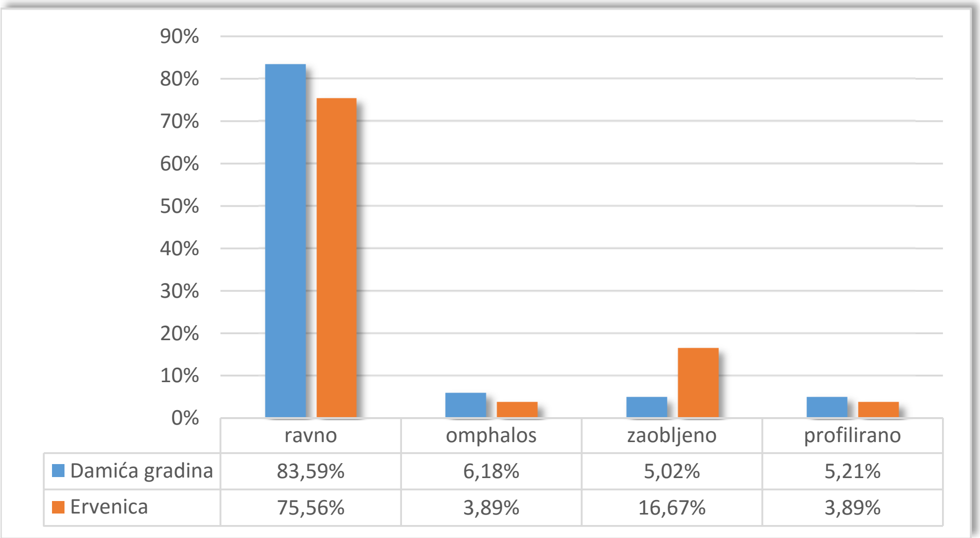
Već je u prethodnim poglavljima spomenuto kako je rub vrlo važna morfološka karakteristika, posebno bitna kod klasifikacije keramičkih oblika. Rub je definiran kao margina otvora posude, a njegov oblik određuje se u odnosu na dvije karakteristike: smjer u odnosu na stijenku posude i debljinu (Shepard 1985: 245). Prema prvoj karakteristici rub koji slijedi opću liniju stijenke i predstavlja gornju krajnju točku posude zove se direktan rub ili usta (Horvat 1999: 94). Rub može odstupati od te linije, pa će tako biti izvučen prema van, uvučen unutra, vodoravno izvučen prema van, a može imati razne varijante profilacije na rubu usta.

Na obrađenom materijalu izdvojene su tri vrste ruba: ravni, uvučeni i izvučeni rub koji je ujedno i najtipičniji oblik otvora posude na obrađenom materijalu (*Slika 47*).

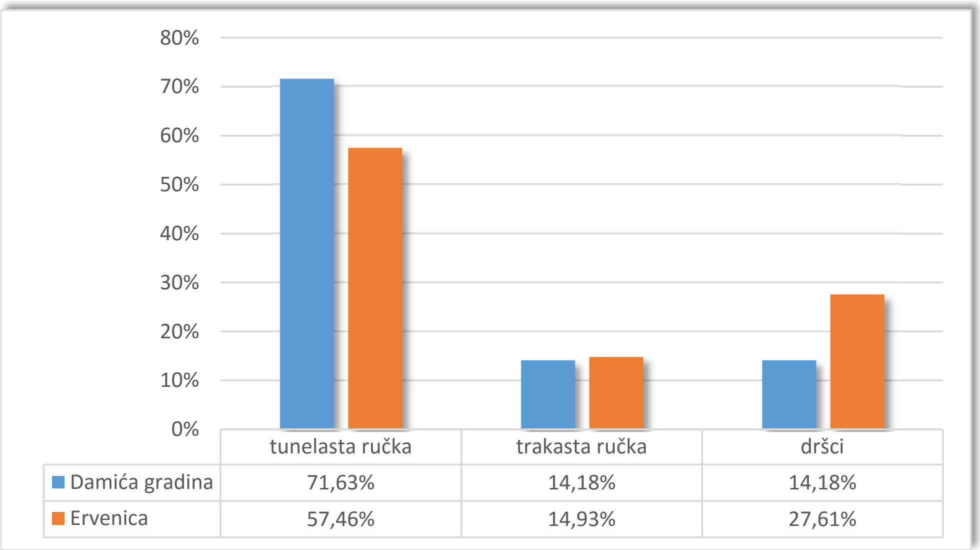


Slika 47 - tipovi rubova na cjelokupnom uzorku

S obzirom na oblikovanost izdvojene su četiri vrste dna: jednostavna/ravna dna koja su i najzastupljenija na svim tipovima, zatim dna s profiliranim rubom, blago zaobljena te *omphalos* dna. Potonja karakterizira uzdignuti središnji dio dna prema unutrašnjosti posude, a termin je preuzet od grčke riječi *omphalós* što znači pupak. Ovaj tip oblikovanosti dna javlja se samo na zdjelama tipa A 2. Profilirana dna karakteristična su uglavnom za lonce, dok se zaobljena javljaju većinom na zdjelama (*Slika 48*). Ručke i ršci (*Slika 49*), kao sekundarni dijelovi posuda, detaljno su opisani u Poglavlju 7.



Slika 48 - tipovi dna na cjelokupnom uzorku



Slika 49 - tipovi ručki i držaka na cjelokupnom uzorku

Atmosfera pečenja vučedolskih posuda većinom se odvijala u redukcijskim ili u uvjetima nepotpunog oksidacijskog pečenja, što je prikazano na *Tablici 3*. Sekundarni faktori koji utječu na

					
Oksidacijsko pečenje		Redukcijsko pečenje	Nepotpuno oksidacisjko pečenje	Redukcijsko pečenje	Redukcijsko pečenje
			proces pečenja je prebrzo završen	sekundarni faktori	dugotrajno izlaganje vatri
DG: E:	n=23 n=34	n= 927 n=353	n=500 n=187	n=55 n=8	n=280 n=74
DG: E:	0,98% 4,72%	39,40% 49,03%	21,25% 25,97%	2,34% 1,11%	11,90% 10,28%

Tablica 3 – atmosfera pečenja prema boji presjeka keramičkih ulomaka boju keramičkog ulomka nastaju kao posljedica izlaganja posude vatri prilikom kuhanja i oni su također dosta česta pojava na keramičkim ulomcima, međutim oni mogu nastati i kao posljedica pečenja u atmosferi nepotpune oksidacije. Način pečenja vučedolskih posuda povezan je s pečenjem na otvorenom ili u jami s obzirom da ni na jednom istraženom vučedolskom lokalitetu nisu zabilježene lončarske peći.

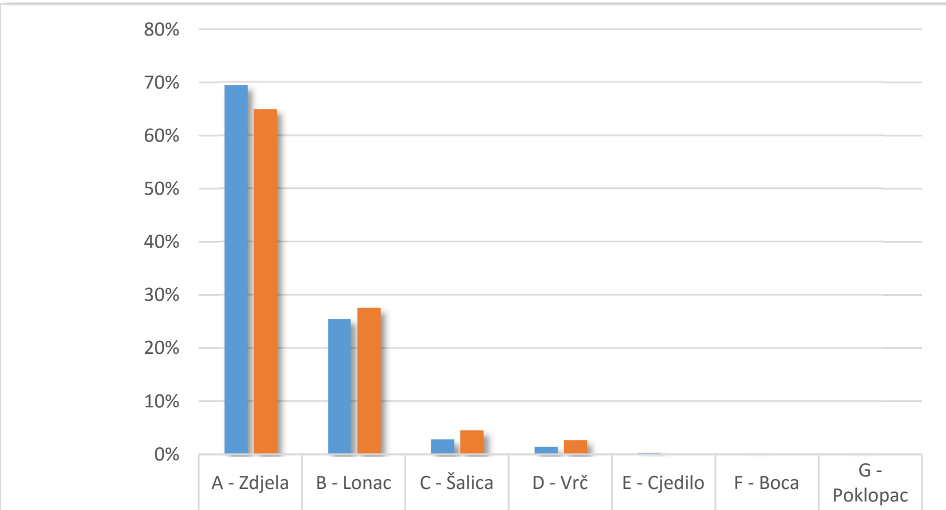
U tabličnim prikazima navedene su srednje vrijednosti (*mean*) svake varijante, sekundarni dijelovi posude, ukras te tretiranje unutrašnje i vanjske površine za oba obrađena lokaliteta (DG = Damića gradina; E = Ervenica). Na obrađenom materijalu izdvojene su četiri vrste obrade, odnosno tretiranja stijenki posuda. Podaci su uzimani posebno za unutrašnju i vanjsku stijenku s obzirom na tehnološku važnost ovog podatka, a ovdje su prikazani podaci najveće zastupljenosti pojedine vrste obrade. U kategoriju ulomaka *grube obrade*, koja je uobičajena u stručnoj literaturi, stavljeni su svi ulomci čija je vanjska strana ogrubljena ili nahrapavljena (tretirana barbotinom). *Glatka obrada* podrazumijeva neobrađenu ili nekvalitetno tretiranu površinu posude. *Glačana površina* podrazumijeva vrlo kvalitetnu obradu pri čemu se dobije sjajna površina posude. Više o ovoj tehnici napisano je u Poglavlju 6. *Djelomično uglačana površina* uključuje sve posude koje su tretirane ovom tehnikom, međutim, nedovoljno da bi posuda dobila kvalitetan sjaj.

U tabličnom prikazu tretman površine označen je na sljedeći način: GR - gruba; G - glatka; GL - glačana; DG - djelomično uglačana obrada.

Veličina posuda određena je prema polumjeru otvora sa tri kategorije: mala (1 - 8 cm), srednja (9 - 13 cm) i velika (14 - 22 cm). Razdvajanje u ove tri kategorije napravljeno je prema statističkom podatku učestalosti i odstupanja u dimenzijama za polumjer otvora. Vrijednosti koje nisu bile mjerljive nisu prikazane u tablicama.

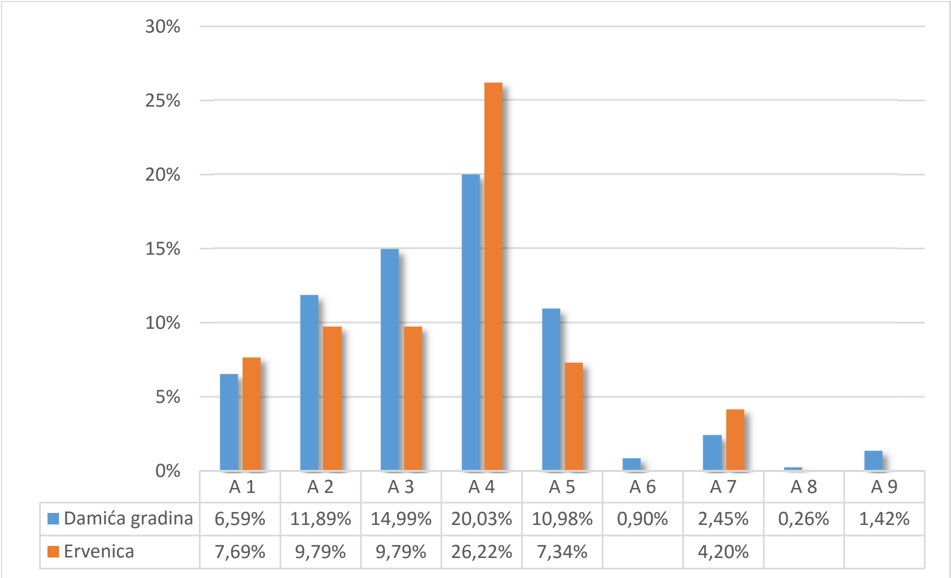
A - ZDJELE

Za definiciju funkcionalnog oblika zdjele uzeti su sljedeći parametri: ovaj oblik može imati profilirani rub, uglavnom nema vrat, iako to nije pravilo, a visina mu varira od 1/3 pa sve do jednakog maksimalnog promjera posude. Zdjele čine najbrojniji funkcionalni oblik na oba lo-

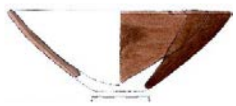


	A - Zdjela	B - Lonac	C - Šalica	D - Vrč	E - Cjedilo	F - Boca	G - Poklopac
Damića gradina	69,51%	25,58%	2,84%	1,42%	0,39%	0,13%	0,13%
Ervenica	65,03%	27,62%	4,55%	2,80%			

Slika 50 - ukupna zastupljenost funkcionalnih tipova kaliteta, na Ervenici su zastupljene sa 65,03%, a na Damića gradini sa 69,51% od ukupnog broja funkcionalno odredivih tipova. Na Ervenici je izdvojeno 6 tipova, a na Damića gradini 9 te nekoliko podtipova unutar svakog oblika. Na slici 50 prikazana je zastupljenost pojedinih tipova u postotcima, stoga se ovi podaci neće ponavljati u daljnjem tekstu.



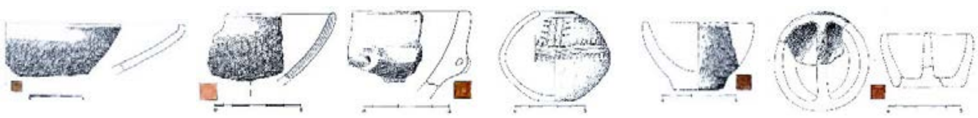
Slika 51 - ukupna zastupljenost tipa A

Tip A 1		**A 1a**	**A 1b**	**A 1c**	**A 1d**
					
Obris		2 KT			
Zastupljenost	DG:	1,29%	1,16%	1,42%	2,71%
	E:	1,75%	2,80%		3,15%
Visina (cm)	DG:	5,58	2,60	6,05	13,23
	E:	5,18	5,90		-
Polumjer otvora (cm)	DG:	10,03	2,66	6,46	7,50
	E:	10,90	5,50		11,87
Debljina stijenki (mm)	DG:	12,73	6,21	7,25	8,44
	E:	12,09	6,59		7,96
Dršci		+	+	-	+
Ručke		-	-	-	-
Tretiranje površine (v/u)		G/G	G/G	G/G	G-DG/G-DG
Ukras		-	-	-	-
Veličina		S	M	M	S, V
Tabla/Slika		T. 1, 2; Slika 29, 30, 34, 75	T. 3: 1, 2	T. 3: 3, 4	T. 3: 5, 6

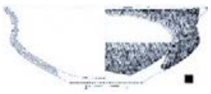
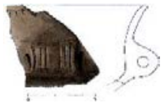
Tablica 4 – slikovni prikazi varijanti A 1a, 1c i 1d – Damića gradina; A 1b – Ervenica

Tip A 2		**A 2a**	**A 2b**
			
Obris		1 KT + 1 UT + 1 UTVT	1 KT + 1 VTVT + 1 UTVT
Zastupljenost	DG:	4,65%	2,97%
	E:	3,85%	2,45%
Visina (cm)	DG:	13,67	4,20
	E:	-	3,36
Polumjer otvora (cm)	DG:	9,24	8,94
	E:	8,74	8,74
Debljina stijenki (mm)	DG:	6,25	6,52
	E:	7,00	7,00
Dršci		+	-
Ručke		-	-
Tretiranje površine (v/u)		GL-DG/ GL-DG	GL-DG/GL-DG
Ukras		+	+
Veličina		S, V	M, S
Tabla/Slika		T. 4; Slika 32, 34, 75	T. 5; Slika 1, 28: 2

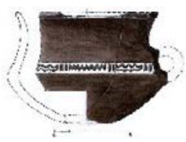
Tablica 5 – slikovni prikazi varijanti A 2a – Damića gradina; A 2b – Ervenica

Tip A 3		**A 3a**	**A 3b**	**A 3c**	**A 3d**	**A 3e**	**A 3f**
							
Obris		2 KT + 1 VTVT					
Zastupljenost	DG:	10,98%	2,20%	1,16%	0,26%	0,26%	0,13%
	E:	9,79%					
Visina (cm)	DG:	7,37	4,12	-	4,90	4,33	3,70
	E:	-					
Polumjer otvora (cm)	DG:	13,91	4,60	9,57	1,75	3,35	3,10
	E:	11,10					
Debljina stijenki (mm)	DG:	7,96	5,44	7,29	4,74	5,42	7,50
	E:	7,55					
Dršci		-	-	+	-	-	-
Ručke		-	-	-	-	-	-
Tretiranje površine (v/u)		GL-DG/GL-DG	G/G	G-DG/G-DG	G/G	G/G	G/G
Ukras		-	-	-	+	-	-
Veličina		S, V	M	S	M	M	M
Tabla/Slika		T. 6	T. 7: 1, 2	Slika 24	T. 7: 3	T. 7: 4	-

Tablica 6 – slikovni prikazi varijanti A 3a – Ervenica; A 3b - 3f – Damića gradina

Tip A 4		A 4a	A 4b	A 4c	A 4d	A 4e
						
Obris	2 KT + 1 UT + 1 UTVT					
Zastupljenost	DG:	4,26%	1,42%	12,40%	1,68%	0,26%
	E:	13,64%	3,15%	8,39%		1,05%
Visina (cm)	DG:	7,9	-	-	-	5,81
	E:	9,20	-	6,9		-
Polumjer otvora (cm)	DG:	11,51	11,38	12,56	-	6,16
	E:	11,46	14,88	13,58		-
Debljina stijenki (mm)	DG:	6,58	7,37	6,96	7,85	7,25
	E:	6,88	6,91	7,03		7,17
Division Dršci	+		+	+	-	-
Ručke	-		-	-	+	-
Tretiranje površine (v/u)	GL-DG/DG-GL		GL-DG/ DG-GL	GL-DG/GL-DG	DG/G-DG	GL-DG/GL-DG
Ukras	-		-	+	+	+
Veličina	S, V		S, V	S, V		M
Tabla/Slika	T. 7: 7; Slika 23		T. 7: 5, 6	T. 8-10; Slika 28: 3-4; 58, 74, 75, 81, 83	-	T. 11, 12

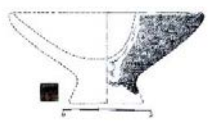
Tablica 7 – slikovni prikazi varijanti A 4a - 4c – Ervenica; A 4d i 4e – Damića gradina

Tip A 5		A 5a	A 5b
			
Obris	2 KT + 1 VTVT + 1 UTVT + 1 TI		
Zastupljenost	DG:	3,10%	1,29%
	E:	1,05%	0,70%
Visina (cm)	DG:	11,78	12,00
	E:	12,00	-
Polumjer otvora (cm)	DG:	6,87	5,50
	E:	5,50	5,98
Debljina stijenki (mm)	DG:	6,32	5,91
	E:	6,88	6,08
Dršci	-		-
Ručke	+		+
Tretiranje površine (v/u)	GL-DG/DG-GL-G		GL-DG/DG-GL-G
Ukras	+		+
Veličina	M, S		M, S
Tabla/Slika	T. 13, 14; Slika 19, 30, 56, 57, 73		T. 15; Slika 22, 31

Tablica 8 – slikovni prikazi varijanti A 5a i 5b – Damića gradina

Tip A 6	A 6a	
		
Obris	2 KT + 1 VTVT + 1 UTVT + 1 TI	
Zastupljenost	DG:	0,90%
Visina (cm)	DG:	-
Polumjer otvora (cm)	DG:	14,30
Debljina stijenki (mm)	DG:	9,14
Dršci	-	
Ručke	+	
Tretiranje površine (v/u)	GR/DG	
Ukras	+	
Veličina	V	
Tabla/Slika	T. 17: 1, 2	

Tablica 9 – slikovni prikaz varijante A 6a – Damića gradina

Tip A 7		A 7a	A 7b	A 7c
				
Obris		2 KT + 1 UT		
Zastupljenost	DG:	0,13%	0,39%	0,39%
	E:	0,35%	1,05%	0,70%
Visina (cm)	DG:	-	4,25	-
	E:	-	5,00	-
Polumjer otvora (cm)	DG:	-	4,50	-
	E:	-	6,00	-
Debljina stijenki (mm)	DG:	8,37	5,77	6,69
	E:	9,30	6,56	4,91
Dršci		-	+	-
Ručke		-	-	-
Tretiranje površine (v/u)		GL/ GL-DG	GL- DG /DG-G	GL/ GL-DG
Ukras		+	-	+
Veličina		-	M	-
Tabla/Slika		T. 17: 3; Slika 75	T. 18: 1, 2	T. 18: 3, 4, 5, 7

Tablica 10 – slikovni prikazi varijanti A 7a - 7c – Damića gradina

Tip A 8	A 8a	
		
Obris	2 KT	
Zastupljenost	DG:	0,26%
Visina (cm)	DG:	7,40
Polumjer otvora (cm)	DG:	5,20
Debljina stijenki (mm)	DG:	6,56
Dršci	-	
Ručke	-	
Tretiranje površine (v/u)	G/G	
Ukras	-	
Veličina	M	
Tabla/Slika	T. 21: 1	

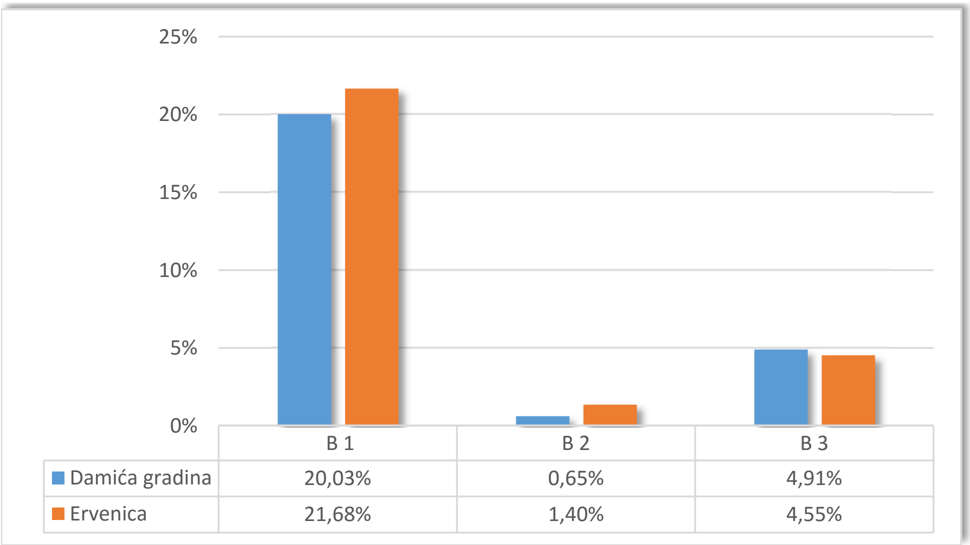
Tablica 11 – slikovni prikaz varijante A 8a – Damića gradina

Tip A 9	A 9a		A 9b	A 9c
				
Obris	2 KT + 1 UTVT + 1 VTVT + 1 TI		2 KT + 1 UT + 1 UTVT	2 KT + 1 VTVT + 1 UT
Zastupljenost	DG:	0,52%	0,13%	0,78%
Visina (cm)	DG:	4,90	-	8,40
Polumjer otvora (cm)	DG:	2,70	3,80	4,12
Debljina stijenki (mm)	DG:	4,23	4,57	5,76
Dršci	-		-	+
Ručke	-		-	-
Tretiranje površine (v/u)	GL-G/G-DG		GL/DG	G-DG/G
Ukras	-		-	+
Veličina	M		M	M
Tabla/Slika	T. 21: 2, 3		-	T. 21: 4, 5

Tablica 12 – slikovni prikazi varijanti A 9a - 9c – Damića gradina

B- LONCI

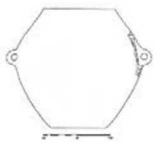
Lonac je definiran kao posuda s vratom ili bez njega, čija je visina uglavnom veća od maksimalnog promjera posude. Na Damića gradini ovaj tip zastupljen je sa 25,58%, a na Ervenici sa 27,62% od ukupnog broja odredivih tipova (*Slika 52*).



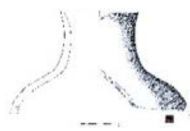
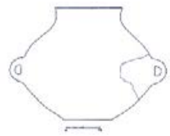
Slika 52 - ukupna zastupljenost tipa B

Tip B 1		B 1a	B 1b	B 1c	B 1d
					
Obris		2 KT + 1 VTVT + 1 UTVT + 1 TI			
Zastupljenost	DG:	11,37%	7,49%	0,90%	0,26%
	E:	10,14%	3,50%		2,10%
Visina (cm)	DG:	34,91	22,40	-	-
	E:	-	-		-
Polumjer otvora (cm)	DG:	10,74	7,22	13,12	9,00
	E:	9,30	6,50		6,10
Debljina stijenki (mm)	DG:	8,82	6,98	8,76	9,05
	E:	8,03	6,18		7,19
Dršci		+	+	+	+
Ručke		+	+	+	+
Tretiranje površine (v/u)		GR/DG	GR-G/DG	GR/DG	GR/DG
Ukras		+	+	+	+
Veličina		S, V	M, S	S, V	M, S
Tabla/Slika		T. 22-24; Slika 25, 75, 78	T. 25; Slika 79	T. 26	T. 27

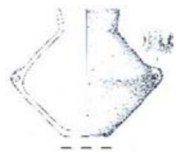
Tablica 13 – slikovni prikazi varijanti B 1a - 1c – Damića gradina; B 1d – Ervenica

Tip B 2		**B 2a**	**B 2b**	**B 2c**	**B 2d**
					
Obris		2 KT + 1 VTVT			
Zastupljenost	DG:		0,13%	0,39%	0,13%
	E:	1,40%			
Visina (cm)	DG:		10,50	-	-
	E:	-			
Polumjer otvora (cm)	DG:		3,00	-	6,00
	E:	-			
Debljina stijenki (mm)	DG:		5,95	6,96	7,10
	E:	5,14			
Dršci		+	-	-	+
Ručke		+	+	+	-
Tretiranje površine (v/u)		GL-G/G	GL/G	GL/DG	GL/G
Ukras		+	+	+	+
Veličina		-	M	-	M
Tabla/Slika		T. 28: 3	Slika 15, 30	T. 28: 1	T. 28: 2

Tablica 14 – slikovni prikazi varijanti B 2a – Ervenica; B 2b - 2d – Damića gradina

Tip B 3		**B 3a**	**B 3b**	**B 3c**	**B 3d**
					
Obris		2 KT + 1 VTVT + 1 UT			
Zastupljenost	DG:	0,13%	1,94%	0,39%	0,13%
	E:	0,35%	3,50%	0,70%	
Visina (cm)	DG:	8,70	31,10	-	-
	E:	11,40	-	-	
Polumjer otvora (cm)	DG:	2,24	6,50	-	-
	E:	3,10	7,99	-	
Debljina stijenki (mm)	DG:	4,24	8,37	7,33	6,64
	E:	4,94	9,97	8,14	
Dršci		-	+	+	-
Ručke		-	+	+	+
Tretiranje površine (v/u)		GL/DG	GL-G/G	G/G	DG/G
Ukras		+	+	+	+
Veličina		M	S, V	-	-
Tabla/Slika		Slika 55	T. 29; Slika 21, 80	-	-

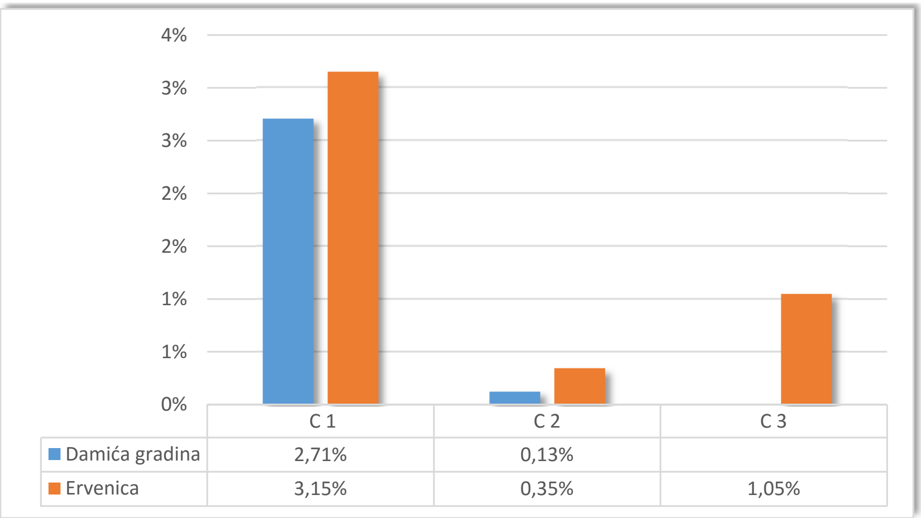
Tablica 15 – slikovni prikazi varijanti B 3a i 3c – Ervenica; B 3b i 3d – Damića gradina

Tip B 3		**B 3e**	**B 3f**	**B 3g**
				
Obris	2 KT + 1 VTVT + 1 UT			
Zastupljenost	DG:	0,13%	0,13%	0,26%
Visina (cm)	DG:	12,20	-	-
Polumjer otvora (cm)	DG:	3,10	8,00	-
Debljina stijenki (mm)	DG:	5,06	10,07	5,47
Držci		-	-	-
Ručke		+	+	+
Tretiranje površine (v/u)		GL/DG	GR/G	GL/DG
Ukras		-	+	+
Veličina		M	M	-
Tabla/Slika		Slika 16, 33	-	-

Tablica 16 – slikovni prikazi varijanti B 3e - 3g – Damića gradina

C – ŠALICE

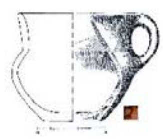
Šalice su definirane kao posude s ručkom čiji je promjer otvora uglavnom jednak visini posude. Izdvojena su tri tipa, a njihova zastupljenost prikazana je na slici 53.



Slika 53 - ukupna zastupljenost tipa C

Tip C 1		**C 1a**	**C 1b**
			
Obris		2 KT + 1 VTVT + 1 UTVT + 1 TI	
Zastupljenost	DG:	2,71%	
	E:	2,45%	0,70%
Visina (cm)	DG:	10,50	
	E:	8,00	-
Polumjer otvora (cm)	DG:	3,83	
	E:	3,90	-
Debljina stijenki (mm)	DG:	5,99	
	E:	4,75	6,36
Držci		-	-
Ručke		+	+
Tretiranje površine (v/u)		GL-DG-G/G-DG	GL/G-DG
Ukras		-	+
Veličina		M	M
Tabla/Slika		T. 30: 1-2; Slika 75, 76	-

Tablica 17 – slikovni prikazi varijanti C 1a – Damića gradina; C 1b – Ervenica

Tip C 2 – C 3		**C 2a**	**C 3a**
			
Obris		2 KT + 1 VTVT + 1 UT	2 KT + 1 UTVT + 1 UT
Zastupljenost	DG:	0,13%	
	E:	0,35%	1,05%
Visina (cm)	DG:	-	
	E:	8,05	8,16
Polumjer otvora (cm)	DG:	-	
	E:	4,00	4,25
Debljina stijenki (mm)	DG:	5,48	
	E:	5,45	5,12
Držci		-	-
Ručke		+	+
Tretiranje površine (v/u)		G/G	GL-DG/G-DG
Ukras		-	-
Veličina		M	M
Tabla/Slika		-	T. 30: 3

Tablica 18 – slikovni prikazi varijanti C 2a i C3a – Ervenica

D – VRČEVI

Vrč je definiran kao posuda s vratom i ručkom, s visinom većom od maksimalnog promjera posude.

Tip D 1 – D 2		D 1a	D 2a
			
Obris		2 KT + 1 VTVT + 1 UT	2 KT + 1 VTVT + 1 TI
Zastupljenost	DG:	0,13	1,29%
	E:	0,35%	2,45%
Visina (cm)	DG:	-	-
	E:	14,00	-
Polumjer otvora (cm)	DG:	-	6,00
	E:	6,60	6,25
Debljina stijenki (mm)	DG:	4,68	7,08
	E:	4,95	7,80
Dršci		-	-
Ručke		+	+
Tretiranje površine (v/u)		G-DG/G-DG	G-DG/G-DG
Ukras		-	-
Veličina		M	M
Tabla/Slika		Slika 75	-

Tablica 19 – slikovni prikazi varijanti D 1a – Ervenica; D 2a – Damića gradina

E - CJEDILA

Tip E 1 – E 2		E 1a	E 2a
			
Obris		2 KT + 1 VTVT	
Zastupljenost	DG:	0,13%	0,26%
Visina (cm)	DG:	7,50	-
Polumjer otvora (cm)	DG:	9,00	6,50
Debljina stijenki (mm)	DG:	6,50	7,65
Dršci		+	-
Ručke		-	-
Tretiranje površine (v/u)		GL/GL	GL/GL
Ukras		-	-
Veličina		M	M
Tabla/Slika		Slika 75, 77	Slika 75

Tablica 20 – slikovni prikazi varijanti E 1a i E 2a – Damića gradina

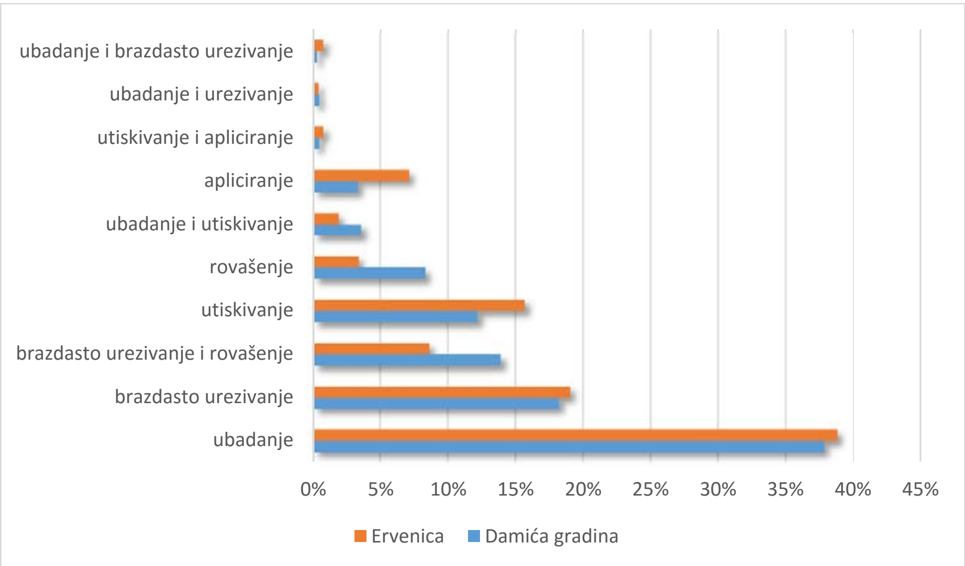
F - BOCA

Tip F	**F 1a**	
		
Obris	2 KT + 1 VTVT + 1 UT	
Zastupljenost	DG:	0,13%
Visina (cm)	DG:	21,5
Polumjer otvora (cm)	DG:	2,95
Debljina stijenki (mm)	DG:	5,02
Ršci	-	
Ručke	+	
Tretiranje površine (v/u)	GL/DG	
Ukras	+	
Veličina	S	
Tabla/Slika	T. 31, 32	

Tablica 21 – slikovni prikazi varijante F 1a – Damića gradina

UKRAŠAVANJE

Ukrašavanje ili stil odnosi se na vizualnu komponentu koja je specifična za određeno vrijeme i mjesto, a koja nam prenosi informacije o identitetu zajednice koja ga je napravila i mjestu gdje se pojavljuje (Rice 1987: 244). Nekoliko je različitih pristupa analize dekorativnog stila, koja se od 60-ih godina prošloga stoljeća pomaknula od atribucije stila samo kao kronološkog parametra i svrstavanja po kulturnim grupama (Shepard 1985; Rice 1987). Ne ulazeći u te ana-



Slika 54 - zastupljenost tehnika ukrašavanja na cjelokupnom uzorku
Fig. 54 – Comparative figures for decoration techniques in the whole sample

lize, bilježenje ukrasa na keramičkim posudama treba biti dovoljno precizno da posluži upravo onima koji će se posebno baviti analizom ukrasa ili komparacijom jednog stila s drugim. Formalni aspekti ukrasa uključuju adaptaciju na oblik posude, kompoziciju, upotrebu, simetriju i boju, a na majstoru je da odabere mjesto na posudi gdje će taj ukras staviti (Shepard 1985: 255-261).

Tehnike i stil ukrašavanja te bogat repertoar vrlo precizno izvedenih motiva izdvajaju vučedolsku kulturu od ostalih keramičarskih stilova prapovijesnih zajednica. Ukrašavanje je postalo vučedolski *brand*, segment po kojem je ova kultura prepoznatljiva i za što nas veže prva asocijacija kada se spomene vučedolska kultura. Upravo u klasičnoj fazi razvoja vučedolske kulture razvijen je osebujan repertoar oblika i ukrasa koji su postali stilski izrazito prepoznatljivi. Iako su tehnike ukrašavanja, pojedini motivi i oblici preuzeti iz kultura koje su joj prethodile vještina i stil koju su razradili vučedolski lončari izdvaja keramičku proizvodnju ove kulture kao vrlo prepoznatljivu pojavu.

Motivi na vučedolskim posudama izvedeni su tehnikama brazdastog urezivanja i rovašenja koji se primjenjuju samostalno ili u kombinaciji s običnim urezivanjem i ubadanjem, pri čemu se izdubljeni motivi ispunjavaju bijelom ili rjeđe crvenom pastom – inkrustacijom. Više o načinu izvođenja ovih tehnika bilo je riječi u Poglavlju 6.

Ispunjavanje motiva inkrustacijom, iako već poznata tehnika, za vučedolsku kulturu imala je veliko značenje (*Slika 55*). Smjesa je rađena od izrazito fine teksture, vrlo precizno nanešena u izdubljene motive (*Slika 56*), a koji su na pojedinim posudama do te mjere naglašeni da prekrivaju gotovo čitavu površinu posude. Provedene analize pokazale su da se radi o smjesi od riječnih školjaka (Poglavlje 16).

Obrazac pojavljivanja motiva ukazuje da su određeni ukrasi „rezervirani" za određene tipove. Tako se motiv klepsidre javlja na gotovo svim ukrašenim posudama osim na tipovima A 5 i A 7, dok je solarni motiv prisutan samo na tipovima A 5 i A 4e.

Slika 55 – motivi izvedeni brazdastim urezivanjem i ispunjeni inkrustacijom
Fig. 55 – Motifs rendered by furrowing and filled with incrustation

Položaj ukrasa najčešći je na prijelazu ramena u tijelo posude i u kombinaciji s ukrašavanjem ispod ruba, dok su tipovi A 7a, A 7c i A 4e ukrašeni po cijeloj unutrašnjoj i vanjskoj površini (T. 11, 12, 19, 20). Tunelaste ručke gotovo u pravilu su ukrašene, vrlo često motivom Andrijinog križa (*Slika 56, 57*) koji je vrlo uobičajen motiv i na zdjelama tipa A 4c (*Slika 58*).

Ukrašavanje na posudama fine obrade, koje pripadaju funkcionalnom tipu zdjela, karakterizira tzv. arhitektonski stil koji je specifičan za klasičnu fazu vučedolske kulture, odnosno B-2 stupanj prema podjeli S. Dimitrijevića (Dimitrijević 1979), a kojoj pripadaju i obrađeni lokaliteti u ovoj knjizi. Karakteristika ovakvog načina ukrašavanja je izrazita sklonost k geometrizaciji površine, s vrlo raznolikim repertoarom motiva

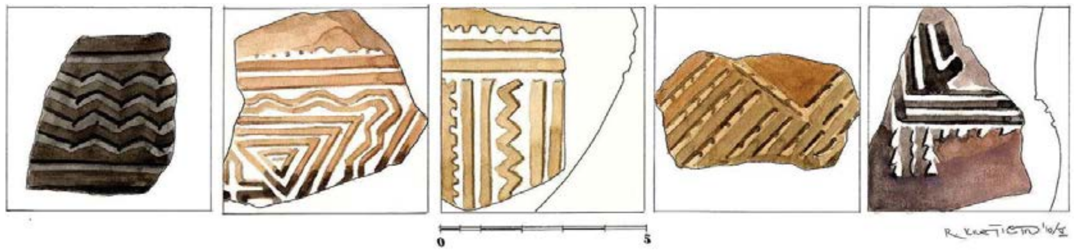
Slika 56 - rovašeni motiv ispunjen inkrustacijom
Fig. 56 – Notched motif filled with incrustation

Slika 57 – ukrasi na tunelastim ručkama
Fig. 57 – Decoration on tunnel handles

Slika 58 – motiv Andrijinog križa
Fig. 58 – Motif of St. Andrew's cross

- od jednostavnih cik-cak linija, trokutastih i pravokutnih motiva, vrlo čestog motiva klepsidre, pa sve do složenijih varijanti kompleksnih kombinacija kao što su rombovi umetnuti u pravokutna polja, Andrijini križevi ili šahovske ploče (T. 9, 10, 16, 31, 32). Cijela površina posude organizirana je u pravilne frizove unutar kojih se nalaze motivi ispunjeni bijelom te rjeđe crvenom inkrustacijom (T. 18: 6; *Slika 60*).

Brazdasto urezivanje najdominantnija je tehnika ukrašavanja na zdjelama (*Slika 59*), izvedena samostalno ili u kombinaciji s običnim urezivanjem i rovašenjem.



Slika 59 – motivi izvedeni tehnikom brazdastog urezivanja
Fig. 59 – Motifs rendered by furrowing

Velike rovašene površine ispunjene inkrustacijom najkarakterističnije su za tip A 5, a ovako izvedeni motivi ostavljaju dojam trodimenzionalnosti zbog izrazitog kontrasta crne površine posude te bijelog ili crvenog motiva (*Slika 56, 60*). Veća površina na kojoj se mogla izvesti ova tehnika, koja zahtijeva odstranjivanje gline iz izdubljenog motiva, zapravo i nije izvediva na ostalim tipovima zdjela zbog ograničene plohe za primjenu ove tehnike.

Slika 60 – motivi izvedeni tehnikom rovašenja
Fig. 60 – Motifs rendered by notching

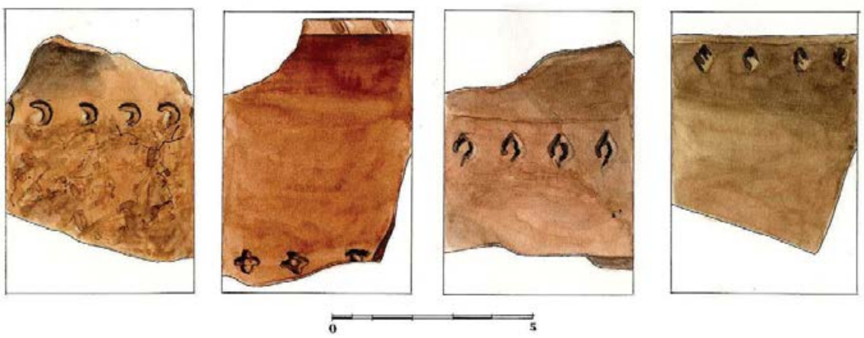
Ubadanje je najzastupljenija tehnika koja se koristila na posudama grube fakture, odnosno funkcionalno tipu koji pripada loncima, a najčešće je korištena na prijelazu vrata u rame i ispod ruba posude. Motivi dobiveni ovom tehnikom pokazuju da se najviše koristio alat okruglog presjeka, a slijede ga alati koji ostavljaju četvrtaste, trokutaste i duguljaste motive (*Slika 61*) te motive nastale od neobičnih alata (*Slika 62*). Korišteni alati najčešće su se radili od prirodnih materijala pa ih zato rijetko nalazimo u arheološkom kontekstu. Najčešće se radi o drvenim i koštanim alatkama koje mogu biti u svom prirodnom obliku ili su modificirane u željeni oblik, ovisno o afinitetu majstora.

Druga najzastupljenija tehnika na loncima je utiskivanje, koje je najčešće izvedeno prstom ili noktom te alatom koji ostavlja duguljaste linije. Ovom tehnikom ukrašavao se rub posude, prijelaz vrata u rame posude te aplicirana traka (*Slika 63*). Tehnika žlijebljenja koristila se isključivo na tunelastim ručkama i nije prisutna na ostalim morfološkim dijelovima posude (T. 24; *Slika 20*).

Precizno izvedeni i raskošni motivi još su jedan segment u vučedolskoj keramografiji koji pokazuju izrazitu vještinu, znanje i iskustvo lončara. Oni manje vješti mogu se prepoznati i po nedovršenim ili nesimetričnim motivima, dok neki ostavljaju svoj osobni “trag“ na izrađenoj posudi (*Slika 64*).

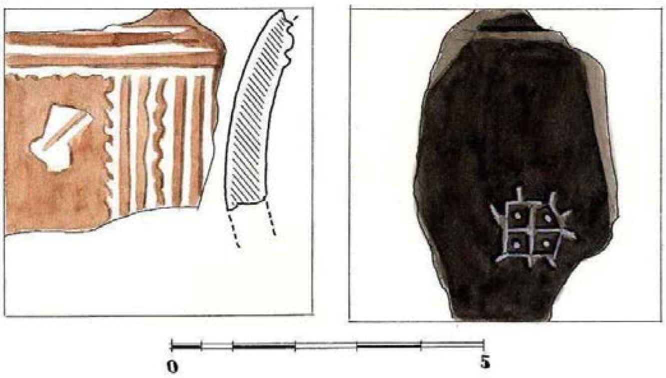
Sigurno je da su pojedini oblici posuda i motivi koji se na njima nalaze imali i posebno značenje za zajednicu u društvenom ili religijskom aspektu, odnosno da su služili za posebne prilike, isticanje moći ili hijerarhijskih odnosa koji su u vučedolskoj kulturi prepoznatljivi te u pogrebnim obredima. Međutim, analiza stila te posebno simbolike pojedinih motiva i njihovih kompozicija iziskuje poseban pristup i metodologiju koji nisu izravna tema ove knjige.

Slika 61 – okrugli, četvrtasti, trokutasti i duguljasti motivi izvedeni tehnikom ubadanja
Fig. 61 – Round, square, triangular and elongated motifs made by puncturing



Slika 62 – tehnika ubadanja izvedena neobičnim alatima
Fig. 62 – Puncturing technique applied with unusual implements

Slika 63 – tehnika utiskivanja
Fig. 63 – Impression technique



Slika 64 – primjer nedovršenog rovašenog motiva i neobičnog motiva s unutrašnje strane posude
Fig. 64 – Example of an unfinished notched motif and an unusual motif in the vessel's interior

14. POLJOPRIVREDNI I GOSPODARSKI SEGMENT VUČEDOLSKIH NASELJA

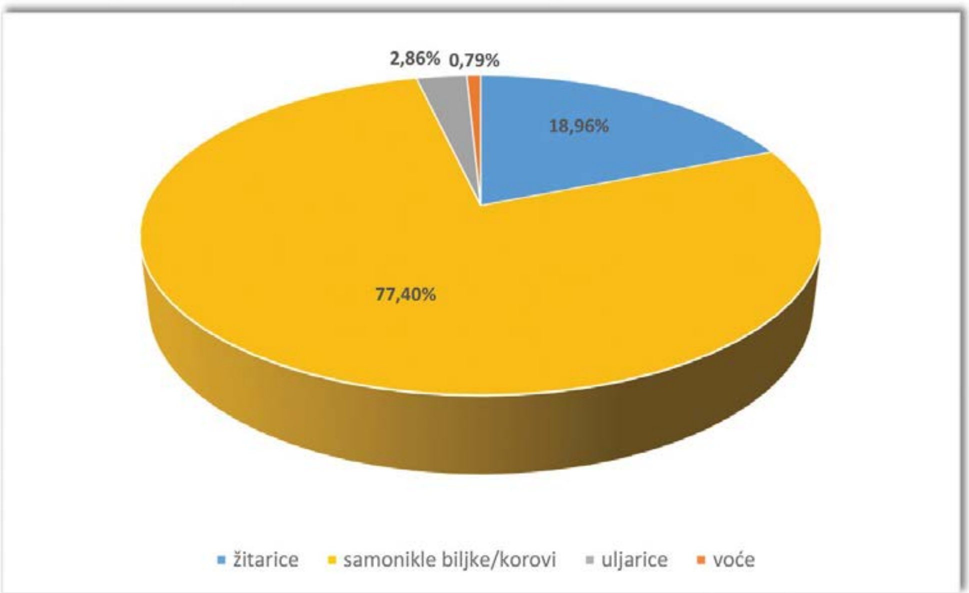
ARHEOBOTANIČKA ANALIZA

Istraživanja krajolika u kojem je čovjek živio pionirski je započeo Graham Clark u poslijeratnom vremenu, a proširila su se na analizu krajolika i klimatskih uvjeta u kojima je obitavao čovjek. Clark je time potaknuo veliki znanstveni skok, a laboratorijska istraživanja bioloških ostataka, kao što su životinjske kosti i biljni ostaci sakupljeni tijekom arheoloških istraživanja i njihova interpretacija u smislu ekonomskog i ekološkog segmenta, postale su specijalizacije poput zooarheologije, paleoetnobotanike i bioarheologije (Trigger 1989).

Jedan od glavnih ciljeva arheobotanike je istraživanje povijesti kultivacije biljaka, odnosno proučavanje veze između čovjeka i vegetacije. Za razliku od analize polena, arheobotanika primarno proučava ostatke biljnih vrsta koje su isključivo vezane za ljudsku aktivnost (Price 2007: 350). U ostacima arheoloških struktura koje su dokaz ljudske aktivnosti, poput kulturnih slojeva, otpadnih jama ili kuća, mogu se naći dokazi koji omogućuju rekonstrukciju i identifikaciju fosilnih biljaka, odnosno vezu između čovjeka i krajolika. Ta veza pomaže nam predočiti kompletnu sliku kulturnih i prirodnih promjena kroz vrijeme, način na koji je čovjek iskorištavao krajolik koji ga okružuje, u kojoj mjeri mu se prilagođavao, a u kojem je omjeru utjecao na njegove promjene.

Danas, kada je arheologija nedvojbeno postala interdisciplinarna znanost, arheobotanika je disciplina bez koje ne možemo zamisliti rekonstrukciju krajolika, stupanj kultiviranosti zemljišta i prehrambene navike stanovništva u bilo kojem arheološkom okruženju. S pomoću ostataka fosilnih biljaka u mogućnosti smo odrediti poljoprivrednu aktivnost tadašnjeg stanovništva, odnosno vrste biljaka koje su se uzgajale i koristile u svakodnevnoj ishrani.

Arheobotanička analiza napravljena je na četiri uzorka s lokaliteta M. Gupca 14 na Ervenici. Jedan pripada jami SJ 49/50, a ostala tri jami SJ 47/48. Analize je napravila dr. sc. Kelly Reed sa Sveučilišta u Leicesteru (Reed 2012). Izdvajanje karboniziranih biljnih ostataka sakupljenih prilikom arheološkog iskopavanja provedeno je ispiranjem uzoraka zemlje s pomoću uređaja za



Slika 65 – ukupna zastupljenost biljnih ostataka flotaciju. Biljni ostaci koji se mogu identificirati nakon sušenja i izdvajanja od ostalog materijala (zemlje, recentnih korova i trava) nalaze se u vrlo dobrom stanju jer nisu podložni bakterijama i gljivicama. Veliki broj identificiranih biljnih vrsta na lokalitetu na Ervenici te dva uzorka koja sadrže preko 384 biljna ostatka ukazuju da se na naseljima koja su intenzivno i dugoročno naseljavana uzorci bolje sačuvaju (Reed 2016).

Rezultati provedene analize pokazali su veću zastupljenost samoniklih biljnih vrsta (77,40%) u odnosu na kultivirane biljke, posebno žitarice (18,96%) (*Slika 65*).

Od žitarica najzastupljenija je pšenica i to dvozrna pšenica (*Triticum dicoccum*), potom jednozrna pšenica (*Triticum monococcum*), prava pšenica (*Triticum spelta*) i meka/tvrda pšenica (*Triticum aestivum/durum*). Nakon pšenice najzastupljeniji je šestoredni ječam (*Hordeum vulgare*) i ječam s golim zrnom (*Hordeum vulgare var. nudum*). Raž je zabilježena samo s jednim primjerkom (*Secale cereale*) što ne znači da se raž namjerno uzgajala, ona je mogla doći kao primjesa na poljima koja su zasijana pšenicom. Raž se kao „sekundarni usjev“ počela uzgajati u centralnoj Europi tek u mlađem željeznom dobu, a došla je kao korov pšenice i ječma (van Zeist 1974-78: 13). Obično proso (*Panicum miliaceum*) zabilježeno je samo s dva primjerka (*Tablica 22*).

ŽITARICE	Broj makrofosila	%
Žitarice (Cerealia indet.)	16	5,13%
Pšenica *(Triticum* spp.)	51	16,35%
Dvozrna pšenica (*Triticum dicoccum* L.)	125	40,06%
Jednozrna pšenica *(Triticum monococcum* L.)	53	16,99%
Triticum mono/dicoc	32	10,26%
Meka/tvrda pšenica *(T. aestivum/durum* L.)	16	5,13%
Ječam s golim zrnom *(Hordeum vulgare var. nudum* L.)	9	2,88%
Šestoredni ječam *(Hordeum vulgare hulled* L.)	7	2,24%
Raž *(Secale cereale* L.)	1	0,32%
Proso (*Panicum miliaceum* L.)	2	0,64%
Ukupno	312	100,00%

Tablica 22 - ukupan broj makrofosila žitarica

Pšenična pljeva je rijetka, a sjemenke lana (*Linum usitatissimum*) zastupljene su u većem broju nego na ostalim nalazištima iz istog razdoblja (Reed 2016).

Od divljih voćaka, čiji su se ukusni i vitaminima bogati plodovi sakupljali u obližnjim šumama, prisutan je drijenak (*Cornus mas*), bazga (*Sambucus sp.*) i zimska trešnja (*Physalis alkekengi*). Neki od divljih plodova mogli su se koristiti i u ljekovite svhe. Zimska trešnja ima plod koji je iznimno ljekovit, dok je drijen grmoliko drvo od kojeg se u ljekarničke svrhe koriste samo plodovi. Ostaci ovih divljih vrsta pronađeni su i na obližnjem lokalitetu Sopot (Krznarić Škrivanko 2015). U uzorcima je prisutan i dosta velik broj samoniklog bilja i korova, uključujući veliku koncentraciju korova ovsika (*Bromus* sp.), bijele lobode (*Chenopodium album*), trave (*Gramineae*), žitnog korova/kukolja (*Agrostemma githago*) te jedan uzorak cvijeta ljubice (*Viola* sp.) (*Tablica 23*).

SAMONIKLE BILJKE I KOROVI	Broj makrofosila	%
Agrostemma githago L.	2	0,16%
Asteraceae	1	0,08%
Gramineae	230	18,05%
Bromus sp.	381	29,91%
Lolium sp.	1	0,08%
Sambucus ebulus	3	0,24%
Phleum sp.	10	0,78%
Chenopodium sp.	108	8,48%
Chenopodium album L.	513	40,27%
Cyperaceae	1	0,08%
Dasypyrum/Secale sp.	1	0,08%
Galium aparine L.	2	0,16%
Hypericum sp.	1	0,08%
Polygonum sp.	2	0,16%
Potentilla sp.	1	0,08%
Teucrium sp.	2	0,16%
Verbena officinalis L.	1	0,08%
Viola sp.	2	0,16%
Sitnozrne mahunarke	12	0,94%
Ukupno	1274	100,00%

Tablica 23 - ukupan broj makrofosila samoniklog bilja i korova

U poljoprivredi pod korovima se podrazumijevaju obične, samonikle biljke koje protiv naše volje rastu na obradivim površinama zajedno s usjevima i pričinjavaju im štetu koja se odražava na njihov prinos. Obično se javljaju na mjestima gdje je prisutna ljudska aktivnost. Korove se može podijeliti na prateću vegetaciju ljetnih i zimskih usjeva. Od korova koji prate ljetne usjeve (klasa Chenopodiete) na Ervenici su zabilježeni ostaci bijele lobode (*Chenopodium album*) i uzlatog dvornika (*Polygonum lapathifolium*). Srodne ovim plodovima su i ruderalne biljke koje rastu pored smetlišta, uz rubove šuma, putova i na ruševinama, a neke od njih prelaze i na poljo-

Zastupljenost samoniklih biljaka/korova koji prate ljetne usjeve	Ukupan broj makrofosila	%
Chenopodiaceae	108	8,48
Chenopodium album L.	513	40,27
Polygonum sp.	2	0,16
Zastupljenost samoniklih biljaka/korova koji prate zimske usjeve		
Bromus sp.	381	29,91
Ukupno samoniklih biljaka/korova	1274	100,00

Tablica 24 - zastupljenost korova koji prate ljetne i zimske usjeve privredne površine. Zbog toga je teško povući granicu između te dvije biljne zajednice (Kučan et al. 2006: 66). Korovi koji su specifični kod uzgoja zimskih žitarica (klasa Secalietea) zastupljeni su samo vrstom ovsika (*Bromus*). Po postotku zastupljenosti može se pretpostaviti da su žitarice više uzgajane kao ljetni usjevi (*Tablica 24*). Dvozrna pšenica (*Triticum dicoccum*) i proso (*Panicum miliaceum*) uzgajani su kao ljetni usjevi, dok je jednozrna pšenica (*Triticum monococcum*) uzgajana kao zimska vrsta ploda. Ječam (*Hordeum vulgare*) posjeduje najveću mogućnost prilagođavanja prema uvjetima staništa, te može biti uzgajan kao ljetna ili zimska sorta (Kučan et al. 2006: 66).

Samonikle biljke vjerojatno su se koristile kao zamjena za žitarice u vrijeme nestašice te kao začini ili zelenilo za neku vrstu juhe (Hršak 2009). Novija istraživanja sugeriraju da su mnoge korovske biljke, nađene u kontekstu arheoloških iskopavanja, služile kao prvo povrće u ishrani stanovništva. U tu kategoriju pripadale bi sjemenske obične bijele lobode (*Chenopodium album*) i uzlatog dvornika (*Polygonum lapathifolium*), biljaka koje dolaze kao korov u jarim žitaricama i vrtovima, kojima odgovara umjereno topla klima i staništa bogata dušikom (Kučan et al. 2006: 66). Na Ervenici je identificiran veći broj sjemena bijele lobode (33,91%), dok uzlati dvornik nije zastupljen u značajnijoj količini (0,13%). Zasad ostaje otvoreno pitanje jesu li stanovnici Ervenice sakupljali bijelu lobodu i koristili je u prehrani kao povrće (radi njezinih mesnatih listova). Slična situacija zabilježena je i na neolitičkom lokalitetu Okolište (Kučan et al. 2006).

Velika količina samoniklog bilja i korova mogla bi i ukazivati na mogućnost da žitarice nisu bile očišćene, a te bi vrste ujedno bile i pokazatelj biljne vegetacije koja raste na obližnjim livadama, vrtovima i u okolici samog naselja. Podatak o zastupljenosti samoniklih biljaka i korova svakako je vrlo vrijedan podatak o prapovijesnom okolišu, odnosno vegetaciji i iskoristivosti obližnjih livada i pašnjaka.

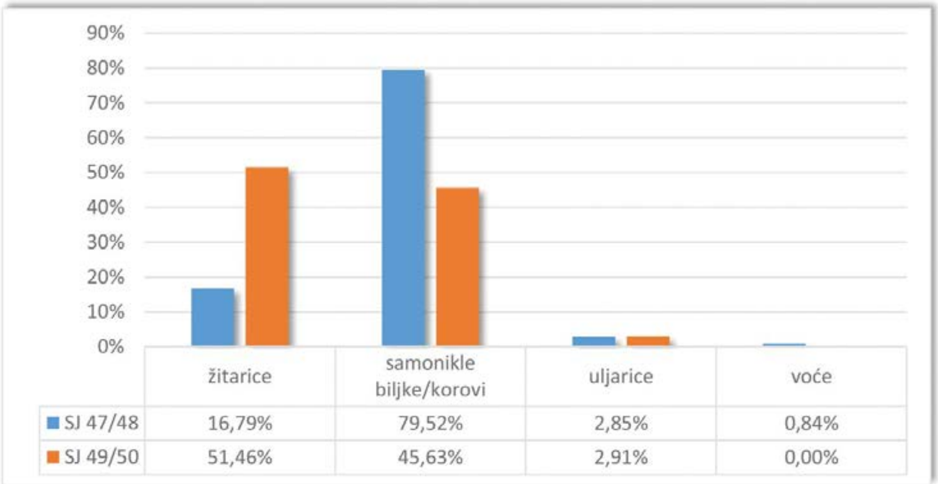
Žitarice pronađene na Ervenici uobičajena su slika zemljoradničke privrede u eneolitiku srednje i jugoistočne Europe, što pokazuju i rezultati arheobotaničke analize na lokalitetima s tog područja (van Zeist 1974.-78; Bankoff & Winter 1990; Jovanović 2004; Gyulai 2010). Arheobotanička analiza prapovijesnih lokaliteta pokazala je da većina biljnih ostataka pripada jednozrnoj pšenici (*Triticum monococcum*), dvozrnoj pšenici (*Triticum dicoccum*) i ječmu (*Hordeum vulgare*), koje su potvrđene kao najstarije domesticirane biljne vrste. Osim ovih vrsta uzgajao se još grašak, bob, leća i zob, čiji ostaci na Ervenici nisu zabilježeni.

Sa pšenicom i ječmom započela je proizvodnja hrane koja je na koncu postavila temelj neolitičke agrikulture i postala glavni element zaslužan za njezino uspješno širenje. Prije nego je krenula kultivacija ovih vrsta, samonikli divlji plodovi žitarica sakupljali su se i koristili u prehrani. Jednozrna i dvozrna pšenica, zajedno s ječmom činile su glavnu osnovu poljoprivrednih kultura koje su se uzgajale u prapovijesno vrijeme. Od jednozrne pšenice usjev je bio slabiji, ali se uspio održati i proširiti jer podnosi siromašno tlo. Dvozrna pšenica davala je bolji usjev i kvalitetniji kruh. Negdje krajem željeznog doba opada njihova proizvodnja pa su ove vrste danas prisutne samo kao relikti. Dominacija dvozrne pšenice uglavnom je uobičajena pojava u dijelovima srednje i jugoistočne Europe pa se naselje na Ervenici uklapa u postojeće okvire.

Arheobotanička analiza s lokaliteta Vučedol pak pokazuje dominaciju jednozrne pšenice, ječma pa tek onda dvozrne pšenice. Isto tako pokazuje veći udio žitarica (91%) nad samoniklim biljkama i korovima (7%) (Reed 2012). Ista je situacija zabilježena i na ostalim naseljima iz srednjeg/kasnog bakrenog doba (Đakovo-Franjevac, Tomašanci-Palača, Slavča, Čepinski Martinci-Dubrava) (Reed 2016). Na Ervenici imamo posve drugačiju sliku, odnosno dominaciju divljih trava/

korova u odnosu na žitarice. Razlog tomu može biti u drugačijim ekonomskim prioritetima ili predispozicijama i iskoristivosti krajolika. To bi moglo sugerirati da su se stanovnici Ervenice u manjoj mjeri bavili poljoprivredom te da su više bili orijentirani na stočarstvo, odnosno da su više zemlje ostavljali slobodnom za ispašu. Međutim, treba naglasiti da ovakav omjer žitarica i korova na Ervenici ne mora nužno pružati konkretne zaključke o njihovoj ekonomiji. Naime, arheobotanički uzorak trebao bi biti veći, prikupljen s više vučedolskih lokaliteta na Ervenici i iz različitih vrsta odlagališta (iz jama, kuća, okolice kuća).

Vrlo je zanimljiva usporedba ukupnog udjela biljnih vrsta za pojedinu jamu, prikazana na *Slici 66*. Jama SJ 49/50 pokazuje nešto veći udio žitarica (51,46%) nad samoniklim biljkama i korovima (45,63%), dok je u jami SJ 47/48 situacija obrnuta jer samonikle biljke i korovi (79,52%) dominiraju nad ukupnim udjelom žitarica (16,79%). Na ovakav omjer biljnih ostataka iz jama može utjecati nekoliko faktora koji su vezani za podrijetlo žitarica i aktivnosti vezane za njihovu upotrebu. To uključuje očuvanost naselja, bacanje i odlaganje otpada koji je nastao tijekom vršidbe ili raspršenost sjemenki unutar naselja uzrokovane naletima vjetra i kiše.



Slika 66 - zastupljenost biljnih vrsta u jamama SJ 47/48 i 49/50

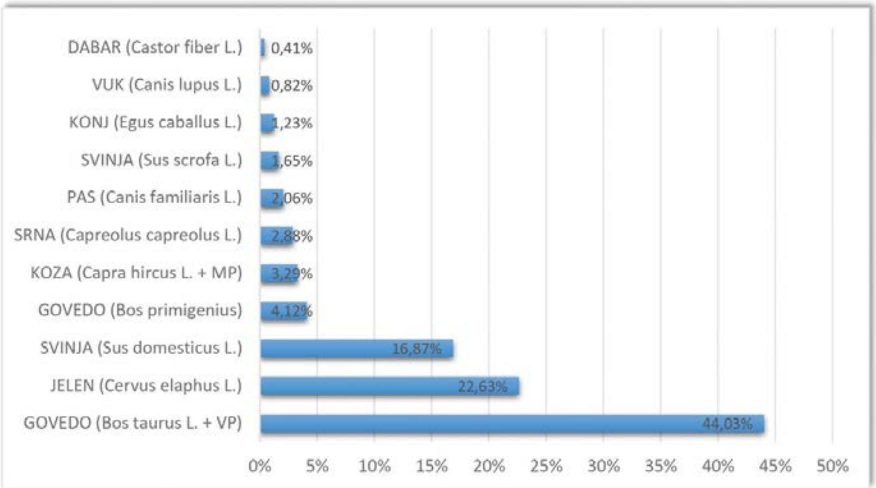
Druga vrsta žitarica koja se koristila od najranijih prapovijesnih vremena je ječam. Ječam je igrao važnu ulogu u zemljoradnji Europe, stoga ne čudi njegova upotreba u vučedolskoj zemljoradničkoj privredi. To je žitarica koja dobro uspijeva i na siromašnijoj zemlji, pa se zato uspjela zadržati i do današnjih dana. Osim za kruh i kaše, ječam se još od neolitika koristio i za proizvodnju piva te kao hrana za domaće životinje. Ova je žitarica vrlo zahvalna zbog svoje otpornosti na različite temperature, kratku sezonu rasta i veliku mogućnost prilagodbe (Gyulai 2010: 42).

U procesu domestikacije žitarice su odigrale višestruku ulogu. Ova vrsta poljoprivredne kulture uspijeva na otvorenoj obradivoj površini (najbolje na tvrdoj plodnoj ilovači), završava svoj životni ciklus u manje od godinu dana, a može se pohraniti na duže razdoblje (Zohary & Hopf 1988: 10-22). Prehrana na bazi žitarica uvela je i velike promjene u svakodnevnoj ishrani, s obzirom na njihovu kalorijsku vrijednost. Žitarice općenito imaju veliku nutritivnu vrijednost, bogate su ugljikohidratima, a pšenica u svom sastavu ima još proteina i glutena.

OSTEOLOŠKA ANALIZA

Arheozoologija je znanost koja se bavi proučavanjem životinjskih ostataka s arheoloških lokaliteta, odnosno mjesta koje je stvorio i naseljavao čovjek u neko doba u prošlosti (Lyman 1982). Njezina svrha je postizanje boljeg razumijevanja odnosa ljudi i njihovog okoliša, prije svega sa životinjskim populacijama te uočavanje promjena u iskorištavanju životinja kroz vrijeme i prostor (Reizz & Wing 1999).

Analiza životinjskih kostiju s lokaliteta M. Gupca 14 na Ervenici napravljena je na temelju 526 ostataka kostiju, zuba i rogova. Analizu i interpretaciju napravila je dr. sc. Tajana Trbojević Vukičević sa Zavoda za anatomiju, histologiju i embriologiju Veterinarskog fakulteta Sveučilišta u Zagrebu. Skeletno i taksonomski determinirana su 243 fragmenta (46,20%) (*Slika 67*).



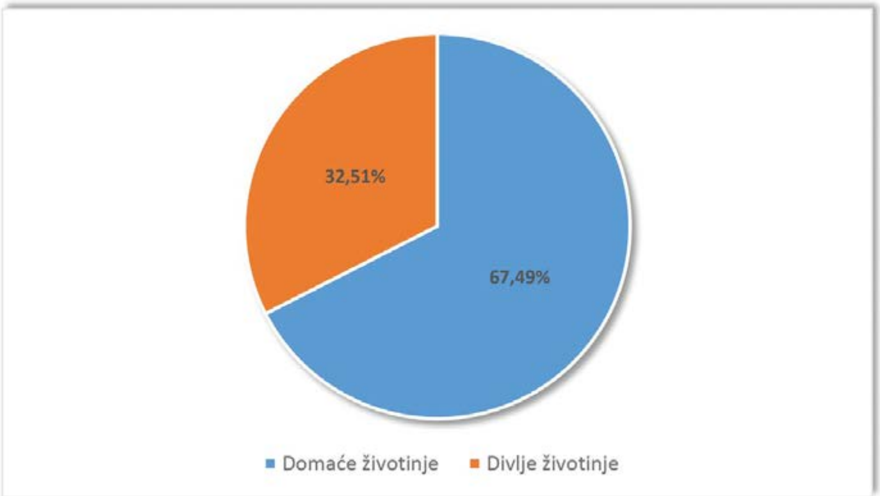
Slika 67 - postotni udio identificiranih uzoraka (% NISP)

Zbog fragmentiranosti uzoraka, posebice dugih kostiju i pojedinačnih zuba, bitno je otežano točnije razlikovanje pojedinih vrsta. Stoga su uz neke skeletne elemente koze (*Capra hircus* L.) navedene kosti koje pripadaju domaćem malom preživaču, ali se zbog nedostatka bitnih anatomskih elemenata nije mogla odrediti preciznija pripadnost kozi ili ovci (*Ovis aries* L.). Iz istog su razloga uz skeletne elemente goveda navedene kosti velikog preživača, odnosno nije se moglo sa sigurnošću odrediti pripada li taj koštani element govedu (*Bos taurus* L.) ili jelenu običnom (*Cervus elaphus* L.).

Temeljem osteometrijske analize pojedinih dugih kostiju (nadlaktična, bedrena i kosti metapodija) goveda i usporedbom sa sličnim istraživanjem eneolitičkog goveda vučedolske kulture s Vučedola, ustanovljeno je da najmanje 10 koštanih elemenata pripada divljem govedu, turu (*Bos primigenius* L.). Razlikovanje pasa (*Canis familiaris* L.) i vukova (*Canis lupus* L.) teško je i u slučajevima cjelovitih recentnih kostura (i kostiju) pa je taksonomska odredba na oštećenim i nepotpunim arheološkim uzorcima gotovo nemoguća. Manje i uglavnom subjektivne morfološke razlike uočljive su na nekim dugim kostima i kostima lubanje pa su temeljem navedenog kriterija ovi mesojedi tako razvrstani.

U analiziranom uzorku tragovi u smislu ureza (eng. *cut marks*) vidljivi su na rogovima jelena običnog, ali samo u smislu odvajanja od ostatka lubanje, odnosno nisu uočeni tragovi daljnje obrade u svrhu izrade određenog alata (ili oružja, nakita i sl.). Na jednom fragmentu duge kosti, koja se ne može odrediti ni skeletno ni taksonomski, vidljivi su tragovi obrade u svrhu izrade, najvjerojatnije šila. Na nekoliko kostiju zastopalja goveda i jelena običnog vidljivi su urezi koji upućuju na izglobljavanje i ubrajaju se u tzv. sekundarno mesarenje (eng. *butchering*), odnosno odvajanje i komadanje na manje dijelove prikladne za konzumaciju. Zatiljna kost svinje prerezana je po sredini, što također upućuje na sekundarno mesarenje i pristup do mozga (Trbojević-Vukičević 2011).

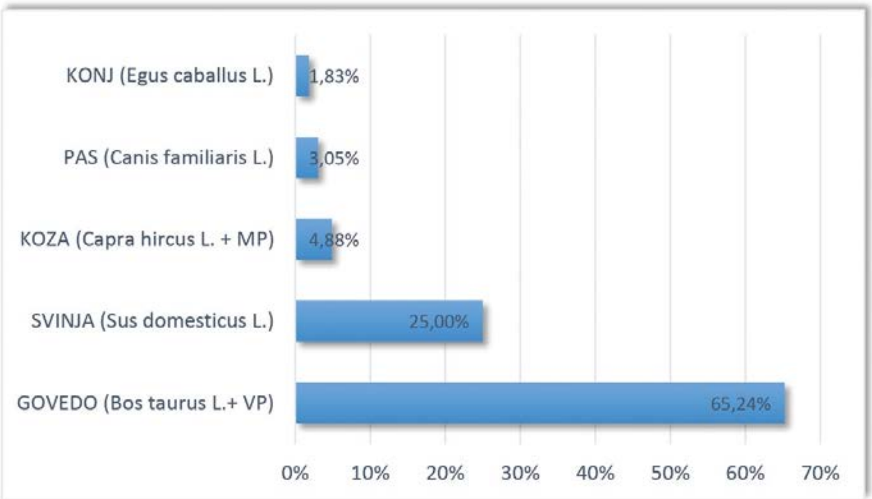
Rezultati su pokazali veću zastupljenost domaćih (67,49%) nad divljim životinjama (32,51%).



Slika 68 - zastupljenost domaćih i divljih životinja (% NISP)

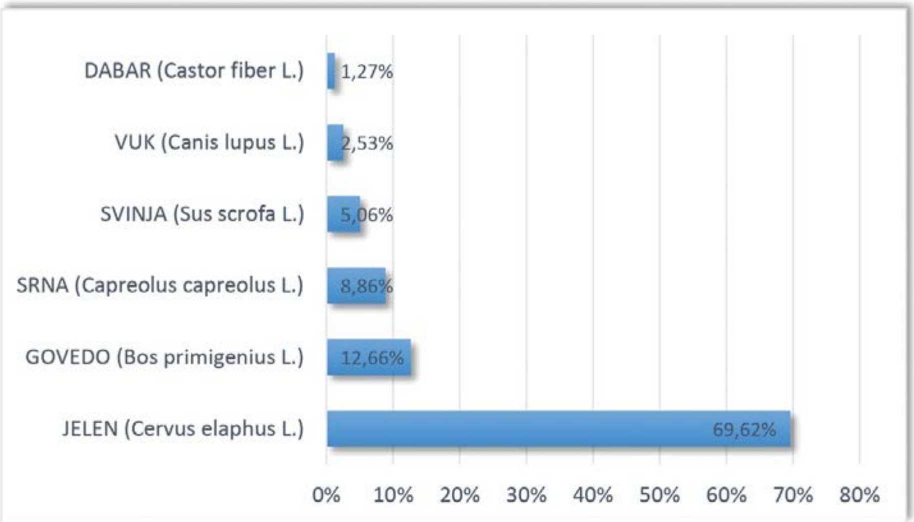
Od domaćih životinja najviše je zastupljeno domaće govedo (*Bos taurus* L.), koje tijekom eneolitika postaje osnova stočarstva. Uz domaće, prisutno je i divlje govedo (*Bos primigenius* L.) čija je zastupljenost krajem eneolitka polako u opadanju.

Domestikacija goveda počela je još u srednjem neolitiku kada se javila potreba za proširenjem stada te se polako počinje s domestikacijom lokalnih divljih životinja, svinje i divljeg goveda. Već u kasnom neolitiku govedo postaje najbrojnija vrsta među domaćim životinjama i tako će ostati tijekom cijelog eneolitika. Početkom brončanog doba domestikacija goveda je u potpunosti završila, divlje govedo postaje rijetkost, a njegovu ulogu u lovnim aktivnostima zamjenjuje jelen obični (Bökönyi 1971). Druga važna domaća životinja je svinja (*Sus domesticus* L.), dok je koza, odnosno ovca na zadnjem mjestu (*Slika 69*).



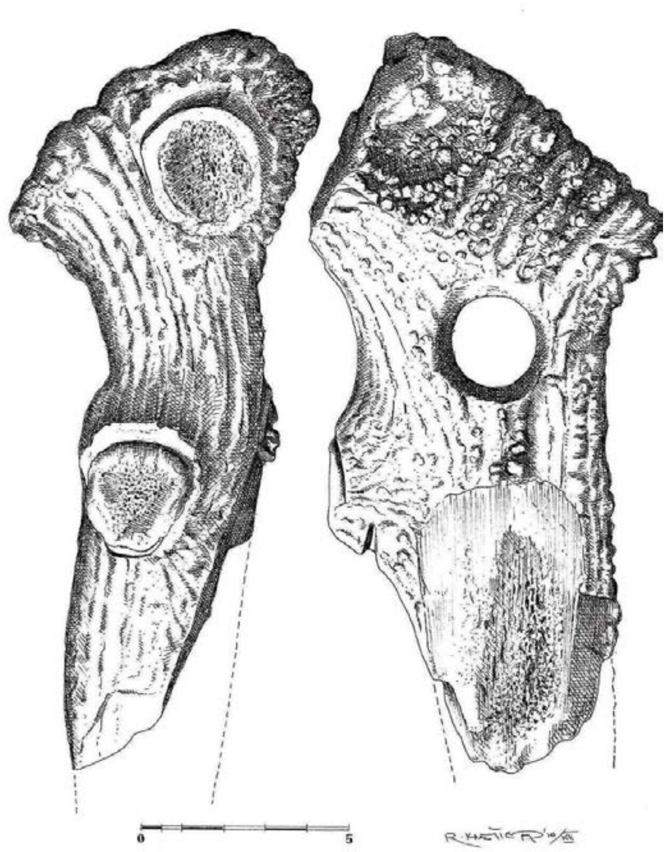
Slika 69 - zastupljenost domaćih životinja

Od divljih životinja najzastupljeniji su jelen obični (*Cervus elaphus* L.), divlje govedo (*Bos primigenius* L.) i srna (*Capreolus capreolus* L.) (*Slika 70*).

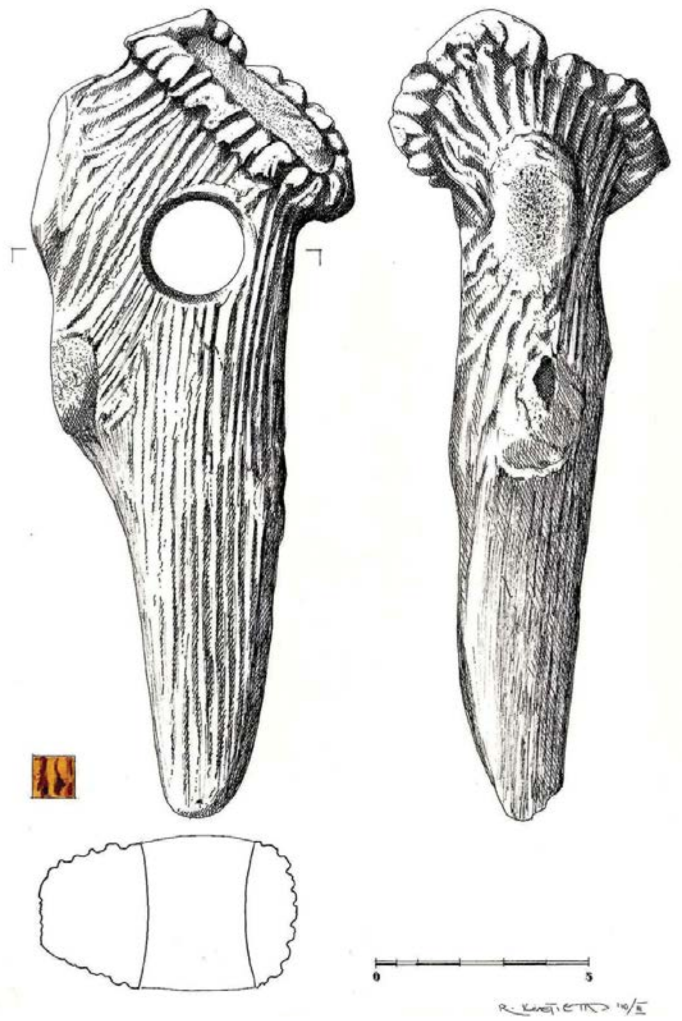


Slika 70 - zastupljenost divljih životinja

Iako je u svim razdobljima jelen lovljen ponajprije radi mesa, poznato je da se njegova koža najvjerojatnije koristila za izradu odjeće, crijeva za šivanje, a kosti i rogovi za izradu ratarskih i kućanskih alata (Trbojević Vukičević et al. 2006). Veća količina motika od jelenjih parožaka s rupom za nasad drška, koje su se koristile za obradu zemlje, nađena je na oba lokaliteta (*Slika 71, 72*).



Slika 71 - rogovi jelena s rupom za nasad drška sa Damića gradine
Fig. 71 – Red-deer antlers with a shafting hole from Damića Gradina



Slika 72 - rogovi jelena s rupom za nasad drška s Ervenice
Fig. 72 – Red-deer antlers with a shafting hole from Ervenica

Prema analiziranim životinjskim kostima može se utvrditi da su stanovnici Ervenice ipak svoju privredu zasnivali u većoj mjeri na stočarstvu, gdje je govedo imalo dominantnu ulogu, a slijede ga svinja i u manjoj mjeri koza/ovca. Osim za hranu, govedo se moglo koristiti i kao pomoć pri obradi zemlje. Znamo da badenska kultura prva u Europu uvodi zaprežna kola na 4 kotača. Na vučedolskim lokalitetima vrlo čest predmet su upravo manji i veći utezi koji prikazuju model kotača (T. 34: 1-3; 35: 3).

Analiza životinjskih ostataka sa susjednog lokaliteta „tel Tržnica" pokazala je veći udio divljih (52,50%) nad domaćim životinjama (47,50%). Međutim, ostaci životinjskih kostiju s Ervenice pokazivali bi veću sličnost s lokalitetom Vučedol (položaj „Vinograd-Streim") gdje je utvrđena dominacija domaćih (78,20%) nad divljim životinjama (21,80%) (Jurišić 1988: 25).

Analiza životinjskih ostataka s lokaliteta na Damića gradini nije bila moguća zbog poremećenih stratigrafskih slojeva, međutim, dobivena osteološka analiza jednog životinjskog ukopa pokazala je da se radi o ostacima goveda i laneta koji je apsolutno datiran u razdoblje od 2630. do 2470. g. pr. Kr. (Poglavlje 12, Tablica 1)

Provedene arheobotaničke i osteološke analize stavljaju naselje na Ervenici u opću sliku eneolitičkog života na području JI Europe čije stanovništvo živi od zemljoradnje uzgajajući uglavnom jednozrnu i dvozrnu pšenicu te od stočarstva i lova koji im podižu životni standard. Od domaćih životinja govedo je imalo najznačajniju ulogu, a nakon njega svinja te potom koza/ovca. Od divljih životinja najviše se lovio jelen obični, srna, divlja svinja i divlje govedo. Nekoliko ribljih kralježaka i riječnih školjaka, koje se zbog nedovoljno pokazatelja ne mogu točnije determinirati, upućivali bi na iskorištavanje Bosuta u svakodnevnim prehrambenim navikama, ali u manjoj mjeri.

15. ORGANSKI OSTACI U KERAMIČKIM POSUDAMA

ARHEOLOŠKI BIOMARKERI

Iako se prvi radovi o organskim ostacima u znanstvenim časopisima pojavljuju u 60-im godinama prošlog stoljeća, te intenzivno rastu u 80-ima, tek u zadnjih 10-ak godina

analiza organskih ostataka u keramičkim posudama postala je vrlo raširena disciplina u arheologiji (Barnard & Eerkens 2007). U međuvremenu, radile su se mnoge analize i eksperimenti na keramičkom materijalu kako bi se utvrdili tragovi arheoloških biomarkera, odnosno supstanci u organskim ostacima koji nam pružaju informacije vezane za ljudsku aktivnost u prošlosti (Evershed 2008: 897).

Organske ostatke nalazimo na gotovo svakom arheološkom nalazištu, neke kao vidljive dokaze ljudske aktivnosti (poput kostiju, ugljena, drva, karboniziranih sjemenki, pigmenata); neke manje primjetne poput biljnih i životinjskih masti i ulja, smola i voskova; te veći dio kao neprimjetne supstance koje se „kriju“ u obliku arheoloških biomarkera poput lipida ili proteina (Miloglav & Balen 2013).

Svi organski ostaci na arheološkim nalazištima biološkog su porijekla i mogu se analizirati kombinacijom raznih metoda. Jedna od najčešće korištenih metoda za analizu molekularnih struktura organskih ostataka je metoda plinske kromatografije-masene spektrometrije (*Gas Chromatography-Mass Spectrometry* - GC-MS). Korištenje ove metode pri analizi arheoloških keramičkih artefakata omogućilo je rastavljanje i detaljno analiziranje molekularnih komponenti biološkog materijala. Dosadašnje analize pokazale su da organski ostaci apsorbirani u stijenkama posude, kao produkt procesurianja biljnih i životinjskih masti prežive u čak 80% slučajeva kod posuda koje su se koristile za kuhanje i pripremu hrane (Evershed 2008: 904). Informacije koje dobijemo ovom vrstom analize pružaju nam mogućnost da odgovorimo na pitanja koja su vezana za funkciju posude, lokalnu ili regionalnu ekonomiju te tehnološke izbore i promjene.

Organski ostaci na/u keramičkom materijalu mogu preživjeti u nekoliko oblika:

1. kao originalni sadržaj posude *in situ* što je ujedno i najrjeđi oblik sačuvanosti organskih ostataka u arheološkom okruženju;
2. kao vidljivi ostaci na unutrašnjoj ili/i vanjskoj strani posude. Ovi pokazatelji daju nam direktne i vidljive dokaze o upotrebi posude za kuhanje. Vanjska strana često ima tragove čađe, a unutrašnja karbonizirane ostatke, što je posljedica izlaganja vatri. Vidljivi organski ostaci na keramičkim posudama mogu nam poslužiti i za radiokarbonsko datiranje. Međutim, mogućnost kontaminacije ovakvih uzoraka povećana je činjenicom da su ovi ostaci direktno izloženi vanjskim utjecajima iz okoliša ili aktivnostima koje su vezane za nepravilno pohranjivanje nakon iskopavanja. Analiza datiranja keramičkih ulomaka 14C metodom može se napraviti na osnovi sačuvanih lipida u keramici. S pomoću preparativne kapilarne plinske kromatografije (*Preparative capillary gas chromatography* - PCGC) izdvajaju se ulomci koji u sebi imaju dovoljnu količinu lipida, odnosno masnih kiselina (životinjske masti), apsorbiranih u stijenku keramičkog ulomka. Da bi se dobili adekvatni uzorci za radiokarbonsko datiranje akceleratorskom tehnikom (AMS) dovoljna je minimalna količina ugljika (200 μg) iz uzorka. Na ovaj način 14C metoda može nam dosta uspješno omogućiti datiranje keramičke posude, odnosno vrijeme njezine posljednje upotrebe (Stott et al. 2003);

3. kao nevidljivi organski ostaci apsorbirani u stijenke posude. Ovo je najčešći oblik „preživljavanja" organskih ostataka koje nalazimo u keramičkim predmetima, a nekoliko je ključnih faktora koji su za to zaslužni.

Prije svega to je upotreba same posude, način i vremenski raspon korištenja, fizičke karakteristike posude, okruženje u kojem je pohranjena te način tretiranja nakon iskopavanja (Heron & Evershed 1993). Eksperimenti na keramičkom materijalu pokazali su da proteini gube svojstva i propadaju već u prvih nekoliko mjeseci pohrane u zemlji. Lipidi su puno otporniji na uvjete iz okoliša, hidrofobni su i manje podložni strukturalnim modifikacijama, te ostaju pohranjeni u keramičkom ulomku u velikoj koncentraciji i po nekoliko tisuća godina. Međutim, kontaminacija lipida veći je problem za lipide nego za proteine, tijekom i nakon arheološkog iskopavanja. Ona može biti uzrokovana nepravilnim pohranjivanjem keramike u plastične vrećice, lijepljenjem, pranjem, pa čak i učestalim pregledavanjem keramike. Npr. tragovi kolesterola mogu biti životinjskog porijekla (iz životinjskih masti), ali su isto tako prisutni i na površini ljudske kože.

Skvalen, koji je pronađen na nekoliko analiziranih uzoraka, također se može naći u ljudskom organizmu te u biljnom i životinjskom svijetu, a smatra se glavnim indikatorom suvremenih „ljudskih otisaka". To je polinezasićeni tekući ugljikovodik koji se nalazi posvuda u ljudskom tijelu u malim količinama, a također se ispušta preko ljudske kože, ali se i brzo razgrađuje. Ovaj lipid prisutan je u biljnom svijetu u vrlo malim količinama, kao npr. u ulju pšeničnih klica. Prisutnost oba navedena spoja u keramičkim ulomcima, u određenom omjeru, smatra se indikativnim karakteristikama moderne kontaminacije koja je posljedica rukovanja keramikom (Evershed 1993).

Plastifikatori također uzrokuju propadanje lipida, što je vrlo čest oblik kontaminacije arheološkog materijala koji se uobičajeno pohranjuje u plastične vrećice. Iako pranje keramike ne utječe na kontaminaciju lipida, njihova koncentracija se znatno smanjuje što dovodi u pitanje rezultate koje ćemo dobiti. To se posebno odnosi na odstranjivanje tragova zemlje s unutrašnje i vanjske strane ulomka ili slabo vidljive organske ostatke. Stoga je preporučljivo da se keramički ulomci koji se namjeravaju slati na analizu ne peru, ne lijepe, niti signiraju, a ako je moguće uzorak treba poslati zajedno sa zemljom u kojoj je bio pohranjen. Upravo radi svega navedenog, a u svrhu što bolje sačuvanosti organskih ostataka i otklanjanja mogućnosti kontaminacije, analize ovakvog tipa trebale bi biti unaprijed uvrštene u proces iskopavanja (Miloglav & Balen 2013).

Slika 73 – primjer nataloženosti supstanci na vanjskoj strani posude nastalih tijekom dugotrajnog odlaganja u zemlji
Fig. 73 – Example of deposits on the external side of a vessel, resulting from the long period of time it spent underground

Životinjske masti najčešći su ostaci organskih tvari pohranjenih u stijenkama posude, a karakterizira ih visoka prisutnost slobodnih masnih kiselina, posebno palmitinske (C 16) i stearinske (C 18). Ove masne kiseline lako se mogu izdvojiti i analizirati, a nalazimo ih u posudama koje su služile za spremanje ili pohranu hrane. Analize su pokazale da najčešće dolaze iz same posude, a manje iz okoliša, odnosno zemlje u kojoj je posuda pohranjena (Craig 2002; Copley et al. 2003). Međutim, vrlo je moguća kontaminacija lipida njihovom migracijom iz zemlje u kojoj je posuda odložena (Evershed 1993: 87) (*Slika 73*).

Usporedba i analiza vanjske i unutrašnje strane ulomka stoga je posebno važna u slučajevima kada uzorci zemlje nisu dostupni (Stern et al. 2000). Ovakav je slučaj dosta uobičajen kada je riječ o slanju uzoraka sa starijih istraživanja ili iz muzejskih fundusa. Analizom unutrašnje i vanjske strane ulomka isključuje se kontaminacija nastala tijekom dugotrajnog odlaganja u zemlji, rukovanja posudom tijekom i nakon arheološkog istraživanja te neadekvatnom pohranom (*Slika 74*). Kontaminacija ovog tipa uobičajeno je prisutna u jednakoj koncentraciji na obje površine, dok su organski ostaci od arheološke važnosti prisutni samo na jednoj strani (Steele 2011).

Slika 74 – priprema vanjske i unutrašnje strane ulomka za analizu
Fig. 74 – Preparation of the external and internal side of a sherd for analysis

Analiza organskih ostataka u keramičkim posudama, kao vrlo dobar pokazatelj arheoloških biomarkera, bit će interpretativno točnija ako se usporedi s ostalim analizama koje su dokaz ljudske aktivnosti u istom okruženju. To prije svega uključuje analizu biljnih i životinjskih vrsta na nalazištu, analizu keramičkog materijala kojom možemo utvrditi vezu između oblika posude i njezine utilitarne funkcije, abrazivne i neabrazivne procese na posudi te kontekst odlaganja posude (Miloglav & Balen 2013).

Svi ovi tragovi vidljivi su na keramičkim posudama i lako se mogu prepoznati i analizirati, o čemu je bilo riječi u Poglavlju 8. Stoga, dobivene informacije analizom GC-MS nikako se ne bi trebale interpretirati samostalno.

Kao i kod bilo koje druge analize, veliku ulogu u interpretaciji dobivenih rezultata ima uzorkovanje. Slanjem ulomaka koji nisu funkcionalno ili stratigrafski odredivi (iz naselja ili npr. grobnih cjelina) dobit ćemo rezultate koji su interpretacijski neiskoristivi. Da bi se izbjegle ovakve situacije uzorkovanje mora biti promišljeno i planirano, adekvatno unaprijed postavljenom istraživačkom pitanju.

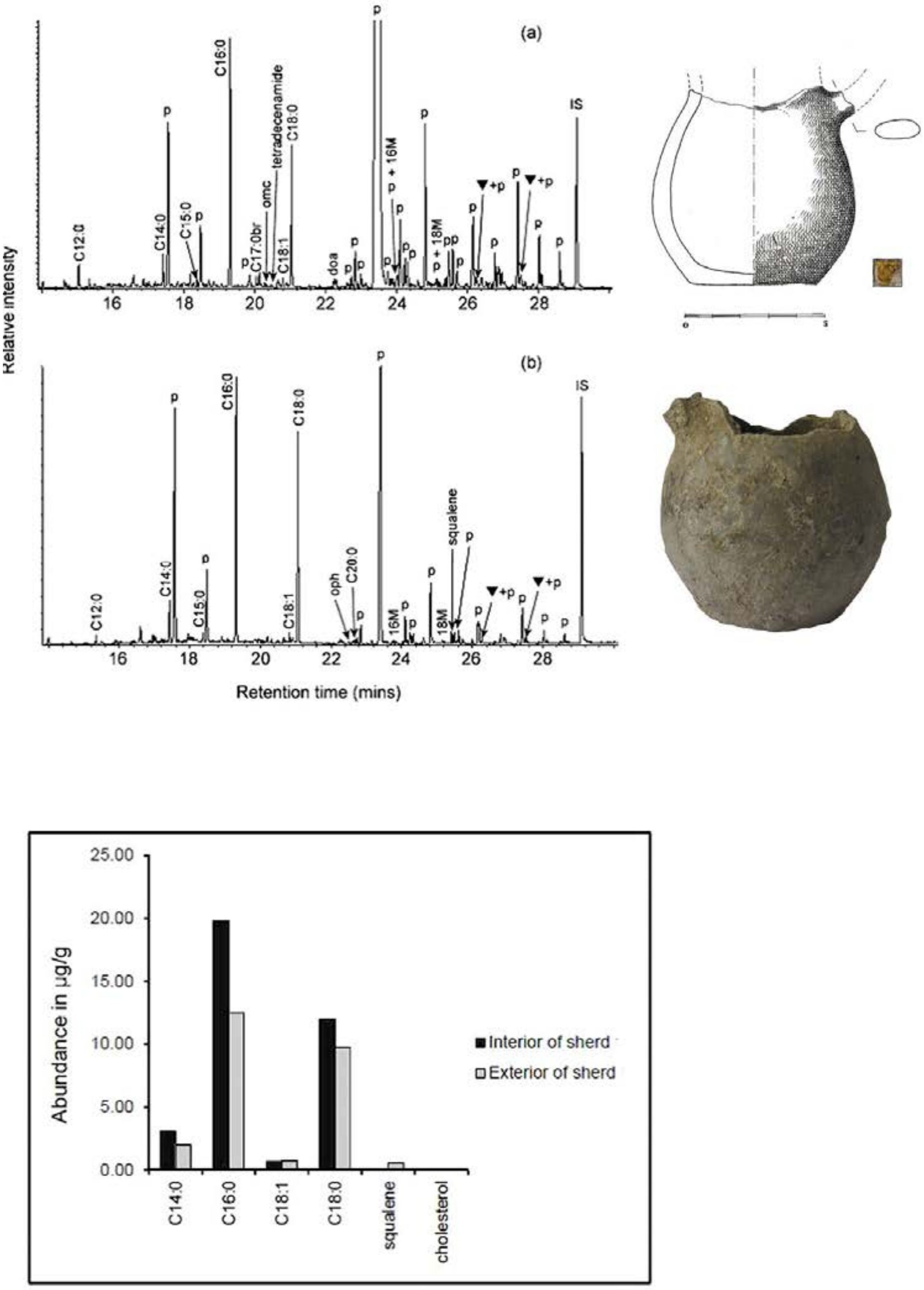
Koncentracija lipida u različitim dijelovima posude (otvor, tijelo, dno) ima veliku ulogu u određivanju funkcije posude jer akumulacija lipida na različitim dijelovima posude može sugerirati njezinu funkciju (npr. za kuhanje ili pečenje) (Charters & Evershed 1995). U tu svrhu napravljeni su mnogi eksperimenti koji su uključivali analizu originalnih dijelova posude i njihovih replika (Charters et al. 1997). Pokazalo se da je kod posuda koje su služile za zagrijavanje vode i kuhanje hrane najveća koncentracija lipida nađena na otvoru posude. Razlog tome je flotacija lipida koji su oslobođeni iz hrane, a talože se na površini vode i isparavaju prema otvoru. Drugi razlog je niža temperatura na otvoru posude (oko 100 C°) gdje ne dolazi do degradacije lipida kao na dnu (gdje temperatura može doseći i do 800 C°). Također, eksperimenti su pokazali da se ostaci lipida mogu identificirati već nakon samo jednog kuhanja. Sa svakim sljedećim zagrijavanjem ta koncentracija se povećava, posebno na tijelu posude i na otvoru. Upravo zbog svega navedenog uzorkovanje različitih dijelova posude, različitih funkcionalnih oblika, različitog konteksta odlaganja, kao i reprezentativnost uzorka omogućit će nam dobivanje podataka koje komparativnim i kombiniranim analizama možemo interpretirati u okvirima postavljenog analitičkog pitanja ili problema.

REZULTATI ANALIZE KERAMIČKIH ULOMAKA METODOM PLINSKE KROMATOGRAFIJE-MASENE SPEKTROMETRIJE (GC-MS)

Metodom GC-MS sveukupno je analizirano 10 keramičkih ulomaka, 8 s lokaliteta na Ervenici i 2 s lokaliteta na Damića gradini *(Slika 75).* Analize su napravljene na Sveučilištu u Bradfordu (*Division of Archaeological, Geographical and Environmental Sciences*). Uzorkovanje je napravljeno na različitim dijelovima posuda (dno, tijelo, otvor), na različitim funkcionalnim oblicima

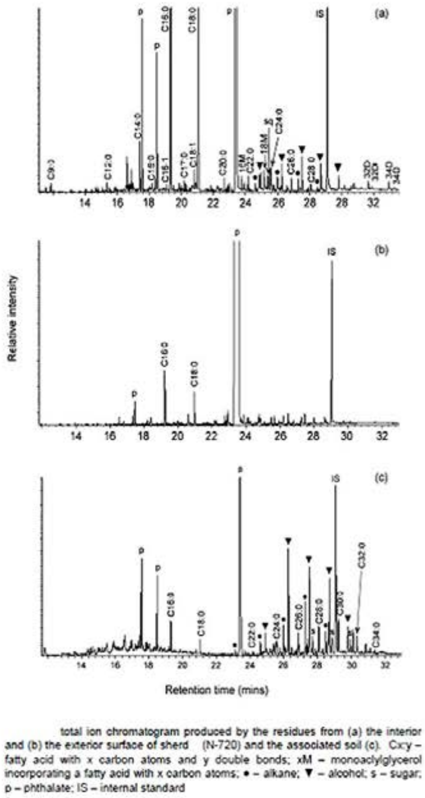
Slika 75 - tipovi posuda kojima pripadaju analizirani uzorci. Oznake se odnose na naziv uzorka, a ne tipa posude (lonac, zdjela, šalica, cjedilo) te na ulomcima različitog tretiranja površine (glačani i djelomično glačani ulomci, ulomci tretirani barbotinom).

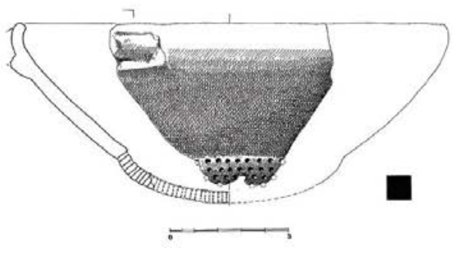
Postavljena pitanja uključivala su tehnološki aspekt izrade posuda, odnosno moguće tehnološke razlike između posuda za kuhanje na vatri i onih koje ne zahtijevaju termičku obradu hrane, te vrstu namirnica koje su se pripremale/kuhale/skladištile u određenom obliku posude. Interpretacija podataka napravljena je zajedno s arheobotaničkom i osteološkom analizom, tipologijom keramičkih oblika, kontekstom odlaganja posuda te analizom gline i primjesa (XRD i mineraloško-petrografska analiza). Da bi se isključila kontaminacija nastala iz okruženja u kojem su posude bile pohranjene te od rukovanja nakon istraživanja, analizirane su obje površine ulomaka (Steele 2011; Miloglav & Balen 2013: 13, Sl. 1).

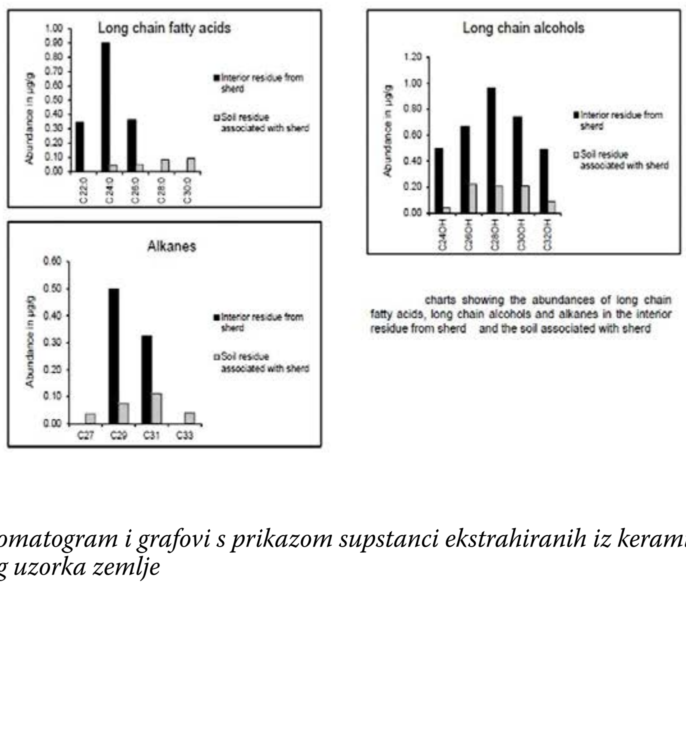


Slika 76 - kromatogram s prikazom supstanci ekstrahiranih iz keramičkog ulomka ER 1 i graf sa zastupljenošću glavnih masnih kiselina, kolesterola i skvalena

Svi analizarani ulomci bili su u određenoj mjeri kontaminirani plastifikatorima od pohrane u plastičnim vrećicama, a većina ulomaka sadržavala je kolesterol i skvalen koji su posljedica rukovanja posudama/ulomcima. Koncentracija lipida nije bila dovoljna za dodatnu analizu stabilnih izotopa (*Gas Chromatography – Combustion – Isotope Ratio Mass Spectrometry* - GC-C-IRMS) kojom bi se dobile detaljnije informacije o porijeklu životinjskih ili biljnih vrsta (Steele 2011). Ovom analizom moguće je preciznije odrediti i razlikovati masti preživača (govedo, koza, ovca) od nepreživača te posebno mliječne proizvode koje je inače teško razlučiti iz životinjskih masti zbog nedostatka jedinstvenih biomarkera za mlijeko (Dudd et al. 1999; Craig 2002; Evershed 2008).







Slika 77 - kromatogram i grafovi s prikazom supstanci ekstrahiranih iz keramičkog ulomka DG 1 i pripadajućeg uzorka zemlje

Svi uzorci sadržavali su veliku zastupljenost C16:0 i C18:0 masnih kiselina koje su nastale iz degradiranih životinjskih masti (Steele 2011). Preciznije razlikovanje životinjskih masti moglo se utvrditi na dva funkcionalna oblika, plitkoj zdjeli (ER 3) i cjedilu (DG 1), a mogući tragovi mliječnih masti zabilježeni su na uzorku koji pripada funkcionalnom tipu šalice.

Degradirane masti prisutne su na obje površine uzorka koji pripada šalici (ER 1), iako su manje zastupljene na vanjskoj nego na unutrašnjoj strani ulomka. Prema interpretaciji (Steele 2011) originalni ostaci životinjskih masti nalaze se u unutrašnjosti posude, a vrlo je moguće da su tragovi s vanjske površine nastali od prolijevanja sadržaja. Također, navedeni ostaci mogu ukazivati na ostatke masti preživača ili mliječnih masti (*Slika 76*).

Iako je vrlo nezahvalno interpretirati ostatke mliječnih masti bez dodatnih analiza stabilnih izotopa, ostale provedene analize pokazuju da je vrlo moguće interpretirati ovaj funkcionalni oblik kao posudu iz koje se pilo mlijeko. Prema analiziranim parametrima ovaj tip posude (šalica – tip C 1a) nije se koristio za pripremu hrane na vatri jer ni na jednom analiziranom ulomku nisu nađeni tragovi koji bi na to ukazivali. Također, prema anliziranim životinjskim ostacima gospodarstvo vučedolskog naselja na Ervenici bilo je temeljeno na stočarstvu, u prvom redu na uzgoju goveda (65,24%), svinje (25,00%) te ovce/koze (4,88%) što je općenita karakteristika eneolitičkog razdoblja. Zahvaljujući upravo analizi GC-MS danas znamo da su se mliječni proizvodi upotrebljavali i iskorištavali još u ranom neolitiku (Craig 2002; Copley et al. 2003; Craig et al. 2005; Evershed et al. 2008; Dunne et al. 2012; Isaksson & Halgren 2012; Salque et al. 2013), stoga je vjerojatno da su i mliječni proizvodi činili dio prehrambenih navika vučedolskog stanovništva.

Masti preživača nađene su i s unutrašnje strane cjedila tipa E 1a (DG 1 – *Slika 77*), kao originalni sadržaj posude (Steele 2011). Cjedilo koje pripada drugom tipološkom obliku (DG 2 – tip E 2a) također sadrži tragove lipida na unutrašnjoj strani, odnosno degradirane ostatke masti ili ulja koji se ne mogu preciznije odrediti zbog nedostatne koncentracije lipida. Cjedilo se u prapovijesti uobičajeno tumači kao posuda za pravljenje sira, dok ga neke interpretacije vežu i za proizvodnju meda (Regert et al. 2001: 567; Elster & Renfrew 2003). Kako na oba analizirana ulomka nisu nađeni ostaci voska već samo tragovi masti preživača, ili općenitije životinjske masti, a s obzirom na ekonomiju vučedolskog stanovništva, vjerojatno je da su oba cjedila služila za proizvodnju sira. Nedavne analize na ulomcima iz Poljske pokazale su da su se slična cjedila u proizvodnji sira koristila prije 7000 godina te da su imala veliku ulogu u proizvodnji mliječnih proizvoda kojima se reducirala laktoza (Salque et al. 2013).

Uzorak niske posude debelih stijenki (tip A 1a) sadržavao je daleko najviše ostataka masnih kiselina na unutrašnjoj strani, najvjerojatnije masti preživača, dok na vanjskoj strani nisu zabilježeni tragovi lipida (ER 3 - *Slika 75*). Ova posuda je zbog vrlo debelih stijenki (čak do 19 mm), male visine (do maksimalno 6,50 cm), vrlo velikog polumjera otvora (do 11,50 cm), tragova čađe i oksidacijskih mrlja na površini služila za termičku obradu hrane.

Tehnološki aspekt analiziranih ulomaka uočen je na tri posude na kojima su nađeni tragovi voska s unutrašnje i vanjske strane uzorka (ER 4 – tip A 4c; ER 5 – tip A 2a; ER 8 – tip C 1a). Na jednom uzorku prisutni su samo tragovi degradiranog voska na unutrašnjoj strani uzorka (ER 2 – tip D 1a). Identifikacija voska na keramičkim ulomcima nije novost, više možda rijetkost, a potvrđena je na keramičkim ulomcima još od neolitika (Heron et al. 1994; Regert et al. 2001; Copley et al. 2005; Mayyas et al. 2010). Poznato je da se med sakupljao kod najranijih prapovijesnih zajednica, a koristio se u medicini, umjetnosti, ritualima, kozmetici, kao dodatak hrani ili za pripravu pića (Needham & Evans 1987; Garnier et al. 2002). Rezultati nedavnog istraživanja 6500 godina stare ljudske mandibule iz Slovenije pokazali su da se radi o najranijem poznatom dokazu terapeutsko-palijativnoj dentalnoj ispuni pčelinjim voskom (Bernardini et al. 2012).

Na keramičkim posudama vosak se može naći samostalno ili s drugim prirodnim materijalima, kao i sa životinjskim i biljnim uljima. Uglavnom se koristio kao sredstvo za začepljivanje pora na keramičkoj posudi kako bi se postigla vodootpornost (Schiffer et al. 1994; Charters et al. 1997; Regert et al. 2001; Ogrinc et al. 2014). U Poglavljima 5 i 6 vidjeli smo mnoge mogućnosti tretiranja površine nakon pečenja kako bi se smanjila propusnost i postigla čvrstoća posude. Vosak je inače kruta tvar koja nije topiva u vodi. Nalazimo ga kod biljaka i životinja, a dio je zaštitne prevlake pa ga možemo naći kod lišća u biljaka, krzna i perja kod životinja. Prirodni voskovi su mekši i tale se na nižim temperaturama (iznad 45°C) što ih razlikuje od masti i ulja. Najpoznatiji životinjski vosak je pčelinji vosak koji se tali na temperaturi oko 65°C. U slučaju uzoraka s Ervenice vjerojatno je da se radi o svojevrsnom vodootpornom filteru koji se dodavao na keramičku posudu kako bi začepio pore u keramici jer su ostaci voska nađeni i s unutrašnje i s vanjske strane posude (Stern 2011). Neke analize pokazuju da je vjerojatno dodavan na keramičku posudu nakon pečenja, i to dok je keramika još bila vruća. Na taj način se vosak otapa i ulazi u stijenke porozne keramike te blokira sitne rupice u strukturi glinene smjese. Stvaranjem takvog vodootpornog sloja onemogućilo bi se istjecanje tekućine iz posude.

Pokušavajući odgonetnuti ulogu voska u keramičkim posudama, napravljen je i eksperiment zagrijavanja voska nad samom posudom. Vosak se topi na temperaturi od 60-65°C, zatim se keramička posuda miče s vatre dok se vosak ne konsolidira s posudom kao tanak namaz/filter. Potom se posuda stavlja iznad vatre, tako da vosak bude u direktnom kontaktu s vatrom. Vosak tada gubi boju i postaje smeđe-crna katranasta masa koja prijanja uz posudu. Ovim bi postupkom posuda dobila crni sjaj i mekoću poput efekta glačanja (Heron et al. 1994). Analize i eksperimenti pokazali su da kada su mješavina masti i voska nađeni zajedno, vosak je u pravilu dodan na posudu prije životinjske masti (Charters & Evershed 1995).

Iako se radi o malom broju analiziranih uzoraka pojedini keramički oblici mogu se dovesti u vezu s određenom funkcijom posude. Tragovi voska na analiziranim ulomcima mogu se interpretirati u okvirima tehno-funkcionalnih karakteristika s obzirom na to da je vosak nađen na različitim oblicima posuda: dva različita tipa zdjela, šalici i vrču. On nije povezan s određenim tipom posude već s određenom upotrebom posude (Miloglav & Balen 2016). Niti jedan od analiziranih tipova posuda nema tragove korištenja na vatri te su služili za konzumaciju i/ili serviranje namirnica u suhom, tekućem ili polutekućem stanju bez termičke obrade. Prema kontekstu nalaza i prevedenoj arheobotaničkoj analizi zdjela tipa A 4 (ER 4 -*Slika 75*) najzastupljeniji je oblik u jami s najvećom količinom žitarica što također može ukazivati na moguću funkciju posude povezanu s odlaganjem otpada zajedno s korištenim namirnicama.

Plitka zdjela (ER 3) služila je za termičku obradu hrane, kao i jedan uzorak lonca tipa B 1a koji ima tragove masnih kiselina samo s unutrašnje strane posude (ER 7 - *Slika 75*). Cjedilo je po svim pokazateljima služilo za pripremu sira, dok je ulomak zdjele na križnoj nozi (ER 6) bio do te mjere kontaminiran plastifikatorima da, nažalost, nije dao nikakve relevantne pokazatelje lipida koji bi bili od arheološke važnosti.

16. LONČARSKA SMJESA VUČEDOLSKIH POSUDA

MINERALOŠKO-PETROGRAFSKA ANALIZA I METODA RENDGENSKE DIFRAKCIJE NA PRAHU

Već smo se u prvom dijelu knjige upoznali s razvojem, problematikom i glavnim ciljevima arheometrije te njezinim značenjem u analizi i interpretaciji arheoloških artefakata. Kada je riječ o keramici, cilj arheometrijskih analiza je utvrđivanje tehnologije proizvodnje (priprema sirovine i oblikovanje, način pečenja i ukrašavanja, receptura glinene smjese), podrijetla sirovine i funkcije keramičkih proizvoda. Analizom ulomaka s oba obrađena lokaliteta pokušalo se odgovoriti na neka od navedenih pitanja. Iako je broj ovdje prikazanih analiziranih ulomaka relativno mali, dobiveni rezultati bili su smjernica za dodatne analize na puno većem broju uzoraka i širem spektru pitanja koja su se nametnula kao posljedica dobivenih rezultata (Mileusnić & Miloglav 2015).

Uzorkovanje keramičkih ulomaka s oba lokaliteta napravljeno je prema postavljenim istraživačkim pitanjima koja su uključivala informacije o: *a)* razlikama u dodavanju primjesa kod različitih funkcionalnih oblika; *b)* načinu i temperaturi pečenja; *c)* sastavu i recepturi glinene smjese. Stoga su uzorkovani ulomci klasificirani u tri kategorije: *a)* ulomci različitih funkcionalnih oblika (zdjela, lonac, šalica itd.); *b)* različite boje presjeka; *c)* različitog tretiranja površine (glačani, djelomično glačani te ulomci tretirani barbotinom).

Nakon postavljenog istraživačkog pitanja na analizu je poslano 17 keramičkih ulomaka, 7 s lokaliteta na Ervenici i 10 s lokaliteta na Damića gradini.

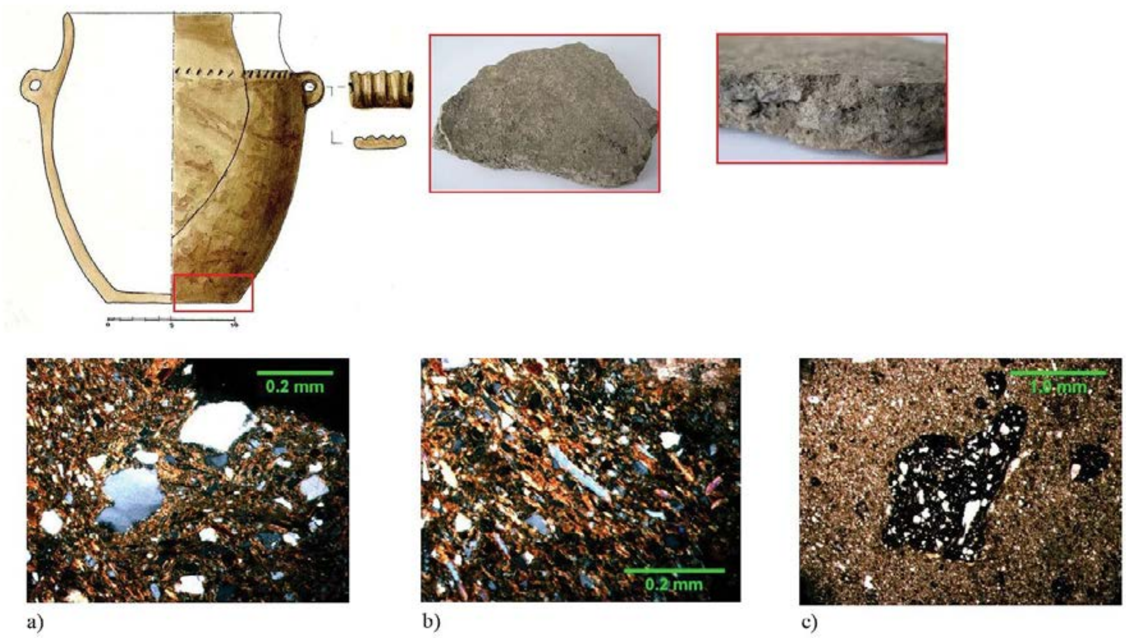
Za utvrđivanje mineralnog sastava sirovine, teksture te vrste i količine primjesa u glinenoj smjesi koristile su se: mineraloško-petrografska analiza korištenjem optičkog mikroskopa (OM) i rendgenska difrakcija na prahu (XRD). Analize su napravljene na Zavodu za mineralogiju, petrologiju i mineralne sirovine Rudarsko-geološko-naftnog fakulteta Sveučilišta u Zagrebu. Osim navedenih analiza napravljena je i infracrvena spektroskopija s Furijeovom transformacijom (FT-IR) na 8 ulomaka s različitih vučedolskih lokaliteta (Ervenica, tel Tržnica, Borinci, Vučedol) kako bi se utvrdio sastav inkrustacije. Ove analize napravljene su na Sveučilištu za prirodne resurse i bioznanosti u Beču. Zasad raspolažemo samo s preliminarnim informacijama o inkrustiranoj smjesi koja se radila isključivo od riječnih školjki.

Rendgenska difrakcija na prahu osnovna je metoda analize mineralnog sastava uzoraka keramike i glina. Prednost ove analize je jednoznačna i direktna odredba pojedinih minerala glina, koju nije moguće odrediti drugim fizikalnim metodama, osobito kada se radi o polifaznim smjesama.

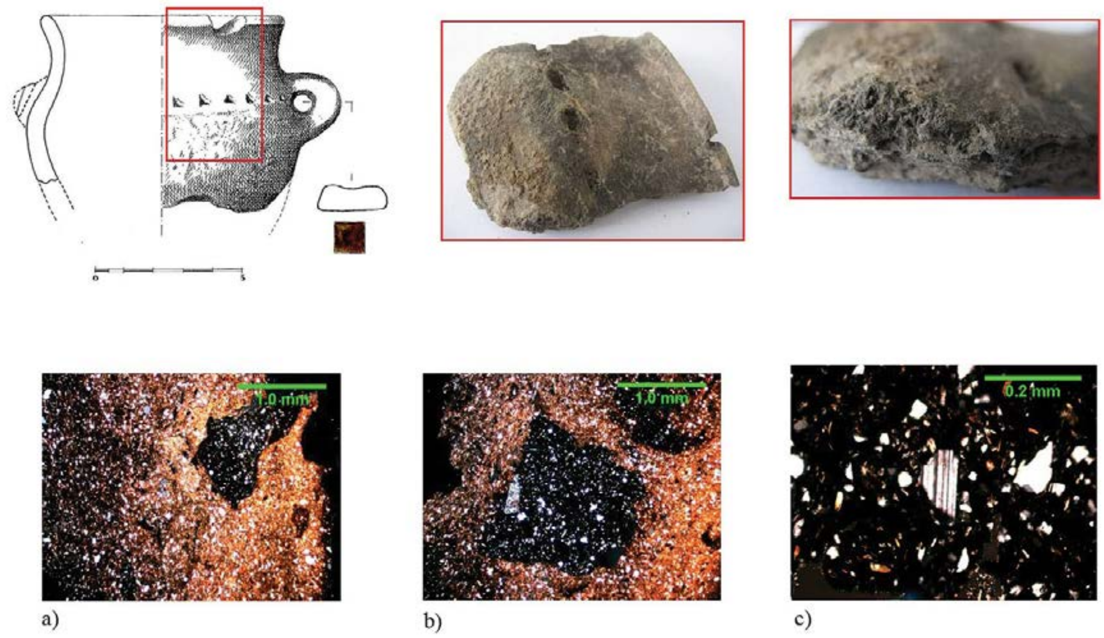
Optičkom mikroskopijom i rendgenskom analizom utvrđen je sljedeći mineralni sastav keramike: kvarc, mineral iz skupine tinjaca (muskovit/sericit), K-feldspat i plagioklas te sitnokristalasta agregatna zrna i možda klinopiroksen. Sporadično su nađene i čestice stijene (kvarcit/rožnjak). Osim toga u ulomcima je uočen i srednje do krupnozrnati grog te zaobljena organska zrna.

Jezgra ulomaka je tamnosmeđe, sive do crne boje, dok pojedini uzorci pokazuju svijetlosmeđu do narančastocrvenu vanjsku i/ili unutrašnju stijenku. Takve strukture mogu nastati pečenjem u redukcijskim uvjetima s krajnjim stadijem hlađenja u oksidacijskoj atmosferi.

Petrografska analiza ulomaka keramike s lokaliteta Ervenica i Damića gradina nije razdvojila uzorke keramike u grupe različitih teksturnih, strukturnih i mineralnih karakteristika jer ulomci s oba lokaliteta ne pokazuju značajne razlike. Matriks obiluje homogeno raspoređenim, sitnozr-



Slika 78 - lonac tipa B 1a: a (ukriženi nikoli) – na mikrofotografiji su prikazana dva relativno veća zrna kvarca s tipičnim unduloznim potamnjenjem; b (ukriženi nikoli) - izduženi muskovit visokih interferencijskih boja; c (paralelni nikoli) - grog s uklopljenim kvarcom.



Slika 79 - lonac tipa B 1b: a (ukriženi nikoli) - vanjska, oksidirana stijenka uzorka s uklopljenim crnim, uglatim fragmentom groga koji se nalazi u gornjem desnom kutu; b (ukriženi nikoli) – veliko zrno groga s uklopljenim izduženim fragmentom rožnjaka na lijevom rubu groga; c (ukriženi nikoli) – plagioklas s polisintetskim sraslačkim lamelama.

natim subangularnim do angularnim kvarcom te listićavim mineralom iz skupine tinjaca. Unimodalna raspodjela kvarca i tinjca dimenzija silta i pijeska unutar matriksa upućuju na to da su minerali prirodna sastavnica sirovine (Velde & Druc 1999).

Jedina primijećena razlika u analiziranim keramičkim ulomcima odnosi se na dodavanje različite količine primjese groga. Kod oblika koji funkcionalno pripadaju loncima, odnosno posudama za termičku obradu hrane, uočeno je dodavanje veće količine krupnijezrnatog groga u glinenu smjesu.

Iako je grog prisutan u velikoj mjeri u svim obrađenim ulomcima, veličina zrnaca groga kod lonaca uglavnom se kreće od krupnozrnatog (1-3 mm, 85,71%) do visokozrnatog (> 3 mm, 14,29%), dok su kod zdjela primjese groga srednje zrnate (0,2-1 mm, 100%). Primijećene razlike u primjesama nisu u korelaciji s dimenzijama posuda s obzirom na to da postoje veći i manji lonci (kao što je slučaj s tipom B 1a i B 1b, *Slika 78 i 79*), pa u ovom slučaju ne bi bila potvrđena teza da veličina zrnaca varira s veličinom posude i debljinom stijenki (Rye 1981).

Već je u prvom dijelu knjige istaknuta važnost dodavanja primjesa u glinenu smjesu, posebno kada je riječ o posudama koje su služile za termičku obradu hrane. O karakteristikama groga također je bilo više riječi u Poglavlju 4 gdje smo vidjeli sve njegove pozitivne i negativne karakteristike koje su važne za termalna i fizička svojstva posude. Stoga primijećene razlike dodavanja veće količine i krupnijezrnatog groga u glinenu smjesu za izradu lonaca ne bi trebalo zanemariti bez obzira na mali broj analiziranih ulomaka.

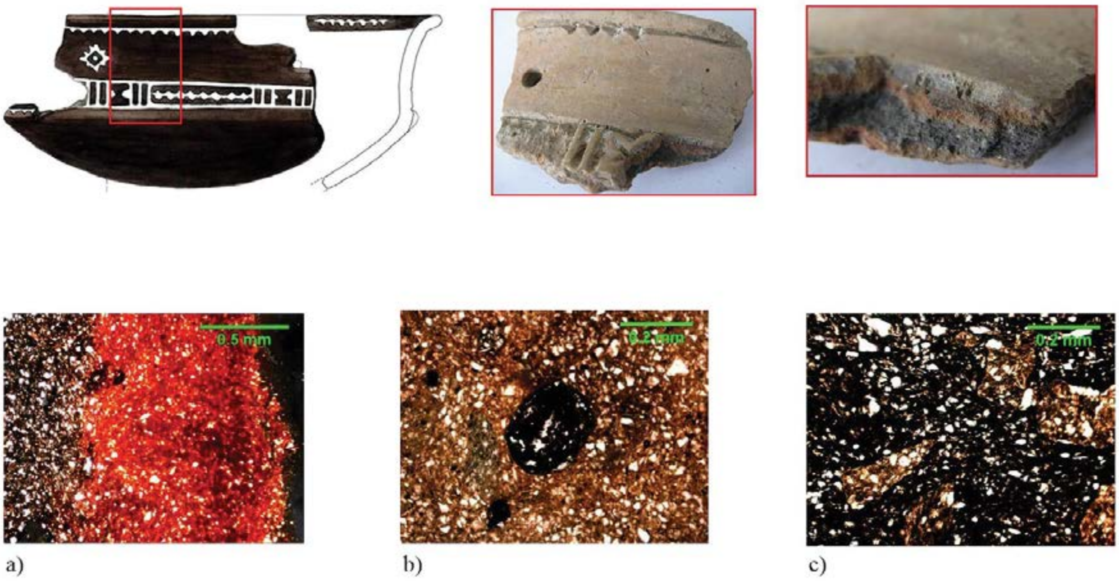
Dodavanje groga u glinenu smjesu jedan je od najstarijih tehnoloških izbora. Razbijeni i polomljeni keramički ulomci uvijek su dostupni u naselju pa njegova priprema ne traži poseban angažman od lončara kada je riječ o nabavi i traženju primjesa. Osim što smanjuje termalni stres kod posuda za kuhanje, dodavanje groga daje glini potrebnu plastičnost za oblikovanje. U analiziranim uzorcima keramičkih ulomaka prevladavaju djelomično uglata zrna groga, a veličina im varira od 0,25 do 6,56 mm. Vrlo često može se uočiti i reciklirani grog unutar ulomka, odnosno manja zrnca starijeg groga koja su uklopljena u veće zrno novoga (*Slika 80*).

Na osnovi provedenih analiza može se zaključiti da glinena smjesa od koje su posude izrađivane ne pokazuje značajnije razlike u strukturi. Mineralni sastav keramike odgovara mineralnom sastavu prapora koji je prirodna geološka podloga na području istraženih lokaliteta. S obzirom na to da je glavni sastojak prapora kvarc, feldspat i minerali iz skupine tinjaca, o čemu je detaljnije bilo riječi u Poglavlju 10, prisutnost ovih minerala u glinenoj smjesi analizirane keramike je očekivana. Stoga možemo pretpostaviti da je za izradu keramičkih posuda korištena lokalna sirovina. Kako bismo utvrdili lokaciju potencijalne sirovine u okolici oba lokaliteta sakupljeni su uzorci gline koji su trenutno u fazi obrade.

Slika 80 - lonac tipa B 3a: a (ukriženi nikoli) – zaobljeno organsko zrno; b (paralelni nikoli) – grog koji unutar svojih granica, u donjem desnom dijelu velikog zrna, sadrži dva uglata groga manjih dimenzija koja su starija od groga koji ih uklapa.

Za izradu svih tipova posuda (zdjela, lonac, šalica, vrč) lončari su koristili glinu fine teksture dodajući grog kao primjesu. U nastojanju da poboljšaju fizičke karakteristike posuda za kuhanje u glinenu smjesu dodavali su veću količinu i veća zrnca groga. Već smo u prvom dijelu knjige saznali da su se različite vrste primjesa koristile za različite vrste posuda pa dodavanje veće količine groga u posude za kuhanje možemo dovesti u vezu s funkcijom posude da izdrži termalne stresove kojima je svakodnevno izložena. Stoga je i izbor primjesa koje lončar namjerno dodaje u glinenu smjesu povezana sa sposobnošću posude da izdrži i preživi takve stresove.

Iako se radi o relativno malom uzorku primijećene razlike u dodavanju veće količine groga kod lonaca bile su smjernica za dodatna uzorkovanja i analize koje se trenutno provode u cilju provjeravanja relevantnosti podataka na širem uzorku s oba lokaliteta.



Slika 81 - zdjela tipa A 4c: a (ukriženi nikoli) – interferencijske boje vanjskog ruba stijenke su prekrivene jakom narančastocrvenom vlastitom bojom; b (paralelni nikoli) - crno, dobro zaobljeno organsko zrno; c (paralelni nikoli) – zrna groga koja se od crnog matriksa razlikuju po svjetlijoj boji te uglatim granicama.

17. STANDARDIZACIJA PROIZVODA, SPECIJALIZACIJA ZANATA I ORGANIZACIJA KERAMIČKE PROIZVODNJE

Specijalizacija je jednako toliko društveni odnos koliko i ekonomski, jer umanjuje autonomiju i stvara nove međuovisnosti na kojima se temelje složeni oblici društvene integracije

(Costin 2005: 1062)

Koristeći interdisciplinarni pristup prilikom obrade keramičkog materijala s oba lokaliteta stvorena je podloga za rekonstrukciju i definiranje konteksta u kojem se keramika proizvodila, distribuirala i upotrebljavala. Svaka od tri navedene kategorije sadrži nekoliko aspekata koji su analizirani i koje se pokušalo interpretirati na osnovi dobivenih podataka. Poseban naglasak stavljen je na organizaciju proizvodnje, specijalizaciju zanata i standardizaciju keramičkih proizvoda. Rezultati i interpretacija provedenih analiza unutar svake od navedenih komponenti omogućili su bolje razumijevanje i definiranje društvenih procesa unutar vučedolskog društva. Mnogo je varijabli koje se mogu definirati u cjelokupnom procesu proizvodnje (Schortman & Urban 2004), a ovdje su izdvojene samo one koje su se mogle interpretirati prema dostupnim i dobivenim podacima.

Iako su rezultati standardizacije i specijalizacije zanata u vučedolskoj kulturi prema obrađenom materijalu s lokaliteta na Damića gradini i Ervenici objavljeni na više mjesta (Miloglav 2012b; 2013) ovdje su prikazani iz razloga cjelovite i sveobuhvatne interpretacije keramičke proizvodnje i njezine uloge u vučedolskom društvu.

ORGANIZACIJA PROIZVODNJE

Definiranje proizvodnog procesa, specijalizacije zanata i standardizacije keramičkih proizvoda intenzivinije se počelo razvijati od 80-ih godina prošlog stoljeća (za pregled vidi: Tite 1999). Mnogo je radova napisano na ovu temu i sve više je istraživanja koja su usmjerena na modele proizvodnje, standardizacije i specijalizacije zanata (Rice 1977; 1981; 1989; 1996a; Arnold 1985; 2000; Hagstrum 1985; Sinopoli 1988; Costin 1991; 2000; 2005; Costin & Hagstrum 1995; Roux 2003a). Većina autora slaže se u jednom, a to je da se organizacija proizvodnje može prepoznati i definirati na više načina. Međutim, bitno je naglasiti da predloženi modeli organizacije proizvodnje trebaju biti fleksibilni u jednoj određenoj mjeri jer se ne mogu linearno primijeniti na sva društva (Vuković & Miloglav 2016).

Za definiranje i prepoznavanje organizirane proizvodnje i specijalizacije zanata većina autora naglašava da je prvo potrebno stvoriti okvir koji je nužan za njihovo nastajanje. Taj okvir uključuje društveno-ekonomske, političke i krajobrazne faktore koji utječu na razvoj i funkcioniranje određene društvene zajednice, a odgovori na ova pitanja ključni su za utvrđivanje tragova organizirane specijalizacije.

Ekonomska strategija vučedolskog stanovništva koja je uključivala zemljoradnju, stočarstvo, lov i metalurgiju imala je za posljedicu društveno raslojavanje gdje se jedan bogatiji sloj zajednice uzdignuo nad ostalima. Gomilanje stoke i metalurških proizvoda omogućili su stjecanje veće količine zaliha, a populacijski rast vjerojatno je bio uvjetovan boljim načinom života. Tragovi društvenog raslojavanja najbolje se očituju u sahranjivanju pokojnika i određenim pokazateljima unutar koncepcije stanovanja i organizacije naselja.

Dokazi društvene hijerarhije vrlo dobro se mogu pratiti na eponimnom lokalitetu Vučedol koji svojom veličinom i prostornom organizacijom odskače od ostalih naselja svog vremena. Proizvodnja bakrenih predmeta imala je posebno mjesto u društvenom i ekonomskom smislu o čemu, između ostalog, svjedoče ostaci metalurških peći, kalupa i pripadajućeg alata pronađeni na mnogobrojnim vučedolskim lokalitetima. Iz svega navedenog sigurno se može reći da je metalurška djelatnost bila visoko specijalizirana, a tragovi organizirane proizvodnje mogu se pratiti na gotovo svim većim vučedolskim lokalitetima. U ekonomskom terminu specijalizacija zanata javlja se u društvima koja imaju određeni stupanj kompleksnosti (Forenbaher 1999) što bi svoju potvrdu nedvojbeno imalo unutar razvijenog vučedolskog društva. Iako specijalizirana metalurška proizvodnja nije tema ovog poglavlja bitno je naglasiti njeno postojanje i važnost u ukupnom ekonomskom okviru vučedolske kulture.

SPECIJALIZACIJA ZANATA

Specijalizacija u smislu arheološkog konteksta i organizacije proizvodnje ima mnogo različitih definicija i tumačenja. Možda je jedna od jasnijih ona koju je dala P. M. Rice (1981: 220) gdje definira specijalizaciju kao regulirano ponašanje i materijalnu raznolikost u proizvodnim aktivnostima. Za C. L. Costin (1991) specijalizacija je relativno stanje, a ne apsolutno, pri čemu razlikuje stupanj i tip specijalizacije. Pritom specijalizacija može biti organizirana na mnogo načina od specijalizacije na individualnoj razini do specijalizacije zajednice, od specijalizacije na razini domaćinstva do većih organiziranih radionica. Po njoj je proizvodnja „transformacija sirovinskog materijala u upotrebljiv proizvod" a specijalizacija „način na koji je organizirana proizvodnja".

Jedan od možda najcitiranijih modela je onaj koji donosi Earle (vidi: Costin 1991) o povezanoj i neovisnoj specijalizaciji. On razlikuje proizvodnju specijalnih, prestižnih predmeta koje konzumira i kontrolira elita od proizvodnje utilitarnih predmeta za širu distribuciju koja nema sustav kontrole. Ovu definiciju uskoro su prihvatili brojni autori (npr. Hagstrum 1985; Sinopoli 1988; Costin 1991). Govoreći o specijalizaciji P. M. Rice (1989: 110) razlikuje individualnu specijalizaciju od one na razini zajednice, kao i specijalizaciju posebnog oblika ili posebne funkcije posude.

Kao što je već naglašeno postoji mnogo tipova i definicija specijalizacije, jer ona nije jednoznačna pojava i ovisi o mnogo različitih faktora, prije svega o društvenim, ekonomskim, političkim te krajobraznim uvjetima. Kada govorimo o ekonomiji bitno je naglasiti da svi ekonomski sustavi imaju tri komponente: proizvodnju, distribuciju i konzumaciju. Zajedno distribucija i konzumacija informiraju nas o ekonomskom, društvenom i političkom kontekstu proizvodnje (Costin 1991). Distribucija je vezana za model razmjene i o njoj će u jednoj mjeri ovisiti organizacija proizvodnje. Zadnja karika u lancu je konzumacija, odnosno potreba za krajnjim proizvodom. C. L. Costin (1991) u tom smislu razlikuje a) prirodu potražnje koja je definirana funkcijom proizvoda u okviru društveno-ekonomskih uloga ljudi koji ih koriste; b) stupanj potražnje koji se odnosi na broj proizvoda koji su u opticaju i broj koji je potreban da bi se zadovoljila potraživanja; c) logistiku distribucije koja uključuje identifikaciju putova kojima proizvođač nabavlja sirovinski materijal i dostavlja završene proizvode do krajnjeg korisnika; d) razloge dobavljača/proizvođača koji identificiraju osnovnu stimulacijsku silu koja stoji iza proizvodnje i distribucije. U arheološkom okruženju upravo je komponenta konzumacije najteže uočljiva i interpretativno postaje najslabija karika u ekonomskim sustavima najranijih društava.

Ponuda i potražnja vrlo su važne komponente svake studije o organiziranoj proizvodnji. U klasičnim ekonomskim sustavima to su osnovni ekonomski principi i glavna okosnica tržišne ekonomije. Međutim, u arheološkom kontekstu susrećemo se s ekonomijama koje nisu tržišne ni kapitalističke, stoga se ovi termini odnose na društvene i političke faktore koji utječu na potrebu za određenim proizvodom. Potražnja ili uvjeti potrošnje/konzumacije ne mogu se uvijek jasno prepoznati u arheološkom okruženju, a odnose se na pitanja: za koga se roba proizvodila?, za koju potrebu? i u kojem kontekstu?. Jedna od komponenti potražnje je i funkcija proizvoda a odnosi se na upotrebu određenog proizvoda i njegovu funkciju u svakodnevnom životu, u ritualima ili u društvenom životu (Costin 2005: 1047). Karakteristika potražnje uključuje tri seta analitičkih tehnika: a) identifikaciju konteksta u kojem su proizvodi nađeni; b) morfološku analizu keramike kako bi se utvrdila funkcija (koja uključuje analizu organskih ostataka, analizu sirovinskog materijala te analize tragova korištenja i trošenja na posudi); c) kvantitativne i kvalitativne metode (Costin 2005: 1048). Ovo su sve atributi koji se mogu prepoznati kao karakteristike proizvodnog sustava.

Govoreći o keramičkoj proizvodnji bitno je naglasiti da ona može biti organizirana na mnogo načina (Rice 1981; Sinopoli 1988; Costin 1991; 2000; Costin & Hagstrum 1995).

Ovdje donosimo model koji je napravio van der Leeuw, a odnosi se na različite stupnjeve organizacije keramičke proizvodnje koja je poznata iz etnoarheoloških i arheoloških istraživanja (vidi Sinopoli 1991: 98-117). Po njemu se organizacija keramičke proizvodnje može podijeliti na četiri stupnja.

Na najnižoj razini to je proizvodnja unutar domaćinstva. U ovoj fazi proizvodnja se odvija periodično, na otvorenom s vrlo oskudnim i ograničenim investiranjem u alat i sirovinski materijal (glinu i njene primjese). Uglavnom se odnosi na keramičku proizvodnju koja zadovoljava godišnje potrebe pojedinog domaćinstva.

Drugi stupanj također bi uključivao proizvodnju unutar domaćinstva, ali je većina proizvodnje orijentirana na potrebe izvan njega, odnosno na trgovinu i razmjenu unutar naselja. Lončari još uvijek nisu specijalizirani u smislu „stalnog radnog mjesta“, već se posao odvija parcijalno (*part-time job*), a keramička proizvodnja odvija se na razini opskrbljivanja za potrebe naraslih gospodarskih potraživanja. Ova razina uključuje povećanu i frekventniju proizvodnju u odnosu na prijašnju fazu.

Tek bi treći stupanj keramičke proizvodnje podrazumijevao radioničku industriju u smislu potrebe za specijaliziranom radnom snagom koja svoju aktivnost provodi svakodnevno (*full-time job*). Ova razina uključivala bi i velike promjene u tehnološkom smislu. Međutim, pod pojmom tehnoloških inovacija neki autori podrazumijevaju i organizaciju rada, odnosno podjelu među populacijom koja čini okosnicu radne snage, njihov društveni status ili mjesto gdje se taj posao obavlja (Miller 2007: 185-186). Kako lončarstvo postaje regularna aktivnost proporcionalno s tim raste i broj keramičkih posuda, što za posljedicu dovodi do prvih znakova standardizacije, jer lončari nastoje smanjiti vrijeme i energiju koja im je potrebna za izradu jedne posude. U ovom razdoblju keramičke posude rade se i za širu distribuciju.

Posljednja razina obuhvaćala bi pojam proizvodnje na višoj razini, a značila bi masovnu proizvodnju i zapošljavanje velikog broja visokospecijaliziranih lončara. Ovaj stupanj podrazumijeva postojanje radionica i organiziranje rada u smislu „tvorničkog poslovanja“. Keramika je izuzetno standardizirana, a tehnologija visoko specijalizirana.

Još jedan zanimljivi model koji će poslužiti i za definiranje organizacije proizvodnje unutar obrađenih vučedolskih lokaliteta donosi i C. L. Costin (1991). Ona razlikuje osam stupnjeva organizacije proizvodnje na temelju četiri parametra: konteksta proizvoda, koncentracije proizvodnih sadržaja, stupnja i intenziteta proizvodnje.

KAKO PREPOZNATI POSTOJANJE ORGANIZIRANE KERAMIČKE PROIZVODNJE?

Općenito, arheolozi se slažu da postoje dva opća dokaza koji omogućavaju rekonstrukciju organizirane proizvodnje: direktni i indirektni. Direktni dokazi su mjesta keramičke proizvodnje, keramičke peći, alati, otpadni materijal, pigmenti, kalupi itd. Međutim, postoji razlika između mjesta proizvodnje (eng. *production locus*) i proizvodnih jedinica (eng. *production units*). Mjesta proizvodnje su lokacije gdje se odvija izrada keramičkih posuda, a odnose se ili na samo mjesto proizvodnje ili na zajednicu u kojoj se proizvodilo, bez specificiranja broja proizvođača ili radionica. Proizvodna jedinica implicira ne samo mjesto proizvodnje već i elemente diskretne organizacije (Costin 1991: 29-30).

Kako ni jedna keramička peć nije pronađena unutar vučedolske kulture, pečenje se očito odvijalo na otvorenom ognjištu ili u jami. Organizacija vučedolskih naselja podrazumijevala je vrlo zgusnute kuće s prolazima koji su uži od jednog metra (Forenbaher 1994), stoga je vjerojatno da se okoliš kuće vrlo često čistio od smeća i otpadnog materijala kako bi bio prohodan. Zbog toga je vrlo teško arheološkim iskopavanjem pronaći i definirati direktne dokaze mjesta proizvodnje kao i mjesta odlaganja otpada.

Možda jedini indirektni dokaz koji bi ukazivao na mjesto proizvodnje čine tri velike nakupine hematita koji se koristio za ukrašavanje (inkrustaciju) posuda, a koje su nađene u neposrednoj blizini kuće na lokalitetu Vučedol (položaj Vinograd Sreim). Iako se radi o dokazima koji sugeriraju mjesto proizvodnje na lokalitetu Vučedol, a ne na lokalitetima koji su obrađeni u ovoj knjizi, bitno je naglasiti njihovu važnost u smislu prepoznavanja mjesta proizvodnje koji ne uključuje jame, ognjišta ili peći za pečenje, alate ili neobrađenu glinu (Miloglav 2013: 207, Sl. 4).

Indirektni dokazi su oni dokazi kada u arheološkom kontekstu nismo u mogućnosti locirati mjesta proizvodnje, a keramički proizvod postaje sam po sebi dokaz specijalizirane proizvodnje. Međutim, kod indirektnih dokaza rijetko se može prepoznati kontekst, stupanj i intenzitet proizvodnje. Nekoliko je faktora koji se uzimaju u obzir kada je riječ o indirektnim dokazima. To je prije svega prepoznavanje velikog broja manje ili više standardiziranih proizvoda te vještina i efikasnost u izradi. Indirektne dokaze vještine najčešće se mjeri kroz tehnološke atribute gotovih proizvoda. Postoji nekoliko prijedloga kojima se može izmjeriti vještina, a uključuju geste koje se koristi za ukrašavanje posuda (Hagstrum 1985) ili kontrolu pokreta (Costin & Hagstrum 1995). Neka etnoarheološka istraživanja sugeriraju da lončareve vještine i repertoar variraju s godinama iskustva te da vještina izrade velikih posuda linearno raste s godinama (Kramer 1985; Roux 2003a).

Vještinu je jako teško definirati u arheološkom kontekstu. To je kombinacija društvenog i individualnog učenja koja se prenosi u praksi i akumulira s godinama. Stupanj vještine lončara moguće je definirati kroz tzv. tehnološki potpis koji se može prepoznati na izrađenim posudama. Kako svaki lončar posjeduje određeni stupanj vještine tako i svaka posuda zahtijeva različiti stupanj vještine u izradi, ovisno o kompleksnosti oblika i namjeni. Tako će npr. manje posude jednostavnih oblika poput šalica i manjih zdjela zahtijevati manji stupanj vještine od većih posuda kompliciranog oblika kao što su lonci za skladištenje namirnica ili urne. Također, posude jednostavnijih formi zahtijevaju manje koraka u lancu operacija cjelokupnog proizvodnog postupka.

Jedan od načina mjerenja stupnja vještine donosi S. Budden (2008) kroz 12 tehnoloških varijabli koje se mogu definirati i izmjeriti unutar različitih morfoloških oblika, odnosno stupnja tehnološke kompleksnosti u izradi posude. Ovaj pristup mjerenja i definiranja vještine relativno je jednostavno mjerljiv tijekom obrade materijala.

Kako na lokalitetima na Ervenici i Damića gradini nisu identificirana područja koja bi sugerirala mjesta organizirane proizvodnje sam keramički materijal poslužio je kao indirektni dokaz za definiranje specijalizacije zanata i organizacije proizvodnje.

STANDARDIZACIJA PROIZVODA

Standardizacija keramičkog materijala uobičajeno se koristi u analizi organizacije proizvodnje (Rice 1989; Stark 1991; Blackman et al. 1993; Kvamme et al. 1996; Arnold P. J. 2000). Definiciju standardizacije možda je najbolje postavila P. M. Rice (1987; 1996a: 178-179) koja ju definira kao smanjenje varijabilnosti oblika, dimenzija i ukrasa keramičkih posuda. To podrazumijeva i smanjivanje lanca operacija u proizvodnom postupku te shodno tome i pojednostavljenje tehnika izrade (Rice 1981: 220). Nadalje, ona smatra da treba razlikovati standardizaciju unutar proizvodne tehnologije od redukcije u varijabilnosti koja je vezana uz specijalizaciju i povećanje broja osoba koje izrađuju keramičke posude. Također, naglašava da treba razlikovati povećanje proizvodnje (intenzifikaciju) od specijalizacije, koje ne moraju nužno biti povezane. Prvi segment uključuje ekonomski proces, odnosno potrebu za masovnom proizvodnjom koja znači povećanje radne snage i sredstava, dok specijalizacija uključuje posebne vještine koje su potrebne pri izradi određenog proizvoda.

Standardizacija zapravo mjeri broj produkcijskih grupa i obično se smatra integralnim dijelom specijalizacije i to iz dva razloga. Prvi je razlog što specijalizirani sustavi imaju manje proizvođača, tj. manje individualne varijabilnosti, a drugi je što specijalisti prakticiraju svoj zanat učestalije kroz obuku i praksu te razvijaju rutinizirane radnje (Costin 1991: 33-35; Costin 2005: 1067). Međutim, neki autori smatraju da na smanjenje varijabilnosti keramičkih proizvoda ne mora utjecati specijalizacija, već rutina. Tako se stalno ponavljanje istih radnji, odnosno rutinski zahvati, uglavnom odvajaju od specijalizacije koja podrazumijeva standardizaciju proizvoda (Arnold 1991).

Općenito gledajući može se reći da na stupanj standardizacije utječe stupanj proizvodnje, a za identifikaciju stupnja standardizacije veliku ulogu imat će odnos broja lončara/specijalista i krajnjih korisnika/potrošača. Kao što smo vidjeli, proizvodnja se može organizirati na nekoliko načina, od malih keramičkih jedinica na razini domaćinstva do većih radioničkih centara. Ona obuhvaća nekoliko komponenti koje zajedno tvore proizvodni sustav. Jedan od modela donijela je C. L. Costin (2005), a on bi obuhvaćao:

a) majstore (ljude koji izrađuju proizvode);

b) sredstva proizvodnje (sirovinski materijal, alat, vještine, znanje);

c) organizacijske i društvene odnose proizvodnje (odnos proizvođača i potrošača);

d) predmete;

e) odnose distribucije (mehanizme kojima su predmeti prenijeti do potrošača);

f) potrošače.

Prva komponenta ovog proizvodnog sustava obuhvaća lončare, odnosno specijaliste koji izrađuju standardizirano posuđe, kao rezultat njihova znanja, vještina i iskustva. Pritom se obično naglašava da treba razlikovati namjerne i mehaničke atribute. Prvi utječu na funkcionalnosti posude, a uključuju tehnološke, morfološke i stilske atribute i mogu nam manje reći o organizaciji proizvodnje. Ove su radnje odraz društvenih i ekonomskih normi te zahtjeva zajednice za određenim funkcionalnim proizvodom. Mehanički atributi su one radnje koje lončar nenamjerno stvara prilikom izrade posude. S obzirom na to da se rade nesvjesno, ove radnje mogu nam više reći o organizaciji proizvodnje, a uključuju odabir gline, te varijabilnost u metričkim mjerenjima kao što su mala odstupanja u morfologiji posude (simetrija ruba, dna, ručke, debljine stijenke itd.). Na mehaničke atribute utječe stupanj vještine, znanja, iskustva i radnih navika (Costin & Hagstrum 1995; Costin 2005).

Hipoteza standardizacije (Blackman et al. 1993) predlaže da je veći stupanj proizvodnje razlog veće uniformiranosti keramičkih posuda, a povezana je s ekonomskom specijalizacijom (Rice 1981; Costin & Hagstrum 1995; Costin 2000; 2005). Specijalizirana keramička proizvodnja mora biti definirana u arheološkom okruženju kroz standardizaciju sirovinskog materijala i tehnike (Rice 1981), forme i dimenzija (Sinopoli 1988), te dekoracije (Hagstrum 1985). Iako se ukras smatra namjernim atributom koji keramičar ciljano stavlja na posudu (Hagstrum 1985; Costin & Hagstrum 1995) većina mjerenja standardizacije keramičkog materijala izbjegava ovu varijablu.

Većina autora slaže se da je za mjerenje standardizacije najbolje usporediti dva različita keramička asortimana jer se po njima najbolje može pratiti stupanj standardizacije (Rice 1981; Blackman et al. 1993; Costin & Hagstrum 1995; Roux 2003a). Prilikom provođenja testa standardizacije najčešće se uzimaju metričke vrijednosti, tehnologija izrade i kemijski sastav gline. Međutim, neki autori smatraju da nam sastav glinene smjese ne može ništa reći o organizaciji keramičke proizvodnje, ali može u velikoj mjeri otkriti organizaciju keramičke distribucije po krajoliku. Također se naglašava da uniformiranost glinene smjese ne može biti dokaz standardizacije proizvoda i intenzivnog stupnja specijalizacije i da u tom smislu trebamo promatrati neke druge faktore poput dostupnosti i nabave sirovine kao i njezinu upotrebu u pripremi glinene smjese. U tom smislu treba imati na umu da tehnološki i krajobrazni faktori ne utječu na isti način na organizaciju keramičke distribucije kao na organizaciju proizvodnje koja je u velikoj mjeri uvjetovana društveno-političkim i društveno-ekonomskim faktorima (Arnold 2000).

Važno je naglasiti da kod utvrđivanja standardizacije, koja će nam poslužiti za interpretaciju specijalizacije i organizacije proizvodnje, treba uzeti u obzir nekoliko stvari:

1. da analizirani atributi reflektiraju organizaciju proizvodnje, a ne nesvjesne radnje koje su uvjetovane društvenim, ekonomskim ili političkim razlozima (Costin 1991)
2. da je potrebno usporediti dvijeili više analitičkih jedinica (lokaliteta, asamblaža, regija, faza ili tipova)
3. kod interpretacije treba paziti na subjektivnost koja je sastavni dio tipološke klasifikacije materijala, stoga je najbolje koristiti razne statističke testove i metode
4. vrlo je bitna veličina uzorka radi reprezentativnosti podataka
5. jako je važno da se prilikom mjerenja i usporedbe uzimaju podaci iz iste tipološke grupe, radi odstupanja metričkih vrijednosti
6. da se razdvoje utilitarni od prestižnih i luksuznih predmeta koji svojim dimenzijama i ukrasom odskaču od uobičajenog repertoara te imaju različito značenje i namjenu za zajednicu
7. imati na umu kumulativno zamagljenje kod interpretacije stupnja proizvodnje

Testovi standardizacije, kao što je već rečeno, najvećim se dijelom provode u sklopu etnoarheoloških istraživanja (Arnold 1985; 2000; Kramer 1985; Stark 1991; Kvamme et al. 1996; Arnold P. J. 2000; Roux 2003a) koja nam pomažu pri interpretaciji arheoloških teza, jer koriste informacije koje se ne mogu dobiti ili ih je jako teško prepoznati u arheološkom kontekstu. To uključuje većinu metričkih mjera (npr. visinu cijele posude ili maksimalan promjer posude), informacije o distribuciji, konzumaciji i proizvodnji te keramičke proizvode jednog majstora ili jedne proizvodne serije.

Etnoarheološka istraživanja posebnu su dragocjena kod definiranja ponude i potražnje koje su važne komponente svakog istraživanja organizirane proizvodnje. Neki od radova pokušavaju upozoriti da se etnoarheološka istraživanja ne mogu u cijelosti projicirati na arheološka istraživanja (Costin 2000; Harry 2005). S druge strane etnoarheološka istraživanja ipak nam daju neka nova saznanja i stavljaju pred arheologe drugačiji način razmišljanja o materijalnom svijetu te pružaju mogućnost provjere vrijednosti naših informacija (Tite 1999). Međutim, u arheološkom okruženju vrlo je teško sakupiti informacije dobivene etnoarheološkim istraživanjima, a vrijednosti koeficijenta varijacije bit će daleko veće. Jedan od razloga je i tzv. kumulativno zamagljenje (eng. *cumulative blurring*) koje nastaje kada se mjere svi keramički proizvodi iz jednog naselja, odnosno posude koje je napravilo više majstora i iz više proizvodnih serija (Blackman et al. 1993). Ovaj problem je u arheologiji dosta uobičajen jer većina materijala ne potječe iz jasno zatvorenih cjelina, kao što je slučaj s obrađenim lokalitetom na Damića gradini. Etnoarheološka istraživanja su pokazala da je koeficijent varijacije daleko manji ako se uzimaju posude koje je izradio jedan majstor (Roux 2003a: 775; Underhill 2003: 250).

REZULTATI TESTA STANDARDIZACIJE NA KERAMIČKOM MATERIJALU S LOKALITETA NA ERVENICI I DAMIĆA GRADINI

Promatrajući obrađeni keramički materijal već na najnižoj razini vizualne percepcije bila je uočljiva sličnost keramičkog inventara s oba lokaliteta, promatrana unutar pojedinih tipoloških oblika (zdjela, lonac, šalica, vrč). Najjednostavnijom komparacijom izmjerenih varijabli unutar tipoloških grupa pokazalo se da se metrički podaci ili poklapaju ili odstupaju u vrlo malim metričkim vrijednostima. Zato je napravljen test kojim je izmjeren stupanj standardizacije, kako bi se potvrdilo ili osporilo njezino postojanje.

Standardizacija se općenito može izmjeriti na nekoliko načina, a jedan od njih je pomoću koeficijenta varijacije (eng. *coefficeint of variation* - KV) koji se koristi za mjerenje skupova podataka u smislu njihove disperzije. Prilikom izračuna koeficijenta varijacije potrebno je standardnu devijaciju (eng. *standard deviation* - SD) određene grupe podataka podijeliti sa srednjom vrijednosti (eng. *mean* - M), a račun se izražava u postotcima (Shennan 2001). Srednja vrijednost određenog skupa podataka je aritmetička sredina koja predstavlja centar distribucije. Ona uključuje sve vrijednosti/mjerenja unutar pojedine grupe podataka, pa nastaje problem ako su podaci široko raspršeni, odnosno ako imamo ekstremno niske ili visoke rezultate za pojedina mjerenja. U tom slučaju srednja vrijednost neće biti odraz tipične vrijednosti za tu grupu podataka. Za korekciju ovih razlika služi nam standardna devijacija koja ima veliku ulogu u mnogim statističkim testovima jer je to najvažnija mjera disperzije podataka oko srednje vrijednosti.

Standardna devijacija danas se uobičajeno izračunava pomoću raznih statističkih programa, a ovdje se koristio program *SPSS* (*Statistical Package for the Social Sciences*). Koeficijent varijacije u arheologiji, kao što smo već spomenuli, koristi se za izračunavanje standardizacije određenih proizvoda. U pravilu što je veća srednja vrijednost veća je i standardna devijacija, a to bi se moglo protumačiti da je i proizvodnja bila manje standardizirana. Da bi se izbjegao ovaj problem, koristi se koeficijent varijacije čija formula glasi $CV = \frac{\sigma}{x} 100\%$ (Shennan 2001).

Kod mjerenja koeficijenta varijacije iz mjerenja su izuzete ekstremne vrijednosti (najniže i najviše) i to najviše 3 mjerenja po pojedinom tipu. Ovakav pristup nije neuobičajen i uglavnom se primjenjuje, i to iz dva razloga. Prvi razlog je što moramo razlučiti utilitarne predmete od onih ekskluzivnih koji su rađeni u posebne svrhe i koji odstupaju i oblikom i ukrasom od ostalog materijala. Drugi razlog je da se smanji subjektivnost i eventualne greške koje su napravljene prilikom tipološke klasifikacije, posebno kada je riječ o veličini posude (Blackman et al. 1993). Mjerenja s ekstremnim vrijednostima koja nisu isključena iz statističke obrade, radi navedenih razloga, daju nam krive i nevjerodostojne podatke. Isto tako je bitno da se prilikom mjerenja i usporedbe uzimaju podaci iz iste tipološke grupe, upravo radi odstupanja metričkih vrijednosti.

Ervenica - Vinkovci					**Damića Gradina - Stari Mikanovci**				
Tip	**n**	**Srednja vrijednost**	**SD**	**KV**	**Tip**	**n**	**Srednja vrijednost**	**SD**	**KV**
A 1a - DS	5	12,10	1,91	15,79%	**A 1a - DS**	9	13,11	2,75	20,97%
A 1d - PR	4	11,87	1,43	12,05%	**A 1d - PR**	7	13,72	2,71	19,75%
A 1d - DS	8	8,13	1,38	16,97%	**A 1d - DS**	18	8,08	1,18	14,60%
A 2 - PR	6	8,57	2,16	25,20%	**A 2 - PR**	30	9,10	1,95	21,42%
A 2 - DS	27	6,85	1,18	17,23%	**A 2 - DS**	88	6,42	1,07	16,66%
A 3a - PR	10	12,60	2,22	17,62%	**A 3a - PR**	33	13,62	1,98	14,53%
A 3a - DS	25	7,32	0,98	13,39%	**A 3a - DS**	78	7,92	0,99	12,50%
A 4a - PR	14	12,02	1,52	12,65%	**A 4a - PR**	14	11,34	1,35	11,90%
A 4a - DS	36	7,00	0,91	13,00%	**A 4a - DS**	28	6,82	0,92	13,48%
A 4b - PR	3	15,50	1,80	11,61%	**A 4b - PR**	3	13,46	1,70	12,63%
A 4b - DS	7	6,80	0,75	11,03%	**A 4b - DS**	9	7,25	1,00	13,79%
A 4c - PR	6	14,26	1,66	11,64%	**A 4c - PR**	28	13,09	1,67	12,75%
A 4c - DS	22	7,19	0,78	10,85%	**A 4c - DS**	90	7,06	0,86	12,18%
A 5 - PR	8	5,57	0,79	14,18%	**A 5 - PR**	24	6,14	1,40	22,80%
A 5 - DS	22	6,34	0,89	14,04%	**A 5 - DS**	75	6,40	1,06	16,56%
B 1a - PR	13	9,31	2,27	24,38%	**B 1a - PR**	49	10,74	2,88	26,80%
B 1a - DS	23	7,33	1,03	14,05%	**B 1a - DS**	87	8,86	1,35	15,23%
B 1b - PR	4	5,75	0,64	11,13%	**B 1b - PR**	32	7,23	1,25	17,28%
B 1b - DS	8	6,54	0,87	13,30%	**B 1b - DS**	56	6,85	1,23	17,95%
B 3b - PR	7	7,28	1,28	17,58%	**B 3b - PR**	11	6,51	1,41	21,65%
B 3b - DS	7	9,32	2,53	27,15%	**B 3b - DS**	15	8,37	1,40	16,72%
C - PR	4	4,10	0,33	8,05%	**C - PR**	3	3,83	0,47	12,27%

n - broj ulomaka; SD - standardna devijacija; KV - koeficijent varijacije; PR - polumjer ruba (cm); DS - debljina stjenke (mm).

Tablica 25 – komparativna tablica koeficijenta varijacije (KV) izmjerenih vrijednosti na tipovima s oba lokaliteta

Za testiranje stupnja standardizacije na materijalu s oba lokaliteta uzete su mjere polumjera ruba i debljine stijenki tijela posude. Etnoarheološka istraživanja su pokazala da su visina posude, promjer otvora i ramena parametri od kojih najviše ovise motoričke sposobnosti (Roux 2003a), a kod današnjih tradicijskih zajednica posebno standardiziran mora biti upravo otvor posude (Underhill 2003). Nepotrebno je ponovno naglašavati koliko je otvor posude važan za njen izgled i funkciju, međutim debljina stijenki (iako bitna varijabla za samu funkciju posude) puno je nezahvalnija za uspoređivanje među pojedinim tipovima, jer fragmentiranost keramičkih posuda uglavnom znači i uzimanje mjera na različitim dijelovima posude. Prilikom određivanja mjera za debljinu stijenki stoga se pazilo da se one uzimaju uvijek s istih dijelova, najčešće s tijela posude. Kod pojedinih tipova uzimane su mjere polumjera dna i visine, a kod tipova gdje je bilo malo ili nimalo relevantnih parametara usporedbe i mjerenja nisu izvršena.

Već prilikom obrade materijala uočena je velika sličnost unutar zdjela tipa A 4. Ovaj tip podijeljen je na 5 varijanti, s tim da varijante A 4a, A 4b i A 4c pokazuju minimalna morfološka odstupanja. Koeficijent varijacije na ovim zdjelama iznimno je nizak i pokazuje najveći stupanj standardizacije. On se za polumjer otvora na oba lokaliteta kreće između 11,61-12,75%, a za debljinu stijenki 10,84-13,79% (*Tablica 25*).

Za razliku od tipa A 4, tip A 2 ne pokazuje izraziti stupanj standardizacije (21,42% i 25,20% za polumjer otvora), a razlog tome jest činjenica što on dosta varira visinom i polumjerom otvora. Iako naizgled slični, ova dva tipa pokazuju velike morfološke razlike, i u obliku i u dimenzijama. Tip A 2 je manji, ima *omphalos* dno i S-profilirani obris. Tip A4 je veći, ima ravno dno i bikonični obris.

Male varijacije u morfologiji zdjela tipa A 4 govore nam da se ovaj tip posude najviše koristio u utilitarne svrhe, dok se tip A 2 očito izrađivao i za neke posebne namjene pa u tom smislu i morfologija posude dosta varira.

Kao što je već naglašeno, jako je važno da se prilikom mjerenja koeficijenta varijacije uzimaju podaci iz iste tipološke grupe, radi odstupanja metričkih vrijednosti i smanjivanja subjektivnosti i potencijalnih grešaka prilikom kreiranja tipologije. Ilustracija ovog problema vidljiva je na zdjelama tipa A 1. Postotak KV za polumjera otvora napravljen na svim zdjelama tipa A 1 na Ervenici iznosi 35,89%, a na Damića gradini čak 43,75%. Isti je slučaj i s vrijednostima koje su napravljene za sve tipove zdjela A 4 i lonaca tipa B 1 (Miloglav 2012: 42, Tablica 3). Kada bismo gledali samo ove rezultate mogli bismo zaključiti da ovaj tip zdjele ne pokazuje stupanj standardizacije. Tip A 1 podijeljen je na nekoliko varijanti, upravo na osnovi visine, debljine stijenke i polumjera otvora, pa je nerealno očekivati stupanj standardizacije mjeren na osnovi svih varijanti ovog tipa zdjele. Međutim, kada se metričke vrijednosti usmjere na iste oblike unutar tipoloških grupa, postotak KV se znatno smanjuje i ukazuje na određeni stupanj standardizacije (*Tablica 25*).

Visok stupanj standardizacije uočen na zdjelama, posebno na tipu A 4 i nije toliko iznenađujući pogotovo kada pogledamo da zdjele i kvantitativno čine najbrojniji oblik na oba lokaliteta. Tip A 4, kao što je prikazano u prethodnim poglavljima, najzastupljeniji je tip zdjele na oba obrađena lokaliteta, na Ervenici čini 40,32%, a na Damića gradini 28,81% od ukupnog broja zdjela. Već je naglašeno da je jedna od analitičkih tehnika koja se koristi za interpretaciju potražnje i funkcija posude. Po svojoj funkciji zdjele tipa A 4 služile su za konzumaciju i serviranje hrane koja nije napravljena termičkom obradom. Na to upućuje nekoliko bitnih faktora. Osim same morfologije posude, ovaj tip posude nema tragove oksidacije na vanjskoj strani, niti tragove koji upućuju na termalne šokove posude koja je izložene stalnom zagrijavanju i hlađenju. Nadalje, analiza

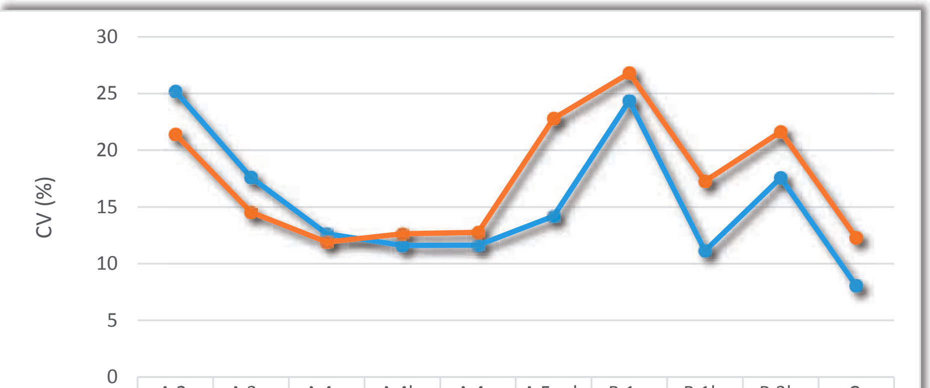
GC-MS (Poglavlje 15) pokazala je ostatke voska koji se nanosio kao vodootporni filter/premaz na unutrašnju i vanjsku stranu posude kako tekući sadržaj ne bi iscurio iz posude. Razlog većeg stupnja standardizacije na ovom tipu zdjela stoga je vjerojatno u njihovoj intenzivnijoj upotrebi u svakodnevnom životu, što bi značilo brže trošenje, deformaciju i lomljenje, a time i učestaliju proizvodnju i veće iskustvo pri izradi (*Slika 82*).

Slika 82 – primjer zdjele tipa A 4c
Fig. 82 – Example of bowl of type A 4c

Tragovi popravaka na keramičkim posudama, koji uključuju perforacije s obje strane loma najprisutnije su upravo na zdjelama tipa A 4, te na tipu A 3a, što bi bila dodatna potvrda intenzivnijeg korištenja i trošenja navedenih tipova te njihovo recikliranje i sekundarnu upotrebu (*Slika 28; Tablica 28*).

Dosta velik KV uočen je na loncima, posebno na tipu B 1a i B 3b, a nešto manja varijabilnost prisutna je na manjim loncima tipa B 1b. Razlog većeg KV na loncima vjerojatno je u dimenzijama posude budući da se greške pri obradi povećavaju linearno s veličinom planiranog završnog proizvoda (Roux 2003a: 778). Ovu bismo potvrdu možda mogli imati upravo na loncima tipa B 1a i B 1b jer se radi o istim funkcionalnim oblicima čije je odvajanje u različite podgrupe unutar istog funkcionalnog tipa isključivo vezano za visinu posude (tip B 1a je znatno veći). Vrlo mali KV na šalicama s Ervenice od 8,04% za polumjer otvora i 4,57% za visinu posude može se protumačiti kao odraz malog broja uzoraka, iako šalice pokazuju dosta visok stupanj standardizacije premda nisu zastupljene u značajnijem postotku.

Vrlo je zanimljivo pogledati graf koji prikazuje međusobne odnose KV za oba lokaliteta na svim obrađenim tipovima gdje se uočava ista putanja KV (*Slika 83*). Vrijednosti koje se najviše poklapaju prisutne su na već spomenutim zdjelama tipa A 4. Ostale vrijednosti mogu se linearno pratiti na oba keramička asamblaža što nam definitivno potvrđuje činjenicu o određenom stupnju standardizacije keramičkih proizvoda. Naime, linearna putanja KV čije se vrijednosti jednako smanjuju ili rastu na oba lokaliteta sigurno daje potvrdu standardizacije koja je ovisila o intenzitetu proizvodnje određenih keramičkih oblika, a koji su gotovo u jednakoj mjeri zastupljeni na Ervenici i na Damića gradini. Veličina posuda na oba lokaliteta dosta je ujednačena kada se pogledaju metrički podaci, stoga bi trebalo napraviti dodatne analize na širem kulturno-geografskom prostoru kako bi se dobili pokazatelji koji upućuju na eventualnu ekonomsku ulogu određene vrste posuda.



	A 2	A 3a	A 4a	A 4b	A 4c	A 5 a-b	B 1a	B 1b	B 3b	C
ERV	25,20	17,61	12,64	11,61	11,64	14,18	24,38	11,13	17,58	8,04
DG	21,42	14,53	11,90	12,63	12,75	22,80	26,80	17,28	21,65	12,27

Slika 83 - vrijednosti koeficijenta varijacije za polumjer otvora na izmjerenim tipovima s lokaliteta Ervenica i Damića gradina

MODEL ORGANIZIRANE KERAMIČKE PROIZVODNJE U VUČEDOLSKOM DRUŠTVU

Vrijednosti koje su dobivene mjerenjima KV s oba obrađena lokaliteta definitivno ukazuju na određeni stupanj standardizacije keramičkog materijala. Ovi se postotci ne mogu mjeriti s onima koja se dobiju etnoarheološkim istraživanjima gdje se vrijednosti kreću do 5%. Istraživači koji smatraju da koeficijent varijacije treba biti standardna statistička tehnika pokušali su donijeti osnovne vrijednosti za minimalni i maksimalni koeficijent varijacije prilikom utvrđivanja standardizacije keramičkog materijala. Tako vrijednost od 1,7% predstavlja minimalnu količinu varijabilnosti, odnosno najveći stupanj standardizacije koji je ostvariv kroz ručno izrađene keramičke artefakte. To je ujedno granica ljudske sposobnosti da percipira razlike u veličini. Vrijednost koeficijenta varijacije od 57,7% predstavljao bi potpuno nestandardiziran keramički materijal. Ova vrijednost ujedno može predstavljati i grešku koja je napravljena od onoga koji stvara tipološke grupe, svrstavajući različite tipove u istu tipološku klasu (Eerkens & Bettinger 2001).

Na osnovi dosadašnjih istraživanja može se zaključiti da je standardizacija odraz intenzivnije proizvodnje i proizvodne organizacije, da proizlazi iz ekonomskog i društvenog okvira zajednice te da utječe na homogenost proizvoda (Miloglav 2012). Dobivene vrijednosti koeficijenta varijacije ukazuju na standardizaciju koja je prisutna na određenom tipu zdjela.

Razlog tome je što su zdjele najmasovnija keramička kategorija, pa je njihova proizvodnja s vremenom dosegla i jedan stupanj vještine koji je vezan uz iskustvo. Povećana proizvodnja zdjela rezultirala je većim iskustvom u izradi, povećanjem motoričkih sposobnosti te većom standardizacijom proizvoda, na što upućuju i rezultati etnoarheoloških istraživanja (Eerkens & Bettinger 2001). Isto tako vrlo je vjerojatno da zdjele i lonce izrađuju različiti majstori jer, općenito gledajući, veća standardizacija znači manji broj lončara/specijalista.

Organizirana keramička proizvodnja u vučedolskom društvu sigurno je morala postojati, a odvijala se još uvijek unutar domaćinstava, ali s intenzivnijom keramičkom proizvodnjom koja je orijentirana na trgovinu i razmjenu unutar i izvan domaćinstva. Još uvijek ne možemo govoriti o radioničkim centrima, ali je sigurno da se određeni broj ljudi izdvaja po svojim vještinama i sudjeluje u keramičkoj proizvodnji. Ova vrsta specijalizacije još uvijek nije na nekom profesionalnom nivou u smislu stalnog radnog mjesta (*full-time job*). Na osnovi provedenih mjerenja može se zaključiti da se radi o nekoliko lončara koji su proizvodili keramičke posude unutar naselja. To možemo vidjeti po postotku KV koji dosta varira te je vjerojatno da je svaki od njih unio svoje mehaničke atribute prilikom izrade posude. Čak i izdvajanjem i mjerenjem iz jedne zatvorene cjeline (jama SJ 47/48) nisu dobivene značajnije razlike u postotku KV (*Tablica 26*). U pravilu veći postotak koeficijenta varijacije upućivao bi na veći broj lončara/specijalista koji su izrađivali keramičke posude, dok manji KV upućuje na jednog lončara. Kako materijal iz jame SJ 47/48, koji je dao najviše keramičkog materijala na lokalitetu s Ervenice, nije podložan „kumulativnom zamagljenju" i ne pokazuje veći stupanj standardizacije od ostalih mjerenja, smatramo da i ovaj podatak ide u prilog tezi o više lončara i keramičkih jedinica u naselju.

Ervenica - jama SJ 47/48				
Tip	**n**	**Srednja vrijednost**	**SD**	**KV**
A 4a - PR	4	13,27	2,20	16,58%
A 4a - DS	12	6,81	0,89	13,07%
A 4 - PR	6	13,85	1,92	13,86%
A 4 - DS	17	6,84	0,80	11,70%

n - broj ulomaka; SD - standardna devijacija; KV - koeficijent varijacije; PR - polumjer ruba (cm); DS - debljina stjenki (mm).

Tablica 26 – rezultati koeficijenta varijacije tipa A 4 iz jame SJ 47/48

Dobiveni rezultati mogu se interpretirati kroz, već spomenuta, četiri parametra koja donosi C. L. Costin (1991: 8) za definiranje organizacije proizvodnje:

a) ***kontekst proizvodnje*** – definira prirodu kontrole nad proizvodnjom i distribucijom. Kontrolu proizvoda u vučedolskom društvu vjerojatno je nadzirala elita kada je riječ o proizvodnji bakrenih predmeta, odnosno metalurškoj proizvodnji. Ovdje je bitna činjenica da se radi o sirovinskom materijalu koji nije lako dostupan i ne nalazi se u blizini niti unutar samog naselja, stoga se ne smije isključiti mogućnost određenog stupnja društvene kontrole nad sirovinom jer konačni proizvodi donose bogatstvo, prestiž i moć. S druge strane elita sigurno nije posebno zainteresirana za kontrolu nad predmetima svakodnevne upotrebe čiji je sirovinski materijal lako dostupan. U slučaju lokaliteta na Ervenici i Damića gradini on se nalazio u neposrednoj blizini naselja (Poglavlje 16). Premda se u vučedolskom društvu mogu pratiti naznake društvene nejednakosti, ona je još uvijek u začetku stoga je vjerojatno da nije postojala kontrola nad svim segmentima ekonomskog i društvenog života. U slučaju keramičke proizvodnje vjerojatnije se radi o individualnim specijalistima koji proizvode utilitarne predmete za sva domaćinstva i distribuiraju ih unutar i izvan naselja, bez kontrole nad proizvodima ili sirovinom. Ovdje treba ostaviti otvorenu mogućnost naručivanja određenih proizvoda posebne namjene i to bogatijih porodica/pojedinaca, što je i potvrđeno na arheološkom materijalu. Pojava predmeta posebne namjene, odnosno posuda koje oblikom, dimenzijama i ukrasom odskaču od standardnog keramičkog materijala potvrđena je na gotovo svim lokalitetima vučedolske kulture pa tako i na Ervenici i Damića gradini (T. 31, 32). Ove posude radili su izrazito vješti lončari/specijalisti, pa nije isključena mogućnost postojanja posebne kategorije specijalista koji izrađuju posebne tipove posuda koje su od velikog društvenog ili religijskog značaja za zajednicu. Ova razlika vjerojatno je najuočljivija na lokalitetu Vučedol, koji pokazuje vidljivije tragove društvene diferencijacije i pojavu velikog broja luksuznih predmeta, međutim trebalo bi napraviti analize, istraživanja i testiranja na samom keramičkom materijalu kako bi se dobili relevantni podaci za znanstvene interpretacije.

b) ***relativna regionalna koncentracija proizvoda*** – odnosi se na geografsku organizaciju proizvodnje, način na koji su specijalisti organizirani po krajoliku, njihov međusobni odnos te vezu s potrošačima za koje proizvode. Ovaj dio proizvodnog sustava možda je najmanje moguće definirati unutar istraženih lokaliteta. Iako se radi o vrlo velikim naseljima, koji u organizacijskom smislu spadaju u veće vučedolske lokalitete, zasad samo možemo nagađati na koji su način specijalisti bili distribuirani po krajoliku i kakav je bio njihov međusobni odnos. Što se tiče distribucije ona je eventualno mogla funkcionirati tako da su se snabdijevala manja naselja u okolici koja nisu bila na takvom stupnju organizacije kao lokaliteti koji su ovdje obrađeni.

c) ***stupanj proizvodnih jednica*** – uključuje broj individualaca koji rade u jednoj proizvodnoj jedinici te podjelu rada. Keramička proizvodnja odvijala se na nivou domaćinstva i mogla je biti organizirana u više proizvodnih jedinica. Njih su činili pojedinci s određenim znanjem, vještinama i iskustvom ili čak članovi iste obitelji. Kako za podjelu poslova nemamo direktne dokaze u arheološkom okruženju ne možemo o njima sa sigurnošću govoriti, ali je ona sigurno postojala na osnovi spola ili rodbinske veze jer se znanje prenosilo s generacije na generaciju uglavnom unutar iste obitelji.

d) ***intenzitet proizvodnje*** – odnosi se na lončarevo utrošeno vrijeme i način na koji je organizirana proizvodnja, odnosno radi li se o *part-time* ili *full-time* poslu. U pravilu vrlo je teško u arheološkom kontekstu govoriti koliko je vremena utrošeno na proizvodnju. Gledano u širem kontekstu društveno-ekonomskih zahtjeva vučedolske zajednice mjesta lončara nisu zahtijevala stalni radni angažman u smislu svakodnevnog obavljanja samo lončarskog posla. Posao se mogao obavljati i parcijalno u kombinaciji s drugim zahtjevima u zajednici. Tako se pečenje posude moglo odvijati u jednom dijelu dana, dok se ostatak dana mogao posvetiti ostalim poslovima (obradi zemlje ili brizi za stoku). Isto tako posude se sigurno nisu izrađivale na dnevnoj bazi već ovisno o vremenskim prilikama i gospodarskim aktivnostima. To znači da se nisu izrađivale za kišnih perioda i da je proizvodnja sigurno bila intenzivnija za vrijeme žetve i ostalih poljodjelskih aktivnosti. Zdjele, kao najmasovnija funkcionalna kategorija, upotrebljavale su se najintenzivnije u svakodnevnom životu, te shodno tome najviše trošile, razbijale, prepravljale i izrađivale. Velik stupanj standardizacije na određenim tipovima zdjela ukazuje na njihovu učestaliju izradu, određeni stupanj vještine stečen iskustvom te manje utrošenog vremena potrebnog za njihovu izradu. Također je vrlo vjerojatno da zdjele i lonce, koji ne pokazuju visok stupanj standardizacije, izrađuju različiti lončari. Općenito gledajući, proizvodnja na razini domaćinstva može varirati od slabo intenzivne do visoko intenzivne (Costin 2005: 1040), a mnoga su etnoarheološka istraživanja pokazala da proizvodnja u manjim zajednicama koja se odvija na razini domaćinstva i bez stalnog radnog angmažman može biti izrazito intenzivna (Henrickson & McDonald 1983; Hagstrum 1985). Ovaj parametar može se procijeniti ukupnom količinom proizvedenih posuda u odnosu na jedno kućanstvo/kuću i njezin životni vijek (Naroll 1962; Brown 1987; Costin 1991; Loeffler 2003), međutim formacijski procesi na oba obrađena lokaliteta nisu pružili dovoljno podataka za ovakve izračune.

Organizaciju proizvodnje unutar vučedolskog društva možda se najbolje može definirati unutar modela koji je donio van der Leeuw, a koja se još uvijek odvija unutar domaćinstva, dok je većina proizvodnje orijentirana na potrebe izvan njega, odnosno trgovinu i razmjenu izvan potrošnje domaćinstva (Miloglav 2012: 51, Sl. 3). Kada bismo išli malo detaljnije razrađivati ona bi bila uzrokovana modelom ponude i potražnje, podrazumijevala bi veću keramičku proizvodnju koja je uvjetovana većim gospodarskim aktivnostima, porastom stanovništva, te društvenom organizacijom u kojoj vidimo raslojavanje društva i stvaranje hijerarhijskih odnosa.

Povećana keramička proizvodnja tako postaje odraz novonastalih društveno-ekonomskih promjena, a uključivala bi podjelu rada u svakodnevnim aktivnostima. Na jednostavnoj razini možemo je objasniti sustavom ponude i potražnje. Organizacija proizvodnje trebala je podmiriti svakodnevne potrebe stanovništva te osigurati dio proizvoda za trgovinu i razmjenu. Isto tako trebalo je zadovoljiti sve slojeve društva, od onih bogatijih pojedinaca/porodica do onih manjih i siromašnijih domaćinstava čija potražnja nije išla dalje od zadovoljavanja godišnjih i sezonskih potreba za keramičkim inventarom.

Općenito gledajući, utvrđivanje i definiranje specijalizacije, te njen značaj u društvu vrlo je arheološki izazovno koliko i nezahvalno, jer je njena veza s društveno-političkom situacijom vrlo složena i kompleksna. Međutim, bitno je još jednom naglasiti da se određeni parametri mogu prepoznati kako tijekom samog arheološkog istraživanja (direktni dokazi) tako i prilikom obrade keramičke građe (indirektni dokazi). Na kraju ostaje na nama da te obrasce uočimo i pokušamo što vjerodostojnije interpretirati u okvirima podataka s kojima raspolažemo.

18. UPORABNA SVOJSTVA I DRUŠTVENI KONTEKST VUČEDOLSKIH POSUDA

Keramičke posude su alati – predmeti koji se upotrebljavaju u određenim aktivnostima kako bi ispunili određenu svrhu.
(Braun 1983: 107)

Već je u uvodnom poglavlju naglašeno da su se keramičke posude proizvodile i upotrebljavale u društvenom kontekstu, da su dio sociokulturnih interakcija i da ih jedino kao takve možemo i moramo promatrati, analizirati i interpretirati. Keramička proizvodnja ovisila je o potrebama zajednice i lončari su se prilagođavali njezinim zahtjevima ujedno poštivajući tradicijsko nasljeđe. U tom smislu proizvodnja određenog tipa posude bila je manje ili više intenzivna. S obzirom na to da je zastupljenost tipova posuda gotovo identična na oba obrađena lokaliteta (*Slika 50-53*) možemo pretpostaviti da su oba istovremena vučedolska naselja imala iste društveno-ekonomske potrebe. Komparativna analiza materijala te 14C datumi pokazuju da naselja na Ervenici i Damića gradini egzistiraju istovremeno (Miloglav 2012). U istom razdoblju vučedolsko stanovništvo živjelo je i u naseljima na Sarvašu, Vučedolu i Gomolavi, iako je većina spomenutih lokaliteta naseljena još u ranijoj (B-1) fazi (Durman 1988; Forenbaher 1994; Balen 2005a; 2010; Petrović & Jovanović 2002; Rajković & Balen 2016).

Raznolikost tipova na Damića gradini u odnosu na naselje na Ervenici može se pripisati veličini istražene površine, odnosno većem uzorku obrađene građe. Naime, ostali vučedolski lokaliteti u Vinkovcima (na Ervenici i telu Tržnica) također pokazuju sličnu zastupljenost tipova kao i na Damića gradini (Dimitrijević 1979; Krznarić Škrivanko 1999; Durman 2000; Gale 2002; Miloglav 2007).

Općenito gledajući posude po svojoj funkciji mogle su služiti za kuhanje, serviranje i konzumaciju, skladištenje te transport. Ovisno o budućoj namjeni lončari su pribjegavali različitim tehnološkim izborima kako bi dobili recepturu smjese koja je dovoljno kvalitetna za pretpostavljenu funkciju posude. Receptura lončarske smjese, kojom se regulira proces izrade posude, rezultat je znanja i iskustva lončara, niza društvenih normi te tehnoloških i tradicijskih praksi. U lancu operacija receptura lončarske smjese, tretiranje površine i oblik igraju ključnu ulogu kod definiranja uporabne komponente posude. U arheološkoj metodologiji tu je još i kontekst nalaza kojim definiramo mjesto njenog posljednjeg odlaganja.

Rice (1987: 224-226) navodi četiri međusobno povezane morfološke karakteristike koje utječu na uporabna svojstva keramičke posude (eng. *use-related properties*). To su:

a) *kapacitet* koji ovisi o obliku i veličini posude, a može se izmjeriti formulom za volumen (Rice 1987: 220-222). Ovdje treba imati na umu da posude mogu imati maksimalni kapacitet i stvarni kapacitet. Npr. posude za kuhanje nikada neće biti pune do ruba, već do polovice ili tri četvrtine ukupnog kapaciteta posude. Stoga se razlika između maksimalnog i stvarnog kapaciteta treba analizirati putem drugih pokazatelja, poput tragova trošenja (npr. karbonizacija unutrašnje stijenke).

b) *stabilnost* je svojstvo posude koje je povezano s oblikom, proporcijama i centrom gravitacije, a omogućuje posudi da stoji uspravno. Npr. posude s ravnim dnom ili nogama imaju veliku stabilnost, dok posude sa zaobljenim dnom imaju ograničenu stabilnost. To znači da takve posude trebaju dodatna „pomagala“ kako bi stajale uspravno na ravnoj površini. Tako neka etnoarheološka istraživanja donose primjere gdje se posude za kuhanje (sa zaobljenim dnom i ograničenom stabilnošću) nakon micanja s vatre stavljaju na neku vrstu tronošca, rub druge posude ili u udubljenja u ognjištima ili podu (Skibo 2013: 32).

c) *dostupnost* odnosi se na mogućnost pristupa sadržaju posude, a ovisi o oblikovanju otvora i vrata posude. Npr. posude za skladištenje tekućine ili sjemenki imaju ograničen otvor što za posljedicu ima ograničenu dostupnost sadržaju (rukom ili drugim predmetom). Takve posude namijenjene su izlijevanju sadržaja izravno iz posude. S druge strane posude za kuhanje imaju relativno širok otvor, odnosno potpunu dostupnost sadržaju što olakšava vađenje ili miješanje hrane.

d) *prenosivost* je svojstvo posude koje omogućava lakši prijenos posude s mjesta na mjesto. Većina posuda nema veliki stupanj prenosivosti jer nisu primarno namijenjene za prijenos/transport. Neke posude vrlo rijetko se premještaju (poput posuda za skladištenje), dok posude za kuhanje imaju ograničenu prenosivost koja je dovoljna da se posuda makne i stavi na vatru (Skibo 2013: 33). Oblik i veličina posude, stanjivanje stijenki, tretiranje površine (poput barbotina koji omogućava da posuda ne isklizne iz ruku) ili dodavanje ručki neke su od karakteristika na koje je lončar trebao paziti prilikom izrade posuda koje su namijenjene prijenosu/transportu.

O određivanju uporabnih svojstava posuda bilo je više riječi u Poglavlju 8 gdje je naglašeno da se pojedini tipovi posuda mogu dovesti u vezu s njenom primarnom funkcijom uspoređujući sve dosupne podatke i provedene analize: morfološke i tehnološke karakteristike, arheometrijske analize te arheološki kontekst. Na osnovi dostupnih podataka i provedenih analiza prikazanih u drugom dijelu knjige u ovom poglavlju bit će predstavljeni pokazatelji koji upućuju na uporabna svojstva pojedinih tipova vučedolskih posuda.

POSUDE ZA KUHANJE

O posudama za kuhanje zapravo je najviše bilo riječi u prvom dijelu knjige. S obzirom na funkciju ove su posude za lončara bile najveći tehnološki izazov jer je trebalo osigurati otpornost posude na termalni stres, nepropusnost i čvrstoću. Stoga je i definiranje funkcije posuda koje su služile za kuhanje vrlo složena zadaća koja ovisi o nizu čimbenika koji se mogu prepoznati obrađujući keramički materijal.

Prema analiziranim podacima može se pretpostaviti da su sve posude tipa B 1 te tip B 3f služile za kuhanje namirnica biljnog i/ili životinjskog porijekla (*Tablica 27*). Morfološka i tehnološka analiza ukazuju na određene „obrasce“ koji su prisutni na ovim posudama. Radi se o posudama blagog S-profiliranog obrisa čiji oblik omogućava ravnomjerni prijenos topline i smanjuje pucanje posude koja je izložena termalnom stresu. Sve posude ovog tipa imaju ravno dno, ručke i/ili drške za lakše podizanje ili vješanje iznad vatre te dovoljno širok otvor za dodavanje i vađenje hrane. Rub je izvučen prema van, vratni segment je uglačan ili djelomično uglačan, a tijelo je premazano barbotinom (*Tablica 13, 16*).

Otpornost na termalni stres postignuta je dodavanjem veće količine i krupnijezrnatog groga te tretiranjem vanjske strane težom teksturom (barbotin) dok je unutrašnjost djelomično uglačana. Tretiranje posude barbotinom, osim što povećava otpornost posude na termalni stres, pucanja i lomove, zbog „reljefne“ površine omogućuje i lakše prenošenje posude jer prsti lakše prianjaju u grebene koje ostavljaju nanosi tekuće gline nakon pečenja. Unutrašnja i vanjska strana posude tretirana na ovakav način osigurava posudi i nužno potrebnu nepropusnost i čvrstoću, odnosno otpornost na mehanička oštećenja poput učestalog miješanja, vađenje hrane ili čišćenja.

Tragovi čađe i oksidacijskih mrlja u pravilu su prisutni na većini ulomaka ovog tipa, a keramičke kuke (*Slika 26*) mogu biti pokazatelj da su se pojedini lonci vješali iznad vatre.

Zanimljivo je da se keramičke kuke pojavljuju u velikom broju na gotovo svim vučedolskim lokalitetima (Durman 1988: 71; Balen 2005a: T. 55, 56, 57: 215-217; Rajković & Balen 2016: T. 43: 270-278), dok su u ostalim kulturama koje joj prethode slabo ili nimalo poznate.

Ostaci lipida otkriveni na ulomku lonca tipa B 1a (*Slika 25*) pokazali su ostatke masti preživača samo na unutrašnjoj strani posude što upućuje na njen originalni sadržaj.

Posude s teksturiranom vanjskom stranom (poput barbotina) povećavaju čvrstoću i otpornost na termalni stres što su glavne karakteristike posuda za kuhanje te posebno ako su takve posude sekundarno korištene za skladištenje (Young & Stone 1990). Također, pokazalo se da posude s teksturiranom vanjskom stranom imaju duži životni vijek (Pierce 2005; Skibo 2013).

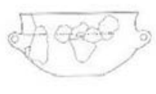
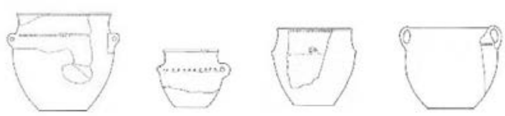
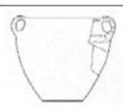
Prijenos topline koji je jako bitan čimbenik kod procesa kuhanja većinom je zanemaren u korist otpornosti posude na termalni stres (Hein et al. 2015: 49). Termini koji su vezani za proučavanje prijenosa topline kod posuda za kuhanje u stručnoj literaturi pojavljuju se kao: efekt zagrijavanja (eng. *heating effectiveness*) (Skibo et al. 1989; Schiffer 1990), brzina zagrijavanja (eng. *heating rate*) (Young & Stone 1990) ili efekt kuhanja (eng. *cooking effectiveness*) (Pierce 2005). Efekt zagrijavanja je kompleksan parametar koji ovisi o termalnoj konduktivnosti, toplinskom kapacitetu, propusnosti i obliku posude kao i o vanjskim ograničenjima (Hein et al. 2015: 50). Kada je riječ o posudama koje su se koristile za kuhanje na vatri ovaj pokazatelj jako je važan za konačnu interpretaciju uporabnih svojstava. U ovom segementu veliku ulogu ima eksperimentalna arheologija kojom se različiti oblici posuda (npr. sa zaobljenim ili ravnim dnom), različitih primjesa te različito tretirane površine (npr. barbotinom, glačanjem) testiraju raznim metodama kako bi se utvrdio efekt zagrijavanja i hlađenja sadržaja (Skibo et al. 1989; Schiffer 1990; Young & Stone 1990; Pierce 2005; Hein et al. 2008; Hein et al. 2015).

Potražnja za posudama za kuhanje bila je gotovo ista na oba vučedolska naselja (*Slika 52*), međutim njihova standardizacija nije uočena (*Tablica 25*). Razlog tome može biti u dimenzijama posude gdje se vjerojatnost greške pri izradi linearno povećava s veličinom posude (Roux 2003a). Nakon pucanja i oštećenja neke od ovih posuda nastavljale su svoj životni ciklus u sekundarnoj upotrebi o čemu svjedoče tragovi popravaka zabilježeni na pojedinim ulomcima (*Tablica 28*). Razna etnoarheološka istraživanja navode prosječan životni vijek posuda za kuhanje od nekoliko mjeseci do 1,3 godine pri čemu su velike temperature prilikom kuhanja te stalno pomicanje posuda s jednog mjesta na drugo glavni uzročnici većine nastalih lomova (Longacre 1985; Tani & Longacre 1999; Arthur 2002). S obzirom na to da više nisu mogle služiti za kuhanje u takvim posudama su se npr. mogle skladištiti suhe namirnice poput žitarica. Popravljanje polomljenih posuda koje više nisu mogle služiti primarnoj funkciji očito je bio jedan od uobičajenih načina reupotrebe posuda u vučedolskoj kulturi. Tragovi popravaka na posudama zabilježeni su gotovo u istom omjeru na oba obrađena lokaliteta. Na Damića gradini takvi ulomci zastupljeni su sa 2,71%, a na Ervenici sa 2,80%.

Iako su zastupljene u puno manjem postotku zdjele tipa A 6 prema analiziranim pokazateljima mogle su također služiti za kuhanje (*Tablica 9, 27*). Tehnologija izrade ista je kao i kod lonaca tipa B 1, a razlika je jedino u morfologiji posude. Radi se o zdjelama s jako velikim polumjerom otvora (min. 14,50; max. 20,50 cm) s ručkama na najširem dijelu posude, a izrađivane su samo u većim dimenzijama. Tragovi oksidacijskih mrlja zabilježeni su na svim ulomcima ovog tipa. Za razliku od lonaca koji su mogli i visjeti iznad vatre, ove posude stavljale su se direktno na vatru na što upućuje njihov oblik, dimenzije i položaj oksidacijskih mrlja.

Zdjele tipa A 1a iako vrlo jednostavne morfologije zapravo su vrlo specifične, a izrađuju se još od ranog neolitika. Radi se o izrazito plitkim posudama debelih stijenki (prosječne vrijednosti 12,51 mm) s promjerom otvora koji je jednak maksimalnom promjeru posude (*Tablica 4, 27*). Kao sekundarni dijelovi dršci su dio morfologije ovih posuda, a omogućavaju lakše pridržavanje i podizanje. Tragovi oksidacijskih mrlja i čađe na vanjskoj strani posude prisutni su na svim primjercima ovog tipa što upućuje na izravan kontakt s vatrom, a provedene kemijske analize pokazale su veliku koncentraciju masti preživača samo na unutrašnjoj strani posude. To nam govori da posuda nije apsorbirala organske ostatke iz okoliša već da su lipidi originalni ostaci njenog sadržaja. Gledano tehnološki, debele stijenke nisu idealan izbor kada je riječ o posudama za kuhanje jer sporije provode toplinu, međutim one omogućavaju zadržavanje stalne temperature sadržaja posude te povećavaju otpornost na mehanička oštećenja, odnosno pozitivno utječu na čvrstoću. Međutim, neka etnoarheološka istraživanja pokazala su da se debele stijenke pojavljuju kao vrlo uobičajen tehnološki izbor kada je riječ o posudama za kuhanje (Henrickson & McDonald 1983).

Kako nije uvijek jednostavno odrediti funkciju posude samo po jednom parametru potrebno je sagledati sve njene karakteristike. Tu svakako veliku ulogu igra morfologija posude koja u ovom slučaju pokazuje izrazitu jednostavnost u oblikovanju bez naglih lomova u obrisu posude, ravne ili djelomično konične stijenke što dodatno povećava otpornost posude na termalni stres. Veće posude ovog tipa s prosječnim promjerom otvora od oko 30 cm, u starijoj literaturi poznatije kao „posude za đuveč“, prema analiziranim primjercima s lokaliteta Vinča interpretirane su kao posude za pečenje kruha (Vuković 2013). Ista interpretacija potvrđena je i na etnoarheološkim primjerima (Henrickson & McDonald 1983). Vučedolske posude imaju puno manji promjer otvora i zasada nisu zabilježeni primjerci većih dimenzija pa je vjerojatno da su ove posude služile za termičku obradu hrane životinjskog porijekla.

Pretpostavljena funkcija	Tip	Oblik	Sekundarna uporaba
kuhanje	A 1a		konzumacija
	A 6a		kratkoročno skladištenje suhih namirnica
	B 1a, 1b, 1c, 1d		skladištenje suhih namirnica, transport
	B 3f		skladištenje suhih namirnica, transport

Tablica 27 – Posude za kuhanje – pretpostavljena funkcija prema morfološkim i tehnološkim karakteristikama

POSUDE ZA KONZUMACIJU I SERVIRANJE

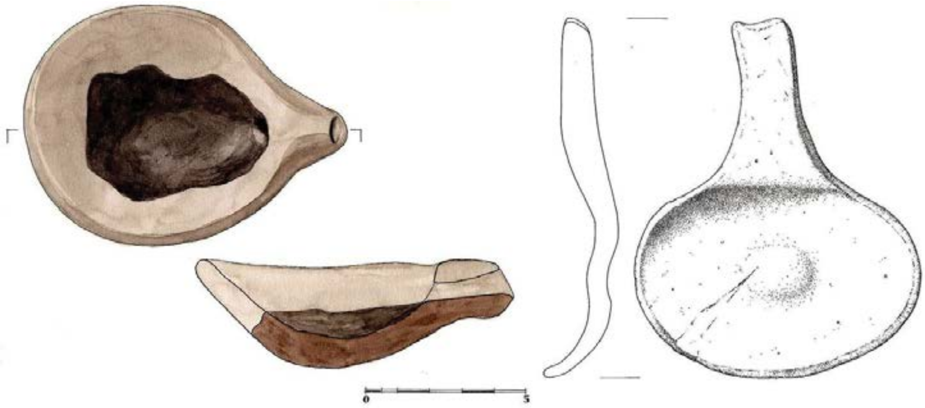
Ovoj kategoriji pripadaju posude koje su služile za svakodnevno konzumiranje i serviranje hrane ili pripravu namirnica koje ne zahtijevaju termičku obradu (npr. razne vrste kaša) (*Tablica 29*). One su mogle služiti za individualnu ili grupnu upotrebu, ovisno o dimenzijama.

Oblik koji spada u ovu kategoriju su zdjele tipa A 2 (*Tablica 5, 29*). *Omphalos* dno, koje je karakteristično za ovaj tip, vjerojatno je služio za lakše pridržavanje posude jednom rukom radi udubljenja na dnu. Takva morfologija omogućava vađenje hrane iz veće posude i konzumiranje iste u tekućem ili polutekućem stanju. Poznato je da su Vučedolci koristili keramičke žlice za miješanje hrane (*Slika 84*), kao i pripadnici kultura koje su prethodile vučedolskoj. Žlice i pribor za miješanje prilikom kuhanja izrađivani su i od drva, međutim takve predmete u arheološkom kontekstu rijetko nalazimo radi prirode materijala od kojih su načinjeni.

Tragovi pčelinjeg voska s unutrašnje i vanjske strane posuda ovog tipa, ukazuju na namjerno tretiranje površine kako bi se omogućila njezina nepropusnost. Već je u prvom dijelu knjige naglašeno da je tretiranje površine posuda smolom, voskom ili biljnim sokovima u svrhu smanjivanja poroznosti, odnosno propusnosti vrlo učestala pojava (Rice 1987: 231; Schiffer et al. 1994). Također, sve posude ovog tipa izrazito su fino uglačane s unutrašnje i vanjske strane što dodatno osigurava posudi nepropusnost i čvrtoću, odnosno otpornost na razne vrste mehaničkih oštećenja. Na propusnost posuda utječu i namirnice biljnog ili životinjskog podrijetla koje se u njima termalno obrađuju jer upravo takve masnoće začepljuju sitne pore u keramičkoj strukturi. Kod posuda koje se ne koriste za termalnu obradu namirnica biljnog ili životinjskog podrijetla nepropusnost se osigurava posebnim tretmanom površine, npr. glačanjem.

Tragovi čađe ili oksidacijskih mrlja nisu zabilježeni na ulomcima zdjela tipa A 2 što je dodatni pokazatelj da ove posude nisu služile za termičku obradu hrane. Manje posude ovog tipa također su mogle služiti i kao poklopci na posudama za skladištenje.

Kao što je već bilo rečeno u Poglavlju 17 zdjele ovog tipa ne pokazuju standardiziranost u izradi, a koeficijent varijacije dosta varira visinom i polumjerom otvora. Vjerojatno je da su se pojedini primjerci ovih posuda koristili i za neke posebne namjene u zajednici (rituali, posebna događanja i svetkovine, naručivanje od strane istaknutih pojedinaca i sl.).



Slika 84 – Keramičke žlice s lokaliteta Damića gradina
Fig. 84 – Pottery spoons from the site of Damića Gradina

O zdjelama tipa A 4a-c (*Tablica 7, 29*) bilo je više riječi u Poglavlju 17. Stupanj intenzivne i standardizirane proizvodnje ukazuje na povećanu potražnju zajednice za ovim tipom posude i veće iskustvo prilikom izrade. Učestalo i intenzivno korištenje ovih posuda u svakodnevnom životu također je značilo brže trošenje, deformaciju i lomove pa su neke od ovih posuda svoj životni vijek nastavile u sekundarnoj upotrebi. Tragovi popravaka na keramičkim posudama, koji uključuju perforacije s obje strane loma, najprisutnije su upravo na zdjelama tipa A 4a-c te na tipu A 3a (*Tablica 28*). Zdjele tipa A 3a (*Tablica 6, 29*) također pokazuju određeni stupanj standardizacije te povećanu potražnju, a prema svim karakteristikama također bi spadale u ovo kategoriju.

Ostaci pčelinjeg voska s unutrašnje i vanjske strane posuda tipa A 4a-c, izostanak tragova čađe i oksidacijskih mrlja, izrazito oštra bikonična profilacija koja nije pogodna za kuhanje na vatri radi nejednakog prijenosa topline te fino uglačana vanjska i unutrašnja stijenka karakteristike su koje ukazuju da ovaj tip posuda nije služio za termičku obradu hrane.

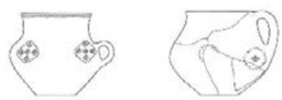
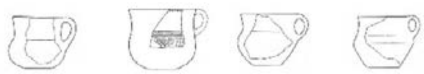
Etnoarheološka istraživanja pokazala su da su posude za konzumaciju i serviranje u većini slučajeva ukrašene, što se poklapa i s obrađenim vučedolskim materijalom. Zdjele tipa A 2 na Damića gradini ukrašene su u 58,70% slučajeva, a na Ervenici u 42,86%. Ukrašeni primjerci zdjela tipa A 4 na Damića gradini čine 70,32%, a na Ervenici je taj postotak nešto manji i iznosi 37,50%.

Tip	Br. ulomaka	%
A 1d	1	4,76%
A 2a	1	4,76%
A 2b	1	4,76%
A 3a	6	28,57%
A 4a	3	14,29%
A 4b	1	4,76%
A 4c	4	19,05%
A 6a	1	4,76%
B 1a	2	9,52%
B 1b	1	4,76%
Σ	21	100,00%

Tablica 28 – Tragovi popravaka na keramičkim posudama s lokaliteta Damića gradina

Premazivanje unutrašnje i vanjske strane posude voskom također je zabilježeno i na tipu šalice C 1a (*Tablica 17, 29*). Tragovi lipida na vanjskoj i unutrašnjoj strani posude interpretirani su kao ostaci masti preživača ili mliječnih masti. Dok se u unutrašnjosti posude nalaze ostaci koji ukazuju na originalni sadržaj posude, vrlo je moguće da su tragovi lipida s vanjske površine mogli nastati prolijevanjem sadržaja. S obzirom na to da znamo da se vučedolsko gospodarstvo temeljilo na stočarstvu, u prvom redu na uzgoju goveda (65,24%), svinje (25,00%) te ovce/koze (4,88%), te da su se mliječni proizvodi koristili u prehrani još od ranog neolitika (za pregled vidi: Salque 2012), možemo pretpostaviti da su oni bili dio prehrambenih navika i vučedolskog stanovništva. Sve posude tipa C su izrazito fino ili djelomično uglačane s vanjske i unutrašnje strane bez zabilježenih tragova koji upućuju na izlaganje vatri. S obzirom na tehno-funkcionalne karakteristike ovog tipa i njihovu morfologiju koja odgovara konzumaciji namirnica u tekućem stanju, može se reći da se ovaj tip posuda koristio za piće. Ostaci lipida na jednom primjerku sugeriraju konzumaciju mlijeka.

Masti preživača koje su kemijskim analizama utvrđene na unutrašnjoj strani cjedila tipa E 1a (*Tablica 20, 29*), kao što je već rečeno u Poglavlju 15, upućivale bi na pravljenje sira. Oba primjerka ovog tipa imaju uglačanu unutrašnju i vanjsku stijenku te izbušene rupice koje sugeriraju da se ovaj tip koristio kao cjedilo. Razne vrste cjedila poznate su od najranijih prapovijesnih kultura, pa njihova prisutnost u inventaru jednog vučedolskog domaćinstva nije neuobičajena pojava.

Pretpostavljena funkcija	Tip	Oblik	Sekundarna uporaba
Konzumacija, serviranje – priprema hrane bez termalne obrade	A 2a, 2b		Poklopci, kratkoročno skladištenje suhih namirnica
	A 3a, A 3c		kratkoročno skladištenje suhih namirnica
	A 4a, 4b, 4c		kratkoročno skladištenje suhih namirnica
	A 5a, 5b		kratkoročno skladištenje tekućih namirnica
	C 1a, 1b, C 2a, C 3a		
	E 1a, E 2a		

Tablica 29 – Posude za konzumaciju – pretpostavljena funkcija prema morfološkim i tehnološkim karakteristikama

POSUDE ZA SKLADIŠTENJE I ČUVANJE HRANE

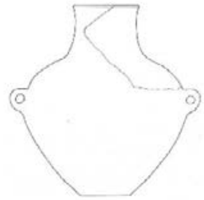
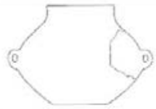
Postoje dvije vrste posuda za skladištenje, a odnose se na pohranu suhih i tekućih namirnica (*Tablica 30*). Ovisno o namjeni ovih posuda tretiranje površine nije isto, s obzirom na to da posude za pohranu tekućih namirnica moraju imati nepropusne stijenke za razliku od posuda u kojima se npr. čuvaju žitarice. Iznimka su posude za čuvanje ulja jer sam sadržaj služi za začepljivanje pora. Također, namirnice se mogu skladištiti dugoročno i kratkoročno, a oblik i veličina posude mogu biti pokazatelji njene funkcije. Posude za dugoročno skladištenje uglavnom su statične i većih su dimenzija dok su posude namijenjene za kratkoročnu pohranu namirnica podložne učestalijim pomicanjima, odnosno premještanjima (Henrickson & McDonald 1983).

Tip posuda B 3b i B 3c (*Tablica 15, 30*) zbog svoje morfologije i tehnoloških karakteristika vjerojatno je služio za skladištenje suhih namirnica. Radi se o velikim posudama s ograničenim otvorom koje ne pokazuju tragove izlaganja na vatri. Ograničen otvor sprječavao je prosipanje sadržaja, a s obzirom na to da unutrašnja strana nije posebno tretirana kako bi se smanjila propusnost vjerojatno je da su ove posude služile za skladištenje suhih namirnica. Da bi se sadržaj zaštitio od prosipanja, glodavaca i insekata posude su vjerojatno imale neku vrstu poklopca. Tragovi trošenja na rubu posude koji su mogli nastati zbog kontakta s poklopcem zabilježeni su na nekoliko ulomaka tipa B 3b. Nadalje, sve posude ovog tipa imaju ravan rub što omogućava lakše zatvaranje posude, bilo keramičkim ili drvenim poklopcem, drugom posudom, kožom ili nekom vrstom tkanine. Iako vučedolska keramografija poznaje poklopac (Durman 1988: 130; Balen 2005a: T. 58: 225; Rajković & Balen 2016: T. 43: 279) on se zapravo vrlo rijetko nalazi u uobičajenom keramičkom inventaru (T. 33). Vjerojatnije je da su u tu svrhu mogle poslužiti i manje zdjele zaobljenog dna, poput tipa A 2. Takva praksa potvrđena je i etnoarheološkim istraživanjima (Hendricksom & McDonald 1983).

U Poglavlju 14 predstavljeni su pojedini elementi društveno-gospodarskih aspekata vučedolskog društva te je na osnovi rezultata arheobotaničkih i osteoloških analiza utvrđeno da se stanovništvo bavilo stočarstvom, lovom i zemljoradnjom. U tom smislu stvaranje zaliha hrane utjecalo je i na proizvodnju spremnika za skladištenje namirnica od kojih je dio napravljen od keramike.

Za razliku od šalica koje su zbog malih dimenzija služile za konzumaciju vrčevi (tip D) su mogli služiti i za kratkoročno čuvanje tekućine (*Tablica 19, 30*). Djelomično uglačana unutrašnja strana ukazivala bi na postizanje nepropusnosti kod ovog tipa posuda. Nažalost, radi malog uzorka na posudama ovog tipa nisu zabilježeni neabrazivni tragovi koji bi upućivali na eventualnu fermentaciju sadržaja. Naime, poznato je da žitarice i mliječni proizvodi fermentiraju i na taj način mogu prouzrokovati oštećenja na vanjskoj te potpunu eroziju na unutrašnjoj površini posude (Arthur 2002: 337).

Posude tipa A 9 (*Tablica 12, 30*) zbog svojih izrazito malih dimenzija (min. 4,90; max. 8,50 cm) predstavljaju vrlo specifične primjere keramičkog inventara te su ujedno i predmet različitih tumačenja koja se odnose na njihovu funkciju. Najčešće se o njima piše kao o kultnim posudama, dječjim igračkama ili svjetiljkama (Letica 1967; Balen-Letunić 1982; Balj 2009; 2010). Posude malih dimenzija u pravilu oponašaju već postojeće veće oblike koji se nalaze u standardnom inventaru, a na osnovi tehnologije izrade može se utvrditi jesu li ih izradila djeca ili lončari s iskustvom. Dječje izrađevine u pravilu nisu vješto oblikovane, debelih su i neujednačenih stijenki i najčešće na sebi imaju tragove prstiju (Balj 2009). Ovakve posude nisu zabilježene na analiziranom materijalu jer se radi o izrazito vješto i precizno oblikovanim posudama koje se s obzirom na tehniku izrade i tretiranje površine ne razlikuju od posuda većih dimenzija. Rupice za ovjes zabilježene na tipu A 9c ukazuju na mogućnost da su ove posude visjele u kuhinjskom prostoru. S obzirom na to da se minijaturne posude kao dio keramičkog inventara pojavljuju još od neolitika ne treba isključiti i njihovu simboličku ulogu koju su imale u društvenoj organizaciji (Tomaž 2005).

Pretpostavljena funkcija	Tip	Oblik	Sekundarna uporaba
Skladištenje suhih namirnica - dugoročno	B 3b		transport
	B 3c		transport
Skladištenje suhih namirnica - kratkoročno	A 9a, 9b, 9c		konzumacija
Skladištenje tekućih namirnica - kratkoročno	D 1a, D 2a		konzumacija

Tablica 30 – Posude za skladištenje – pretpostavljena funkcija prema morfološkim i tehnološkim karakteristikama

POSUDE ZA TRANSPORT

Glavna karakteristika posuda za transport su tanke stijenke zbog kojih su lakše za nošenje i prenošenje. Ručke olakšavaju podizanje i manipulaciju posudom, a oblici ovise o sadržaju i udaljenosti (Henrickson & McDonald 1983). Dodavanje organskih tvari u smjesu od koje su takve posude izrađene osiguravalo im je otpornost na lomove i mehaničke udarce te lakšu prenosivost (Skibo et al. 1989).

Iako oblik posude definira njezinu funkciju ona ne mora nužno biti rezervirana za jedan tip upotrebe, odnosno posude su mogle biti multifunkcionalne. Tako su npr. posude za kuhanje mogle služiti za konzumaciju hrane, kratkoročno skladištenje tekućih namirnica ili kratkoročni transport. Isto tako, neki tipovi posuda za konzumaciju i serviranje mogli su služiti i za kratkoročno skladištenje suhih namirnica, dok su pojedini tipovi posuda za skladištenje mogli poslužiti i za transport. Većina etnografskih istraživanja pokazuje multifunkcionalnu upotrebu posuda kao i mjesta skladištenja (Hally 1983a: 177).

Također, određeni tip posude ne mora biti rezerviran za pripravu samo određene vrste namirnica. Provedene analize organskih ostataka pokazale su da su se određeni oblici posuda koristili za različite tehnike kuhanja. Gledano morfološki, rezultati su pokazali da posude koje zahtijevaju vrenje namirnica i vrlo visoke temperature imaju veliki i neograničeni otvor, dok su S-profilirane posude puno pogodnije za lagano kuhanje i pirjanje (Eerkens 2005).

Kod interpretacije funkcije posuda arheolozi bi trebali biti vrlo oprezni. Naime, određeni oblici posuda nerijetko se interpretiraju isključivo na osnovi subjektivnog dojma ili usporedbama sa suvremenim ili etnografskim primjerima. Neobičniji primjerci, koji oblikom ili ukrasom odskaču od uobičajenog keramičkog inventara, već tradicionalno se svrstavaju u kategoriju „kultnih posuda" bez dodatnih analiza i interpretacija.

Zanimljiv primjer su tzv. vrčevi za mlijeko (*milk jugs*) čiji je oblik tipičan za kulture srednjeg i kasnog eneolitika. Provedene analize organskih ostataka pokazale su da naziv koji sugerira uporabnu funkciju ovih posuda, a koji je izveden iz etnološko-povijesnih usporedbi, ne odgovara njihovoj namjeni. Analizom osam takvih posuda mliječni protein otkriven je samo u jednom primjerku, dok su tragovi mliječnih masti otkriveni u nekoliko ostalih posuda poput dubokih zdjela i velikih lonaca za pohranu (Craig et al. 2003). Također, badenske šalice uobičajeno se interpretiraju kao šalice za ispijanje alkohola, međutim analizom organskih ostataka na četiri takve šalice sa dva lokaliteta (Vučedol i Tomašanci-Palača) nisu potvrđeni tragovi alkohola (Miloglav & Balen 2016). To, naravno, ne znači da se vrčevi za mlijeko nisu koristili za konzumaciju ili pohranu mlijeka ili da se badenske šalice nisu koristile za konzumaciju alkohola već da sve takve oblike nije ispravno pripisivati isključivo jednoj namjeni.

Različite društvene i tehnološke prakse na primjerima tradicijskih zajednica trebale bi nas potaknuti na drugačija razmišljanja koja nisu ograničena uobičajenim podjelama na vrlo „krute" relativno-kronološke faze i podjele. Društvene razlike i njihovi uzroci vrlo su kompleksan proces koji je ovisio o nizu međusobno povezanih faktora, a koji se mogu prepoznati u keramičkoj tehnologiji i proizvodnji. Iako su razlike u stilu osjetljive na promjene koje donosi vrijeme i razni društveni utjecaji etnografska istraživanja pokazala su da promjene u stilu mogu utjecati na proizvodnju u vrlo kratkom razdoblju (Stark et al. 2000).

Interpretacija određenih funkcionalnih oblika taođer se vrlo često prepisuje iz zastarjele literature bez dodatnih analitičkih pristupa. Opasnost ovakvog pristupa nije ograničena samo na definiranje funkcionalnog oblika posude već na sve segmente arheološke interpretacije. Odgovornost svakog arheologa je u kvalitetnoj i objektivnoj znanstvenoj interpretaciji koja je lišena već unaprijed donesenog subjektivnog stava ili dojma o tome zašto?, kada? ili zbog čega? se nešto dogodilo, nastalo, promijenilo ili zašto?, kome?, i što? je značilo.

U današnje vrijeme interdisciplinarnosti trebali bismo se više fokusirati na integraciju ostalih znanstvenih disciplina koje nam pomažu da razumijemo te kvantitativno i kvalitativno interpretiramo arheološke podatke. S obzirom na to da je današnja arheologija skup velike količine podataka (proizašlih iz istraživanja, obrade materijala, znanstvene literature, komparativnih studija, različitih prirodnih i tehničkih analiza itd.) naša zadaća je sažeti sve podatke u što cjelovitiju i objektivniju interpretaciju. Također, moramo biti svjesni da podaci koje smo iznijeli i interpretirali nisu *„zapisani u kamenu"* da su podložni reinterpretaciji, kako samog autora tako i ostalih kolega, jer arheologija stalno donosi nove podatke kako na polju arheološkog istraživanja tako i kod obrade građe.

U arheološkoj interpretaciji *vjerojatnost* je izuzetno značajan termin jer svijest da analizom nisu obuhvaćeni svi dostupni podaci o nalazištu (koje je rijetko u cijelosti istraženo) ili građi koja se obrađuje (koja je samo segment materijalnih dokaza o životu ljudi na određenom području) omogućava stalno propitkivanje rezultata i metoda istraživanja te se na taj način unapređuje arheološka interpretacija.

Ono što bi arheolozi trebali i dalje činiti je postavljati pitanja, jer danas smo itekako u prilici postavljati pitanja s obzirom na različite mehanizme koji su nam dostupni za dobivanje odgovora. Na neka ćemo lakše i „bezbolnije“ znati odgovoriti, a neka će nam zadati mnogo glavobolja, pokušaja i pogreški.

Na osnovi velike količine podataka koje u sebi skriva keramička građa te koristeći interdisciplinarni pristup prilikom obrade, u ovoj knjizi ponuđene su samo neke od smjernica na koji način se mogu iščitati i interpretirati poruke koje u sebi nosi keramička posuda. Za kraj ću ponoviti rečenicu iz Poglavlja 8: *Naša zadaća kao arheologa je prepoznati razliku između onoga što znamo i onoga što možemo zamisliti o keramičkoj posudi, što vrijedi i za sve ostale predmete koji su dio materijalne kulture čovjeka u prošlosti.*

FIRST PART

1 INTRODUCTION

Pottery tends to arouse strong emotions in archaeologists: they either love it or hate it.
(Orton et al. 1993: 3)

Orton, Tyers and Vince (1993) are quite right about the archaeologists' stance on pottery sherds: you either love them or hate them – there is no middle ground. Thus, some archaeologists see pottery sherds as an unlimited source of information, and they are captivated as they study each and every fragment, while others deem those fragments to be a distracting factor during an archaeological dig and a black hole during the post-excavation processing (Orton et al. 1993: 3). The processing of pottery finds is part of regular archaeological work for most archaeologists, or at least for those who take an active part in archaeological excavations. Irrespective of their preference for a period, material or type of artefact, most archaeologists come across at least some primary processing of pottery finds when they compile their reports after the completion of an archaeological excavation. For the rest of us, whose interest goes beyond primary processing, pottery sherds provoke ardour, as we slowly discover hidden and often invisible messages contained in a pottery vessel, conscious of the unlimited possibilities of its processing and interpretation. We put together pieces of information as if piecing together a jigsaw puzzle, as though we were participating in the creation of the pottery vessels and entering the lives of the people who made them. In archaeology, those patterns of human behaviour are best visible in objects of everyday use: that is, in objects which are products of human activity and which have played active roles in the creation of meanings and traditions. Thus, it is important to keep reminding ourselves that pottery vessels – just like any other products which were part of past human activities – were produced and used in a social context, that they form a part of social and cultural interactions, and that they can only be observed, analysed and interpreted as such.

Potters have always produced ceramic vessels with their users in mind, and they have adapted to the socioeconomic requirements of their communities. The choice of raw material, tempers, techniques and shapes depends on a range of interrelated factors which together create a chain of operations in the production of the pottery. Pottery technology has not changed much since prehistory, as testified to by a number of ethnoarchaeological studies made on modern-day traditional communities. It is precisely this long technological tradition, which can be followed over thousands of years, that enables us to compare, verify and link patterns of human behaviour and elements of material culture within the framework of ethnoarchaeology and experimental archaeology. Such an approach is extremely valuable and necessary for our understanding of past archaeological processes.

Both in prehistory and today, the technology of pottery production can best be understood as a social tradition – that is, a set of technological practices historically linked through time and space, where knowledge and experience are inherited through social learning (Jordan & Zvelebil 2010a: 51). Every potter develops his personal style, his identification stamp, which is a part of his social identity, and is conditioned by traditional legacy, the socioeconomic needs of his community, or environmental factors (availability and type of raw material). If we want to identify, absorb and understand patterns of human behaviour in the past, our task is not only to describe, analyse and preserve archaeological artefacts, but also to try to explore, interpret and understand the knowledge, skills and conditions which made it possible for those artefacts to be created. With this in mind, pottery should not be seen merely as objects made of clay and used for storing/serving/cooking food, but rather as 'objects' which carry within them a whole network of social relations. People were making, using, distributing, breaking and discarding ceramic vessels within the context of their everyday lives. Archaeologists find potsherds within one of those five archaeological situations; it is our methodological task to identify them during our research, with a view to collecting as much data as possible that will help us interpret the lifecycle of a vessel within the framework of its social, economic, political or religious life. Therefore, pottery should form a frame for exploration of human behaviour in the past, and not just for determination of chronological attributions. It is our link to times past, and it represents a moment in time. That moment carries within itself answers to some questions concerning the functioning and organization of the society, and it slowly introduces us to the uncovering of the social dimension of past human behaviour.

The technology of pottery production is a process, very complex and not in the least simple, which demands that a potter, or a group of potters, perform a range of interlinked and well-thought-out activities. The first part of this book is dedicated to these activities: that is, to production phases and technological choices that potters make, thus influencing the final appearance and functional properties of ceramic vessels. If we made a survey and asked whether pottery making belonged among simple tasks or hard ones, I believe the majority of respondents would answer without giving it much thought: simple. The intention of this book is to convince the readership that the opposite is true, because making ceramic vessels is not a simple activity. I am sure that most archaeologists believe they could make a pottery vessel without any problems. However, it is one thing to turn a lump of clay into a simple shape, capable of holding our stationery, and a completely different thing to make a vessel which has to sustain mechanical damage and big changes in temperature and remain impermeable for as long as possible. J. M. Skibo (1995) was right when he stated that cooking pots were a "sophisticated technological achievement".

Pottery has been the subject of more texts than any other archaeological artefact. Technological aspects, production system, specialization of the craft, product functions, and recycling are just some of the facets that are addressed in analyses of ceramic material and approached by archaeologists using various analytical techniques, methods and theoretical frameworks. We can say that analysis of ceramic material has been one of the fastest-growing areas of archaeological and ethnoarchaeological research over the past 40 years. Many archaeological, ethnoarchaeological, archaeometric and experimental studies have focused on the function, style and origins of pottery (For an overview, see Rice 1996) and its composition and production (For an overview, see Rice 1996a). What is common to all of them is the fact that pottery is very important for the interpretation of cultural, social, economic, spatial and chronological aspects. The analysis of ceramic material is actually the best example of the interdisciplinary nature of archaeology, and in view of the large quantity of data, methods and analyses, it has been given a special name: "ceramology" (Buko 2008).

Generally speaking, ceramological research can be divided into three main fields: production, use and pottery stratification processes. For each of these there are six questions that archaeologists endeavour to answer: *when?*, *where?*, *how?*, *how much?*, *why?* and *who?*. Taken together, these questions and the corresponding answers form the framework for all ceramological studies (Buko 2008: 15). The processing of material recovered from two Vučedol sites was an attempt to provide answers to some of those questions, and the relevant results are presented in the second part of this book. Such an approach required an interdisciplinary research which involved:

1) typological processing of pottery finds on the basis of their morphological characteristics;
2) descriptive statistics compiled using the *SPSS* program (*Statistical Package for the Social Sciences*);
3) defining models of pottery production which include craft specialization, product standardization and organization of the production (with a statistical test using the coefficient of variation, a standard statistical method applied when defining product standardization);
4) a technological segment complemented by mineralogical-petrographic analysis and X-ray powder diffraction (XRD);
5) the functional component of pottery vessels being interpreted using the results of gas chromatography-mass spectrometry (GC-MS) analysis;
6) the economic segment of the Vučedol community, which includes the agricultural and economic activities and dietary habits of its population, being complemented by archaeobotanic and osteological analyses;
7) both settlements being dated in absolute terms using 14C analysis.

The book is purposely divided into two parts. The first part consists of an overview of analytical techniques and theoretical frameworks about pottery technology, and of parameters for processing pottery finds. Given that a similar review does not exist in the Croatian archaeological literature, my hope is that this book will be useful to students for their individual work on processing and analysing ceramic material, and that it will inspire them to come up with new ideas and reflections on pottery.

The English translation of the Croatian text can be found at the end of the book. It contains the same tables and graphs, only in English, since data contained therein form an integral part of the text. The illustrations are not repeated in the English version, but are presented with bilingual captions, while the text contains references to their numbers and corresponding page numbers.

The second part brings the results of analyses performed at two Vučedol sites in the area of Vinkovci: Ervenica, in Vinkovci, and Damića Gradina, in Stari Mikanovci. It is part of the doctoral thesis *Late Vučedol Culture in the Bosut Valley on the Basis of Pottery Finds*. Some segments of the thesis have been published in Croatian and international journals (Miloglav 2011; 2012a; 2012b; 2013; 2014; 2015), and presented at scientific conferences.

Given that the second part of the book is interdisciplinary, there are several colleagues I am indebted to for analyses they performed and for their interpretation. Dr Marta Mileusnić, of the Faculty of Mining, Geology and Petroleum Engineering of the University of Zagreb, and student Kristijan Bakarić, made a mineralogical-petrological analysis of pottery sherds from both sites, and XRD analysis. Dr Tajana Trbojević-Vukičević, of the Faculty of Veterinary Medicine of the University of Zagreb, analysed and interpreted animal bones from the site at Ervenica, while Dr Kelly Reed of the University of Leicester processed the archaeobotanical finds from the same site. My deep gratitude goes to the staff of the Department of Archaeology of the Vinkovci Town Museum, particularly to Maja Krznarić Škrivanko, for making available the finds and documentation on the two sites. I am especially grateful to my colleague and friend Krešimir Rončević for the beautiful plates of drawings and illustrations contained in this book, but most of all for his support and advice. I am obliged to several colleagues and friends for their technical assistance, useful suggestions, inspirational discussions about potsherds and their support during the writing of this book: Andreja Kudelić, Jasna Vuković, Prof. Tihomila Težak-Gregl, Martina Rončević and Maja Ukas. And finally, my biggest thanks go to Mato and Lovro for their patience and support.

2 ARCHAEOMETRY – ARCHAEOLOGY – ETHNOARCHAEOLOGY: INTERRELATED DISCIPLINES

Various analytical techniques, approaches and methods of processing of ceramic finds have developed intensively since the middle of the 20th century. Nowadays we can say that archaeology is positioned between archaeometry and ethnoarchaeology, where it plays the role of a strong link in the reconstruction of past human activities and behaviour. In this process, a special place within archaeology is held by experimental archaeology, used to confirm or reject results and conclusions of research, and to try to explain technological choices and changes.

POTTERY ARCHAEOMETRY

Archaeometric analysis provides data on the source and mineral composition of the raw material, paste recipe (type and proportion of clay and tempers), firing conditions (atmosphere and temperature) and other aspects of pottery production.

The development of archaeometry as a scientific discipline began in the middle of the 19th c., with scientific analysis of the material that ceramic vessels were made of (Peacock 1970). However, the name itself appeared only in 1958, with the first publication of the English journal *Archaeometry*. In the 19th c., archaeometry developed primarily at universities which dealt with analytical issues in the field of social studies and humanities, and only at the end of the 19th c. and in the early 20th c. were the first specialized scientific laboratories founded within museums and archaeological institutions (Tite 1991). The technological aspect of pottery production, whose development began in the middle of the 20th c., marked the beginning of a slow end of consideration of pottery vessels exclusively through their chronological and typological analysis and interpretation (Matson 1942).

Investigation of the material that a ceramic vessel is made of has been conducted successfully over the past 70 years or so, in an attempt to understand the knowledge and skills necessary to produce an object, and not just to protect it from degradation and put it in a chronological frame (Vandiver 2001). In view of the limited information obtained from archaeological excavation, it is necessary to cooperate with other scientific disciplines in order to get as much information as possible about the archaeological record – that is, about the conditions and way in which people lived in the past.

Modern-day archaeology is a very diverse discipline, encompassing groups whose interests focus on various periods, regions, theoretical frameworks and methodological techniques. This diversity is positive, but it can also entail problems in communication (Jones 2004). The primary focus of archaeometry has always been the physical and mechanical properties of material culture, which involve physical scientists from the fields of chemistry, physics, biology, geology etc. However, the lack of communication between an archaeologist and a scientist can lead to a loss of basic information, and often results in archaeometry existing for its own sake. The lack of communication and scientific discourse can be observed in Croatian archaeological publications, where we often see an enormous number of graphs and tables, with no additional scientific interpretation or conclusions. Rather than on description of the mechanical and physical properties of an artefact or material, we should focus on questions of how these properties featured in the social and cultural life of the people who made the artefacts, used them, exchanged them and eventually discarded them (technological choice, production organization, social relations, environmental adaptation, technological recipes etc.). To be sure, answering those questions should involve all available analytical techniques used by archaeologists. Another important factor in this communication is the 'type of archaeologist' – whether he or she is a field archaeologist, academician, or museum archaeologist – and what his/her theoretical and acquired stances are. Depending on the type of work at hand and their theoretical stances, the requirements made and questions posed by archaeologists will also differ (Tite 1991).

Several factors are important for the relationship between an archaeologist and a physical scientist to function and endure. Firstly, every physical scientist who deals with archaeometry should begin by explaining, to the archaeologist he is working with, the basic methodology of this analytical technique, its limitations, implementation and statistical errors. In the same fashion, every archaeologist should explain to the physical scientist what the archaeological methodology looks like, what its limitations are, and the context and nature of the finds, and they should know how to ask the questions they seek answers to (Maggetti 1994; 2006). This brings us to the key issue when it comes to archaeology. Very often archaeologists cannot ask a research question that they seek an answer to, or they ask it incorrectly, and it is actually unclear what it is that the archaeologists want to learn from a given analysis. If the communication starts off on the wrong foot, the whole cooperation is condemned, and the time and financial resources wasted. For this reason, some minimal previous understanding of archaeometry and archaeology is a winning combination which can improve and facilitate communication and eventually lead to a higher quality of data interpretation. With this in mind, archaeologists should learn about the basic features and possibilities of the analytical method requested and the material they are sending for analysis, and about the method's limitations in respect of any final interpretation, in order to be able to discuss, evaluate and draw scientific conclusions on the basis of the results obtained. Perhaps M. S. Tite (1991) puts it best when he says that "the archaeologist asks the appropriate questions of the scientific technique being applied and that the scientist provides the data that the archaeologist requires and thus avoids the all-too-classic situation of a technique searching for a problem."

The following problem stems directly from what has been described above, and it regards the choice of representative samples we wish to use to obtain answers to the questions raised. The method of sampling the vast amount of pottery material will determine the results of the analysis, necessitating the sampling to be systematic and appropriate for the hypothesis put. There are several types and methods of sampling, and every archaeologist should select the method (for example, random or judgment sampling) based on the type and nature of the material processed, with a view to obtaining data which will be representative. The aim of sampling is to provide answers to the research questions/hypothesis already put, and the sampling method should be attuned to the analytical problem and the nature of the analytical information. For example, if we are trying to learn whether the paste recipe is the same or different for different functional forms – that is, whether the potter made a deliberate technological choice and used specific proportions of clay and certain tempers for different functional forms (pot, bowl, cup) – then we will sample different functional forms identified during the earlier processing. We cannot expect that random sampling of ceramic fragments from a single bag will result in relevant statistical data, and eventually relevant interpretational data, if the sample is not representative. This means that the sample must have all the characteristics typical of the population of – in this case – pottery material.

The final issue is the interpretation of the data obtained, which should be systematic and comparative, which means that data resulting from any kind of analysis cannot and must not be interpreted on their own. They should be considered in a wider context, together with all other analyses performed and all other relevant data (such as the archaeological context of the deposition, material processing, archaeobotany, archaeozoology, chemical analysis etc.) In my view, somewhere along the way we have forgotten to ask *why* an object was made, rather than *how.* Our interpretation should focus on identifying social, economic and traditional elements and links, and research questions can be put from various points of view, by integrating social issues with results obtained from analyses.

Generally, investigation of any archaeological artefact, pottery vessels included, can be divided into three main fields of research. The first focuses on the origin of the raw material, and it includes identification of the location from where clay for the pottery vessels was extracted, with a view to establishing trade routes and contacts which existed between various cultural groups. Here, the analytical techniques used include mineralogical-petrological and chemical analyses such as X-Ray Diffraction (XRD), X-Ray Fluorescence (XRF), Instrumental Neutron Activation Analysis (INNA), Scanning Electron Microscope-Energy Dispersive X-Ray Spectroscopy (SEM-EDX/EDS), Fourier-Transform Infrared Spectrometry (FT-IR).

The second field of research regards technological investigation focusing on material and production technique, where analysing raw materials and admixtures (using the same analytical techniques) can throw light on production processes, technological choices and changes. The most efficient method for determination of firing atmosphere and temperature and pottery technique is thin-section microscopy, where thin sections are prepared for examination under a petrographic microscope.

The third aspect is the functional element: that is, identification of the product's utilitarian function in everyday life (Tite 1999; 2008). When it comes to the analysis of the functional element, an important role is played by gas chromatography-mass spectrometry (GC-MS) analysis, used extensively in archaeology in the last 20 years to identify the origins of plant and animal fats absorbed in a pottery vessel's wall. More will be said about this method and the results obtained from the analysed Vučedol material in the second part of the book (Chapter 15). And finally, combining archaeological data, ethnoarchaeology and experimental archaeology, we piece together the puzzle in an attempt to get a more complete picture which will help us reconstruct patterns of past human behaviour.

ETHNOARCHAEOLOGY

As a term, *ethnoarchaeology* appeared in the 1970s. The word was first used by Jesse Walter Fewkes in 1900, and since then it has seen many variations: active archaeology, ethnography for archaeology, archaeo-ethnography, archaeological ethnography, living archaeology, ethnoanalogy. (For an overview, see Arthur & Weedman 2005). In the Croatian terminological database (STRUNA), ethnoarchaeology is defined as "a scientific discipline which studies contemporary societies with the aim of understanding human behaviour as the basis of material culture in the past."

Nowadays, ethnoarchaeological studies are explained as "archaeologically-oriented ethnographic research" (Kramer 1985: 77), or as "ethnography with an archaeological bias" (Gullick 1985). The goal of ethnoarchaeological research is to enhance our understanding and forge the links between past human behaviour and elements of material culture preserved in the archaeological record.

Ceramic vessels have been produced continuously ever since the end of the Upper Palaeolithic, and they can be found in all geographical regions, thus forming a long tradition which spans space and time. Just as it did in prehistory, today pottery also plays a key role in the social, economic and spiritual life of a community. As the technology of pottery production has not changed much since prehistory, ethnographic studies are a precious source of information, especially as concerns production organization, technological choices, craft specialization, division of labour, and supply and demand – facets that are not always clear and recognizable in an archaeological context. The contemporary communities which practise traditional lifestyles provide an insight into the whole process of pottery activity, since they use the traditional technology devoid of a contemporary way of living.

The explorations which are measurable and available within the ethnoarchaeological context are especially interesting from the point of view of refuse disposal patterns and ceramics uselife. The former aspect is of particular interest to archaeologists, because it opens up some new perspectives during the interpretation of material remains within an archaeological context (DeBoer & Lathrap 1979; Hayden & Cannon 1983; Deal 1985; Arnold 1990; 1991; Deal & Hagstrum 1995; Schiffer 1996; Stanton et al. 2008). The latter aspect poses new questions about the characteristics of the ceramic material we are processing, because the uselife of pottery is linked to its primary and secondary functions and determines the characteristics of all the material (Foster 1960; David 1972; DeBoer 1974; Longacre 1985; Deal & Hagstrum 1995; Shott 1996; Tani & Longacre 1999; Sullivan 2008).

Today – as in prehistory – the technology of pottery production can be best understood as a social tradition passed down from generation to generation over space and time. Nowadays ethnoarchaeological research helps us connect patterns of behaviour and elements of material cultural heritage, and gain a better insight into archaeological processes in the past. It enables us to appreciate the bond between the vessel and the human. Perhaps it has been best defined by David and Kramer in their 2001 work: "Ethnoarchaeology is neither a theory nor a method, but a research strategy embodying a range of approaches to understanding the relationships of material culture to culture as a whole, both in the living context and as it enters the archaeological record, and to exploiting such understandings in order to inform archaeological concepts and to improve interpretation."

3 ORIGINS OF POTTERY

The word 'ceramics' is derived from the Greek word *keramos*, which means 'clay'. *Keramikos* denotes a product made of clay, while *keramike tekhne* indicates the skill of firing ceramics (Miloglav 2011; 2014). In English, the word 'pottery' is used. 'Pottery' designates all ceramic products, and it is also used with reference to the potter's skill or art. Often pottery manufacturing is not an isolated activity of a single person; rather, several people within a community can be tasked with different steps within the production process (procurement of raw material and tempers, vessel shaping, treatment and decoration, firing). Regardless of the possible participation of several people in the manufacturing of ceramics, there is usually one person who is in charge of the vessel's final appearance and characteristics – the potter.

Pottery is among the most common materials processed and analysed by archaeologists. One of the reasons could be the fact that potsherds are statistically the most numerous finds recovered from archaeological sites. There are several important factors which contribute to such a situation. Clay is certainly one of the most abundant, cheap and adaptable materials available in nature, recognized a long time ago as a useful and exploitable raw material (Rice 1987: 7). Two further factors, certainly no less important, are the short period of its use and its resistance to many mechanisms present in the archaeological context, such as oxidation and bacteriological decay (Banning 2000: 161).

Ceramics are a combination of the four main elements: earth, fire, water and air. The transformation of clay into ceramic objects was preceded by wooden, stone and bone objects, which does not mean that clay and its properties had not been known and recognized already at that time. Some of the earliest items made of clay suggest that three important principles of use of this raw material had been recognized. The first is the understanding that moist clay is plastic and can be shaped, and that it will retain its shape when dried. The second important turning point in the exploitation of clay was the discovery of fire as a thermal source that transforms clay into a hard and durable product. Adding various materials to clay to improve its quality and hardness has led to the final understanding of all the possibilities clay can offer as a material suitable for further processing and maximum usage in everyday life (Rice 1987: 8). However, it remains unclear when pottery production became important in human history and gained prevalence in the manufacturing of utilitarian objects for everyday use. It is known that communities of hunter-gatherers began manipulating clay more in the Late Pleistocene and Early Holocene (Rice 1999). Still, the production of ceramic vessels and other utilitarian objects saw a more significant development with the occurrence of neolithization, sedentary lifestyle, plant cultivation and animal domestication. Ceramics are fragile and difficult to transport, and thus they were probably less important among hunter communities which were constantly on the move. On the other hand, ceramic vessels are best suited for thermal processing of food using water, and this method of preparation of foodstuffs such as seeds and grains allowed their easier consumption (Sinopoli 1991: 1–2).

THE OLDEST POTTERY

There are many theories about the emergence of pottery – that is, the realization that clay, if exposed to fire, can produce a hard and durable object. Until recently, the traditional view was that the emergence of pottery was linked to the so-called Neolithic package, and that the first ceramic vessels were produced by sedentary populations at the time when they began cultivating plants and domesticating animals.

For a long time, our understanding of the history of technology and technological changes fell under the influence of social evolutionary notions of progress which emerged in the middle of the 19th century. The power of the idea of the Neolithic revolution had become so influential that archaeologists found it hard to distinguish between the discovery of pottery technology and the Neolithic package, or general processes associated with early agriculture (Jordan & Zvelebil 2010a: 45–47).

The current state of research and data obtained in the last several years by radiocarbon dating have shown that ceramics were used independently, for a long time, as early as the end of the Pleistocene, long before any farming activities were undertaken in the Holocene (Chi 2002; Kuzmin 2002; 2010; Bougard 2003; Keally et al. 2004; Kuzmin & Vetrov 2007; Boaretto et al. 2009; Jordan & Zvelebil 2010; Wu et al. 2012; Craig et al. 2013). The emergence of the earliest pottery vessels in China, Japan and Russia indicates that ceramics have an independent technological history, which is not associated with the beginnings of agriculture in the Neolithic, and that it was initiated by hunter-gatherer communities of the Upper Palaeolithic. After the discovery of pottery in eastern Asia, the practice was slowly incorporated into the social life of hunter-gatherer communities of various periods and in various ways, as it spread to eastern and western Siberia and eventually to eastern and northern Europe. These notions about the early history of pottery in northern Eurasia break the link between communities of hunter-gatherers and farming communities, established by European archaeologists of the 19th and 20th centuries (Jordan & Zvelebil 2010a).

The data obtained to date suggest that ceramics appeared in Japan around 13,500 BP (around 16,750-15,700 cal BP), in southern China from around 14,800-14,000 BP (18,500-17,500 cal BP) (Boaretto et al. 2009), and in Russia from around 13,300 BP (around 16,500-14,900 cal BP) (Keally et al. 2004; Kuzmin 2010). The dates recently obtained in China (Xianrendong Cave) are the oldest obtained to date in relation to the use of pottery, ranging between 20,000 and 19,000 cal BP (Wu et al. 2012). Those vessels, the earliest that we know of, were fired at low temperatures (between 400 and 500°C). Their shapes are simple, mostly with rounded bottoms, and they are decorated with lines, cord impressions with textile patterns. Most of them display traces of soot on their external surfaces, indicating that they were used over a fire (Keally et al. 2004; Boaretto et al. 2009; Jordan & Zvelebil 2010a; Wu et al. 2012). An analysis of phytoliths recovered from the cave have shown remains of wild and cultivated rice, suggesting that cultivated rice was a part of the regular diet of the period (Chi 2002: 31). Similar to what has been seen at other sites, the prevailing remains are those of various types of fish and molluscs (Chi 2002). Analyses of organic remains from the earliest vessels of the Japanese Jomon Culture (15,000-11,800 cal BP) have uncovered traces of fresh-water and sea products on the vessel walls, suggesting that the early pottery was used to prepare such food, especially seafood (Craig et al. 2013).

As far as pottery technology and pottery paste go, differences can be observed in ceramics originating from the three distant regions. The earliest pottery from Japan displays simple forms with flat or conical bottoms, organic tempers (plant fibre) and surface decoration executed by impressions and incisions (Keally et al. 2004: 349). In Russia (in the River Amur area), vessels were of similar shapes, with thick walls and a clay matrix tempered with grass, while they were decorated with vertical grooves, zig-zag lines and cord impressions (Keally et al. 2004: 349). In southern China, the vessels had rounded bottoms, they were tempered with coarse quartzite grains, and their surface was mostly hand-smoothed (Chi 2002: 32; Keally et al. 2004: 349). A very interesting temper has been discovered in a small number of sherds recovered from the Xianrendong Cave – grog, or crushed ceramics (Chi 2002: 33). This discovery pushes the limits of deliberate tempering with grog. Interestingly, the pottery of northern China – somewhat younger – was different in both shape and paste composition. Here, all the shapes can be classified as jugs, and the tempers used included quartz, sand, shells and mica, which testifies to different cultural traditions (Chi 2002).

The above demonstrates that the earliest vessels emerged in different regions, very distant from one another, and culturologically independent of one another, but in almost the same period of time. In view of the different methods of shaping, decorating and tempering, it is likely that pottery development in each of these regions progressed independently, rather than as a result of migrations or technological exchanges (Keally et al. 2004).

NEW TECHNOLOGY – THE REASONS FOR THE EMERGENCE OF POTTERY

As early as the end of the 19th century, Henry Lewis Morgan defined the emergence of pottery within the framework of social and cultural development, i.e. as a difference between barbarism and savagery. Morgan did not associate pottery with agriculture; in his mind, the invention of pottery was a separate step in the social and technological evolution of mankind, from savagery to barbarism. It was only Sir John Lubbock who, in 1865, made the connection between plant cultivation, animal domestication and the discovery of pottery, as interrelated elements which together marked the Neolithic. In western Europe, his arguments were generally accepted and, thanks to Gordon Child, they became very influential and incorporated in the definition of the 'Neolithic package'. (For an overview, see Jordan & Zvelebil 2010a: 45–48).

There are numerous theories about the origin and emergence of pottery. One of the assumptions is that pottery-making was inspired by cracks in the earth which appeared when the soil dried off after abundant rain (Goffer 2007: 239–240). Other theories can be generally summarized as the 'architectural' hypothesis and the 'culinary' hypothesis, social/symbolic elaboration and the notion of resource intensification. (For an overview, see Rice 1999; also Miloglav 2011).

The **'*architectural hypothesis*'** is based on comparisons between use of clay for the production of structural elements needed for construction, and the construction of pottery vessels. According to this theory, the first ceramic vessels were created as an imitation of architectural techniques which had been used for the construction of houses, and these included mixing of clay and straw to obtain a type of plaster, and the method used for the production of clay blocks which were also used for construction (mudbricks, or unfired bricks dried in the sun).

The proponents of the **'*culinary hypothesis*'** believe that ceramic vessels were created once people realized that clay left exposed to the sun hardened and could be used for preparing and storing food and liquids. They associate the invention of pottery vessels with clay used to line the inside of baskets, after which such containers were left in the sun to dry and become impermeable. Furthermore, it has been emphasized that clay was used for lining stoves or firing pits used to heat up stones, and this had already resulted in the realization that clay hardened when dried or heated.

The use of hot stones for heating liquids and cooking food in baskets, animal skins or wooden vessels has been registered in many archaeological and ethnological examples. This method of early food preparation could not achieve high and long-lasting temperature of the liquid used to cook food of plant or animal origin, nor could such objects be used over a long time. The technique required a large amount of fuel to heat up the stones and make it efficient for cooking. The stones were placed next to the fire source or directly in the fire, and, when hot, they were put into baskets or containers made of bark or wood, which also contained liquid and foodstuffs. Heat would be transmitted from the stones to the liquid, and the whole process would be repeated until the liquid was heated to the temperature needed for the food to be cooked (Nelson 2010).

Unlike the containers mentioned above, which were mostly made of organic material, pottery could be placed directly over a fire, and presented no difficulties in terms of maintaining high temperature in vessels containing large amounts of liquid. This is precisely the reason why some authors believe that pottery became widely used: when compared to stone-boiling in baskets or animal skins, it required less attention during food preparation. From this viewpoint, ceramic vessels represented a technological simplification which eventually made it possible for people to devote their time to other tasks and daily activities. In this respect, it has been emphasized that the link between cooking and food is less important than the link between time and energy invested in overseeing the cooking vessel (Schiffer & Skibo 1987; Eerkens 2008).

The concept of ***'resource intensification'*** corresponds to a certain degree to the ***'social/symbolic elaboration'*** of the emergence of the first ceramic vessels. It regards changes in daily activities and social organization within a community of hunter-gatherers at the end of the Pleistocene and in the early Holocene. Mobility was declining, and sedentarization was on the rise, accompanied by linear growth in the demand for food storage. This theory links the first pottery vessels to food used for some special social activities – for example, for ceremonies and offerings – and on special occasions. The symbolic function of such special-purpose objects has been analysed through their surface decorations and the various (symbolic) motifs that can be found on them. One of the theories that are often quoted in this interpretational field of the invention of pottery regards the notion of "prestigious technology", within the meaning of an economically-oriented socio-political scenario, and its originator was Brian Hayden. The emergence of the first ceramic vessels is explained as a result of the need for common feasting and/or the impressing of guests, with a view to hierarchical differences within the society, and the emphasizing of status, welfare or power. (For an overview, see Budja 2010). Hayden later suggested that the first pottery was used for the preparation of special (luxurious) meals, implying that the new technology was used for the production of prestigious products (Hayden 2010). Hayden also lists several types of meals, such as soups and stews, and ingredients such as fish oil, sea-mammal oil, animal fat, nut oil and alcohol. All these foodstuffs required a lot of effort and energy, fuel and large quantities of ingredients – especially for oil extraction – which brought him to the conclusion that such meals had been prepared for special occasions.

A question which still remains open is why people began using 'containers' made of clay, when they were using those made of other materials. Perhaps one of the answers is that pottery provided a new technology which made it possible for some new foodstuffs to be prepared in impermeable vessels. Vessels made of fired clay offered many advantages, among which are (Rice 1999: 8):

1. increased efficiency of preparing new foodstuffs, especially grains (barley, wheat), which could be boiled over a fire or roasted

2. increased capacity and durability of food storage
3. enhanced quality of food resulting from the preparation of fresh ingredients – destruction of harmful bacteria, improved digestion
4. reducing of the time necessary for overseeing food cooked in ceramic vessels, as compared with that cooked in the previously used containers made of stone, bark, animal skins or basketry
5. the ability to consume food containing toxins, which could not be consumed in the everyday diet if not thermally treated.

The invention of pottery has not been completely resolved, and it remains to be seen whether it ever will be. There could have been several reasons for it, and they must be considered bearing in mind the wide range of changes which occurred at the end of the Pleistocene and in the early Holocene. The need for a new technology was probably prompted by a number of existential, climatic and environmental factors. Ethnoarchaeological studies conducted in 862 communities have shown that pottery making is very rare in non-sedentary and very small communities (only 12%) (Arnold 1985).

As regards pottery production, hunter-gatherer communities whose lifestyle was semi-sedentary or sedentary had several advantages: they were not limited by the time needed to make a vessel (the process takes between several days and several weeks), or by weather conditions which impact the making and drying of pottery. Bearing in mind the seasonal moves of distinctly mobile communities, pottery making there depended on other activities performed in the community, which did not allow sufficient time for the production of ceramic vessels. This relates primarily to gathering fruit which ripened during the dry season, making its collection and storage a higher priority for the community (Eerkensen et al. 2002; Eerkensen 2008). Whatever the key reasons for exploitation of clay in everyday life, the understanding that clay and fire manipulation could bring about products that could be used for cooking/preparation/storage of food and liquids was especially important. The appearance of pottery represents a concentration of human experience and knowledge relating to the choice of material, technological processes and needs. It represents a compromise between the needs and characteristics of available resources, design, production technology and final usage (Rice 1999).

Although the reasons which led to the first use of pottery vessels remain unclear, I can agree with those who believe that the creation of pottery was conditioned by the utilitarian need for a water-resistant object that could be used for food storage and preparation over a fire. The technological innovation provided a new object with all the features that were missing in containers such as baskets, and those made of skin or wood. Traces left on the vessels by fire suggest that pottery was used for cooking 'from day one', and that there was no technological transition or adjustment to its use. Given their primary use for thermal preparation of food, pottery vessels were particularly suitable for preparing soups and stews, since they could maximize nutritional values and hold in the juices and taste, resulting in a better, higher-quality diet. Although cooking facilitates meat digestion, most of its nutritional values are lost during its roasting over an open fire. Slow simmering of meat, for example, in a goulash, in a water-resistant container, prevents the loss of nutrients and conserves high-calorie fats. The use of fire was important for the extraction of oil, plant juices and animal fats from ingredients, but it also made it possible for those oils and juices to seal the pores in the pot, making it impermeable (Rice 1999).

Whatever the reasons for the emergence of pottery, one thing is certain: it contributed to a higher quality of life in every aspect. At the simplest level, it improved dietary habits and activities relating to the preparation, storage and transport of food. As active objects, pottery vessels were used in religious and burial practices and for communal feasting; they demonstrated the power, status and identity of the community; and they were, and still are, a part of the continuous and uninterrupted social and cultural interaction.

4 POTTERY PASTE

CLAY

Generally speaking, ceramics consist of three main raw materials: *clay* – doughy fine-grained sediment which becomes plastic when wet; *non-plastic inclusions* – mineral and organic substances found naturally in clay or deliberately added to it to make it more workable (feldspar, calcium carbonate, sand, quartz, calcite); *water* – which is added to clay and its inclusions to make them more plastic. Other raw materials involved in pottery production include various colouring agents and the fuels used for firing (Sinopoli 1991: 9).

The most important of all the materials used for ceramic production is evidently clay. The meaning of the word *clay* differs according to the field of interest. In geology, clay denotes fine-grained minerals which formed as a result of the weathering of siliceous rocks. In chemical minerology, clay is an unconsolidated mineral that belongs to the group called clay minerals, while in soil science, the word *clay* is used to denote inorganic parts in soil, composed of very small particles. In archaeology, *clay* means a material which contains mineral particles, which when mixed with water becomes plastic, when dried off becomes solid, and when heated to a sufficient temperature acquires hardness, strength, and chemical and physical stability (Goffer 2007: 231).

Generally, clay is a complex material whose main characteristics are its very small particles (less than 0.002 mm in diameter) and a relatively high proportion of minerals (Orton et al. 1993: 114). This mineral sediment has been created by decomposition of various magmatic and silicate rocks caused by weathering and other factors (mechanical, chemical and organic decomposition). It consists of mineral particles (the so-called clay minerals) of aluminium silicates which contain water (kaolinites, montmorillonites, illites, halloysites, nontronites, allophanes etc.) and diverse other tempers such as quartz, iron hydroxide, carbonates, orthoclase and organic remains (Zlatunić 2005: 63). Clays (clay soils and clay rocks) make up 70% of all sedimentary rocks; they are classified into primary and secondary.

Primary clays are those deposits which have remained in more or less the same location as the original rocks they developed from. These clays have been made from various kinds of rock such as granite, basalt, diorite and some other volcanic rocks. For this reason, the natural composition of clay includes minerals – remains of the parent rock (Rice 1987: 31 –38). Primary clays are rather pure, uncontaminated with other materials; their structure is uniform and their particles very fine (less than 0.002 mm in diameter). In the majority of cases they are colourless or white, and a very small quantity of mineral such as quartz or iron oxides can make them yellow, brown or green. The presence of more than 20 different types of minerals in primary clay can be established by their chemical composition (kaolinite, illite, halloysite, montmorillonite, chlorite, sepiolite etc.) (Goffer 2007: 231–234).

Secondary clays (sedimentary or transported clays) have been moved from their original position by various natural processes such as erosions, waves, winds, ice etc. Such clays are much more frequent, and they are much more homogenous and fine-grained, as a result of sorting and sedimentation. In the majority of cases they contain 5–10% organic matter (Rice 1987: 31–38). Finer particles make wet secondary clays much more plastic and adaptable, making them more suitable for shaping and firing than primary clays. Another feature of secondary clays is a high proportion of non-clay particles (more than 50%), such as sand, limestone, iron oxides and organic substances, which is a result of their having been moved from their original positions. Iron oxides will make clay yellow, red, brown and sometimes green, while organic tempers will make any clay dark (Goffer 2007: 234–235). Many secondary clays become solid and hard when fired at relatively low temperatures, but they can, on the other hand, be too plastic to be shaped, and they can crack during drying and firing. Their properties can be improved by the inclusion of non-plastic tempers: materials which do not become plastic when mixed with water (Rye 1988: 31).

The choice of raw material can be conditioned by diverse factors, which will be discussed in greater detail in the following chapters. However, three main characteristics of clay are important for any potter: its formability, its plasticity, and controllability (Bronitsky 1986: 212–218). Usually these three characteristics are taken as the material's workability. Workability implies a link between clay, water and tempers, and their proportions depend on the potter's subjective estimate, acquired knowledge, experience and skill (Rye 1981: 20–21). Generally speaking, clay is less workable if more tempers have been added to it, but adding larger quantities of tempers will make ceramics more resistant to thermal stress. Clay properties, grain size and proportions of tempers are interrelated factors which influence the paste's workability.

TEMPERS

Rocks consist of minerals, and thus the natural composition of clay also includes many minerals. Another type of mineral found in clay is the secondary mineral, which has been included deliberately by the potter to improve its forming and firing properties. Various materials have been added to clay, ranging from organic substances to minerals and rocks. The choice of material was determined by geography, in that potters mostly used raw materials from their surroundings (Gibson & Woods 1997: 33).

Tempers are non-plastic materials the potter has deliberately added to the clay paste with the aim of preventing the vessel's shrinkage and cracking during its firing, increasing its resistance to thermal stress, and its hardness and strength after firing. Clay tempering is one of the oldest technological choices made in pottery production, and it can be divided into four categories:

1. ***Minerals*** - the most frequent tempers, predominantly consisting of quartz and calcite, whose properties will be discussed in the next chapter. Traditionally, sands have been used in pottery production due to their high content of quartz and feldspar (Albero 2014: 69). Experiments have shown that clay tempered with sand improves heat transfer to the vessel's contents, resulting in much better heating effectiveness of such vessels, and a shorter time needed to boil the water, than of vessels tempered with organic material (Skibo et al. 1989: 131–132).
2. ***Various metamorphic, sedimentary and eruptive rocks*** - such as granite, basalt, limestone, phyllite etc.
3. ***Organic material*** - which can make up as much as 17% of the natural composition of clay, but is mostly deliberately included in it. The amount of organic material in the paste will influence reduction firing because, due to the lack of oxygen necessary for oxidation, such material will turn into charcoal. Thus it will leave black traces in the pottery pores, resulting in a grey colour (with a small quantity of organic material) or a black colour (caused by soot, i.e. unburnt carbon) in reduction-fired ceramics. If burned at high temperatures, or-

ganic material will leave cracks which increase the vessels' porosity and permeability. The most frequent organic tempers have been grass, various plant fibres, straw, shells, chaff and dung. Shell-tempered vessels are stronger and more resistant to thermal stress (Skibo 2013: 44). A somewhat different tempering includes the addition of milk, blood and other liquid tempers, which has been evidenced in Egypt (Albero 2014: 70).

Vessels tempered with organic material have been explained primarily as a culturally conditioned phenomenon, which logically followed the transition from basketry containers, wooden vessels or animal skins; inclusion of grass in clay has been seen as a kind of link between the two technologies. The addition of dry dung to the paste used for making Early Neolithic pottery has been interpreted by some authors as a symbolic choice, rather than a technological one, marking the transition of economic activities from land cultivation to animal farming, while the inclusion of mineral temper would suggest that new lands had been occupied and cultivated (Gheorghiu 2008: 172–175). From a technological point of view, organic-tempered vessels have poorer heating effectiveness, which goes against their primary function, prompting many interpretations which have claimed that such vessels were not used for cooking over a fire, but rather for stone boiling (see Jordan & Zvelebil 2010a: 43–44; Skibo 2013: 41. However, as already mentioned in the previous chapter, traces of soot have been found on the external surfaces of some of the earliest vessels, undoubtedly pointing to their being used for cooking over a fire (Keally et al. 2004; Boaretto et al. 2009; Jordan & Zvelebil 2010; Wu et al. 2012), while analysis of organic remains has confirmed the presence of remains of the freshwater and marine foodstuffs which had been prepared in them (Craig et al. 2013). As has already been emphasized, the ability to use pottery for cooking over a fire was the main advantage of this technology over containers made of wood, animal skins or basketry (Skibo 2013: 43).

Various analyses and experiments have demonstrated that organic-tempered vessels share several techno-functional characteristics (Skibo et al. 1989):

a) they were resistant to breakage and mechanical impact if the organic temper was large-grained and sparse;

b) they were lighter than mineral-tempered vessels and, as such, more suitable for transportation;

c) experiments have shown that vessels tempered with both organic material and minerals were more resistant to thermal stress than those which were sand-tempered or untempered (Skibo et al. 1989; Schiffer et al. 1994). Furthermore, organic tempers provided higher strength, resulting from tight closure of pores (Schiffer et al. 1994);

d) they are more easily worked and shaped, because this temper is always available in the settlement and at the place of production. In addition, organic-tempered vessels dry more quickly (Skibo 2013: 41–43);

e) one of the shortcomings is their poorer heating effectiveness, so the surfaces of vessels with this type of temper have to be additionally treated (Skibo 2013: 43).

4. ***Anthropogenic tempers*** – grog (crushed ceramics) is the only temper which is manmade, rather than natural. In addition to organic material, grog is the most frequently used temper, and can be found in pottery ever since the Neolithic (Thomas 1991; Hamilton 2002; Spataro 2002; 2011; McClure et al. 2006; Arnăut & Ursu-Naniu 2008; Kreiter et al. 2009; Quin et al. 2010; Vuković 2010; Kreiter 2014). As we could see in the chapter on pottery origins, grog has been found even in the oldest pottery in China (Chi 2002). In later periods (especially in the Bronze Age), large grog particles – containing some even older particles – can often be observed in pastes (Mason & Coper 1999; Gherdán et al. 2007; Kreiter 2007; Kudelić 2015), suggesting that vessel recycling is a long tradition (*Fig. 80, p.*).

One of the reasons for its long technological record is its availability, given that such fragments of broken vessels could always be found in settlements. As a temper, grog appears in two forms: a) that which shares the same mineral properties as the 'host' vessel, and b) that which has different mineral properties (Whitbread 1986: 82). When pottery material is analysed under a polarizing microscope, sometimes it is difficult to distinguish included grog from clay pellets (Cuomo di Caprio & Vaughan 1993). They can be found in a paste, as deliberately added particles of dry clay or as natural inclusions which have formed within a depositional environment. Still, clay pellets can be identified by a high degree of roundness, a similarity of shape and their colour, which can be darker than that of the paste because of the concentration of oxides (Whitbread 1986).

Although it is made of clay, grog does not share the size of grain characteristic of clay, because its mineral properties were destroyed during its firing (Velde & Druc 1999: 83). However, its deliberate inclusion in the paste will make the vessel more resistant to thermal stress and diverse mechanical damage. Grog is also useful when the vessel is dried, because ceramic grains absorb moisture and thus contribute to an equal drying.

In general, tempering with grog is related to the vessel's functional properties, and is normally associated with cooking vessels, because of its low coefficient of thermal expansion. Nonetheless, some ethnographic studies have demonstrated that it is precisely in those vessels that the inclusion of grog is avoided. For example, the Yuma and Mohave communities of the American Southwest use grog in all vessels but those used for cooking. The Yumas temper clay with granite, and the Mohaves with sand. The Hopi community also adds sand to vessels used for cooking and storing, while they produce other types of vessels from untempered clay. In the Yucatan, limestone is added in vessels used for keeping water, and calcite in those used for cooking (Plog 1980: 85–86). On the other hand, ethnoarchaeological studies conducted on three traditional communities in Pakistan have shown that two different tempers, grog and sand, have been used in distinct parts of cooking vessels. A paste composed of 50% clay and 50% sand to facilitate forming has been used for making rims, whereas the vessels' bottoms have been made only from grog-tempered clay, because of its resistance to high temperatures (Spataro 2004: 173). Such examples reveal diverse technological traditions which use different recipes for particular vessel usage.

As a temper, grog is rarely found alone in a pottery paste; together with other tempers it can result in different qualities of paste. Its application is related to cultural traditions and changes in pottery technology which have yielded different recipes. Studies of the Hungarian Neolithic have shown that, in the Early Neolithic, potters tempered their clay only with organic material, while in the Middle Neolithic its use dropped, to be replaced by grog in the Late Neolithic (Kreiter 2014). An entirely different pottery practice has been documented during research on the Spanish Neolithic; there, grog was the predominant temper during the Early Neolithic; in the Middle Neolithic it gradually disappeared and was replaced by calcite; and in the Late Neolithic calcite was the only temper in the pottery paste (McClure et al. 2006).

Grog has more than recycling characteristics, as evidenced by some ethnographic studies. For example, in southeast Asia (Laos), potters produce grog themselves, by mixing clay and rice hulls, firing it and then deliberately crushing it into small fragments to be used in the production of vessels (Rice 1987: 412; Shippen 2005: 44). Clay balls are still fired at low temperatures in Thailand, and then crushed into small bits and used as grog (Velde & Druc 1999: 83). Ethnoarchaeological investigations in western Kenya have shown that, according to the estimates of local potters, one broken vessel can be used to produce three new ones of the same size (Dietler & Herbich 1989: 152).

Besides its functional properties and technological-traditional practices, tempering with grog is also related to a symbolic interpretation of the unbroken transformation of one vessel into another one, and inclusion of ancestral tempers into the next generation of vessels (Gamble 2007: 198). Ethnoarchaeological studies of various traditional practices testify to a symbolic use of grog, linking the person's life and death to the life of the vessel. One example comes from the Peruvian Andes, where all the vessels used by a person in life are deliberately crushed after his or her death, and some of the crushed fragments are set aside and used for the production of a new vessel (DeBoer 1974: 340). In western Africa, vessels are used to express the link between father and son. When the father dies, his son breaks away a part of the rim from the father's vessels, and incorporates it, as grog, into a new vessel (Sterner 1989 according to Kreiter 2007: 132). Grog temper has also been interpreted through a special meaning which the broken vessel, reproduced as grog in a new one, could have held for the community. On the other hand, the avoidance of grog tempering has been explained as deliberate avoidance of inclusion of old broken vessels because of the significance, or superstition, they would incorporate into the new vessel (For an overview, see Hamilton 2002). Continuity of life, reflected symbolically by the continuation of life in the same location, that is, by its social and material continuity, has been observed ever since the Neolithic in the form of deliberate burning of houses. Old houses were burned down and thus incorporated into new ones, which were built on the old foundations, thus establishing a symbolic continuity of the location in respect of a household (Whittle 1996; Stevanović 1997; Tringham 2000; Tripković 2009).

This short overview has demonstrated that the selection of temper is not guided only by its techno-functional properties, but can also be conditioned by its social, ideological, symbolic and traditional meanings, which should certainly be borne in mind.

5 PHYSICAL PROPERTIES OF POTTERY

Generally, pottery analysis is based on three main parameters: functional, technological and stylistic. Within each of them there are several variants significant for the classification of pottery forms. Many authors have dealt with the analysis and classification of ceramic objects, but Anna O. Shepard has left the biggest mark; she was the first to approach systematically the issue of pottery analysis and description (Shepard 1985). In her view, the subject of pottery analysis and description is treated from four angles: *physical properties, composition of materials, technique* and *style.* Understanding of the physical properties of ceramics is necessary if we are to analyse and process pottery material, and understand the technological choice and circumstances of the pottery production. The physical properties of pottery include its colour, hardness, strength, porosity and texture. Those properties are interrelated, and they affect the vessel's quality and lifespan.

COLOUR

Colour is the first feature that we notice on a pottery sherd. When we try to put together fragments that belong to the same vessel, colour is generally the first criterion applied for selecting such fragments. However, there are several factors that can influence the colour of a vessel. The primary factors include clay composition and firing atmosphere, temperature and duration. The secondary factors stem from the post-firing conditions, such as charcoal deposition during the vessel's exposure to fire (visible especially in the lower parts of vessels), deposition of substances from the soil after the pottery object had been discarded, wear after long use, leaching by soil waters, overexposure to high temperatures in the case of a house fire, etc. All the secondary factors should be recognized before the pottery colour is described.

Pottery colour has been regularly specified using the *Munsell Soil Color Charts*, which provide us with three interrelated visual variables. Those are: *hue*, or the position of the colour in the spectrum; *value*, or the intensity of light and dark tones, and *chroma* or *brightness*, that is, the purity of the colour (Shepard 1985: 103–113). However, it should be pointed out that colour reporting using the Munsell system is used primarily to define the colour of the geological layer, rather than of fired soil/clay. The colour can undoubtedly say a lot about the clay and firing method – that is, whether reduction or oxidation firing was applied – but the question which is always raised is whether it is necessary to describe the colour of a pottery sherd in detail, without any further analysis, and how important the colour criterion is for the classification of the pottery. Pottery colour is important only if considered together with other variables.

The firing atmosphere is typically divided into oxidizing, reducing and neutral. If the flow of air is unobstructed and there is sufficient free oxygen which bonds easily with elements present inside and on the surface of the clay objects, this is an oxidizing firing atmosphere. The colours obtained by this firing method are nuances of red. If a vessel fired by oxidation firing contains iron, it will oxidize, and the ceramic vessel will be yellowish (firing at less than 850°C). However, if fired at a higher temperature (above 850°C), more oxidized iron ions will render the pottery yellow or red. An atmosphere in which there is not enough free oxygen (which contains gases that extract oxygen from the clay) is called a reducing atmosphere, and it results in black or grey pottery. Reduction firing depends entirely on the quantity of organic substances in the clay mixture, which turn into charcoal due to the insufficient oxygen necessary for oxidation. This transformation leaves black traces within the pottery pores, and the resulting reduction-fired pottery is grey (if the quantity of organic material is small) or black (because of soot, i.e. unburnt carbon). Ceramics that contain primary clays (such as kaolin) will be white if heated at high temperature. However, the majority of ceramic wares have a specific colour which is primarily a result of the use of secondary clays that contain colouring minerals. For example, iron oxides will render pottery yellow, brown or red, and manganese oxide will make it dark or black (Goffer 2007: 242–245). As we can see, the colour of the surface of fired clay depends entirely on the firing atmosphere and iron compounds in the paste. Thus, when describing objects and their colours, we can only talk about the post-firing surface colour, and not about the clay colour (Horvat 1999: 46–55).

The pottery's surface colour cannot always be easily established, especially if the vessel has been exposed to sudden and frequent changes in temperature (during the firing, or deliberate or accidental incineration in a house fire). Such secondary factors can often be observed on prehistoric pottery, making colour reporting using the Munsell system unreliable for determining the firing atmosphere (*Fig. 1, p. 37*).

Firing atmosphere and temperature can be seen well on thin sections, based on the presence or absence of certain minerals or organic substances, which change their mineral composition and structure when exposed to specified temperatures. Organic substances burn off at temperatures of between 300 and 500°C, calcite disappears at temperatures in the range of 700 to 750°C in an oxidizing atmosphere, and at 750°C in a reducing atmosphere (Spataro 2002: 39).

The vessel's cross-section, i.e. its core, is the least exposed to changes in colour, and it can also reveal a lot about the firing environment and method. Although identifying the firing atmosphere on the basis of the cross-section colour alone is not always the ideal solution, it comes closest to specifying the firing environment, at least if pottery is the only material being processed. Mineralogical-petrological and chemical analyses can provide more reliable data, much as experimental archaeology can. The literature proposes several standards for identification of pottery cross-section colour. One of the first, later taken up by other authors, too, was proposed by O. S. Rye (1988: 116). In the second part of the book, a scale consisting of 5 changes in colour present among Vučedol pottery sherds will be presented.

HARDNESS

Pottery hardness is closely associated with firing temperature, and this variable can reveal the durability of a vessel and its capacity to withstand all mechanical changes during its use. Like the pottery's colour, its hardness also depends on a combination of several factors. Most important among them are the firing temperature, surface treatment, type of temper in the clay, and its microstructural properties. In general, clay hardness increases if firing temperature increases. Clay tempering can also influence pottery hardness, especially if it lowers the temperature necessary for the inception of fusion into a solid mass, which eventually results in a solid surface that resists deformation. On the other hand, salt temper can reduce the surface hardness if it concentrates on the surface, as a soft residue. Microstructural properties, including grain size and porosity, also influence the pottery's hardness. Fine-grained and nonporous materials will be more resistant to deformation and breakage, and they will be harder and more durable (Rice 1987: 354–355).

Mineral hardness is usually measured using the Mohs scale of hardness, established by the Austrian mineralogist back in 1922. The proposed scale of relative hardness consists of 10 minerals, in order from the softest (talc – hardness 1) to the hardest (diamond – hardness 10). Naturally, the scale is not linear in terms of absolute hardness, because the hardness of diamond is many times higher than that of talc (Rapp 2009: 19). Still, it is very important to know what this measuring is being used for and what the results are saying. Measuring hardness using the Mohs scale is done for primary identification of minerals, similar to 'fast scanning', prior to the final identification of the mineral composition of the paste, which is done by optical or chemical analyses in laboratories. Establishing hardness on the Mohs scale actually boils down to a rough estimate of the mineral hardness, which often becomes a purpose in itself (Adams 1966). Nowadays it is often used to establish whether ceramics were well fired or underfired, while archaeometric analysis provides much more precise and reliable results.

STRENGTH

Along with hardness, this variable determines closely-related properties of fired pottery. The strength of pottery refers to its capacity to withstand various types of breakage and mechanical stress. A number of conditions influence pottery strength: its texture, clay structure, porosity, method of preparation, production technique, working technique, firing temperature and duration, size of the vessel and conditions after its discarding (Shepard 1985: 130–131).

One of the most important features of the pottery's strength is its resistance to breakage and cracks during sudden and frequent changes in temperature, and its capacity to withstand blows and pressure. Since the majority of vessels were used for thermal preparation of food, the vessel's reaction to the thermal stresses it would be exposed to was one of the most fundamental features to consider when the clay and temper were chosen. The vessel's capacity to sustain constant heating and cooling can be analysed by various laboratory and experimental methods, which will establish how resistant it was to thermal shock/stress. In cooking vessels, under conditions of high temperature, the outer surface was exposed to stress more than the inner, where the wall was cooler due to the contents of the vessel. This could lead to faster cracking of the vessel, and eventually to breakage or spalling. The external surface could also break during cooling, when the vessel's inner surface was warmer than its outer. A proper choice of clay and temper, increasing the number and size of pores, and of a shape for the vessel that can successfully conduct heat, will lower the stress level and avoid possible damage.

It is worth emphasizing that the vessel's resistance to thermal stress is not a property of the material, but rather a complex parameter which depends not only on the material's physical characteristics – such as thermal-expansion coefficient, mechanical strength and resistance – but, more importantly, on the conditions of the thermal stress (Müller et al. 2014). Experiments conducted have demonstrated that limited thermal stress can be beneficial for vessels that are constantly exposed to such conditions, because the energy of crack propagation increases around temper particles (Müller et al. 2014). Furthermore, it has been shown that vessels containing larger amounts of temper are more resistant to thermal stress. The reason for this lies in the fact that, in a cooking vessel, the temperature inside the vessel will reach 100°C, while that on the external surface will be between 500 and 600°C, which causes thermal stress and results in micro-cracks. If such cracking is not prevented, the cracks will soon spread to the whole vessel and cause irreparable damage. Vessels with low or no thermal stress resistance will break with their very first exposure to a fire. Anything that prevents the appearance of micro-cracks – such as selected type and quantity of temper and surface treatment – increases thermal stress resistance (Skibo 2013: 40). For this reason, cooking vessels contain a high quantity of temper in their paste (up to as much as 40%), as confirmed by archaeometric, ethnoarchaeological and experimental investigations (Plog 1980; Bronitsky & Hamer 1986; Skibo et al. 1989; Skibo & Schiffer 1995; Tite et al. 2001; Pierce 2005; Tite 2008; Skibo 2013; Albero 2014; Müller et al. 2014). Furthermore, fine-grained clays have been shown to conduct heat more slowly, resulting in the external surface heating up faster than the interior. This would cause high thermal stress, in contrast to those clays in which large grains allow for a faster and more even heat absorption. For this reason, the texture of cooking vessels is mostly course-grained (Skibo et al. 1989; Spataro 2003; Skibo 2013).

When it comes to temper selection, it is generally considered very important to use those minerals and other admixtures that have lower or similar coefficients of thermal expansion (such as feldspar, calcite, plagioclase and mica), and grog and crushed shells. However, some of those tempers would have negative impact on the vessel's quality and cause cracks and damage. It is also believed that tempering with calcite and grog results in significant decrease in the thermal stress of vessels constantly exposed to quick heating. However, some properties of those tempers can have both positive and negative effects (Schiffer et al. 1994; Skibo & Schiffer 1995).

On the one hand, calcite tempering increases the plasticity of the wet clay, but on the other hand its presence can cause problems when pottery is fired at intermediate temperatures. When fired in an oxidizing atmosphere, at temperatures above 600–870°C, calcite turns into lime. When cooled, the lime reacts and forms calcium hydroxide, and this process is accompanied by a volume expansion, causing cracks and spalling, which in extreme cases can destroy a vessel (Müller et al. 2014).

Another type of temper often mentioned in relation to cooking vessels is grog, whose features were described in the previous chapter. Given that grog's coefficient of thermal expansion is similar to that of clay, it actually provides very little thermal stress resistance. The reason lies in the fact that a high quantity of clay minerals is not efficient in reducing fracture propagation, and it causes cracks in the particles (Albero 2014: 154). Still, adding a smaller quantity of grog temper will improve the vessel's thermal stress resistance, in comparison to vessels that contain no temper (Skibo et al. 1989; Skibo 2013). Experimental analyses have shown that tempering with 5% grog is optimal for pottery production, while the inclusion of more than 5% grog is harmful for the vessel's mechanical strength, regardless of the temperature of its firing (Vierira & Monteiro 2004).

Quartz, one of the most frequent natural clay inclusions and deliberate tempers, has high capacity for thermal expansion, making it unsuitable for use in cooking vessels. Nonetheless, if used in small quantities and very fine-grained, it can make pottery more resistant to changes in temperature. Moreover, fine quartz particles will make vessels stronger (Bronitsky & Hamer 1986). Quartz passes through its first phase at 573°C, and thus changes which occur at this temperature will cause some stress in the pottery, if this mineral is present in significant amounts, causing crack propagation in the vessel walls. However, smaller quantities of fine-grained quartz will reduce the negative effects of differential thermal expansion of the temper and the paste, thus preventing the initiation of fractures (Albero 2014: 154). Experiments have demonstrated that tempering clay with more than 10% quartz causes individual damaged zones to interact and produce extensive micro-crack networks that cover the entire vessel. During fracture, this micro-crack network encourages crack deflection, thus increasing energy dissipation and contributing to the strength of the material, or vessel (Müller et al. 2014). When the vessel is exposed to a fire, the micro-cracks will allow free space for unimpeded shrinkage.

It has been demonstrated by experiment and analysis that the potter's technological choices can increase the vessel's resistance to thermal stress, and these include the choice of: *1)* clay and temper, *2)* wall thickness, *3)* shape and size of vessel (with thermal stress sensitivity increasing linearly with the vessel's size), *4)* firing temperature and *5)* treatment of the vessel's internal and external walls (especially in vessels fired at lower temperatures). The transfer of fluids from the internal to the external surface of the vessel during cooking, and the way in which heat is transferred from the fire to the vessel's interior, can be regulated by proper surface treatment.

Polished and burnished walls in the vessel's interior will ensure water-resistance and also reduce possible cracking, because the mean temperature of the vessel's walls is lower, and thus a lower thermal gradient is transmitted to the surface, creating less stress. In vessels whose internal surface is characterized by low permeability, thermal cracking and fracture resistance can be increased by stronger texturing of the external surface (for example, by barbotine) (Schiffer et al. 1994; Skibo & Schiffer 1995).

The vessel's shape can also affect its thermal stress resistance. A uniform wall thickness and absence of sharp edges and sudden changes in the vessel's shape will reduce the vessel's exposure to thermal stress, or cracking. For this reason, cooking vessels most often have a simple forms (Rye 1988: 27; Sinopoli 1991: 14–15; Skibo & Schiffer 1995: 83; Skibo 2013: 52). Vessels with thinner walls are more resistant to thermal stress because they conduct heat faster than those with thick walls. The latter, however, have the advantage of maintaining a constant temperature of the vessels' contents, but they are heavier and less suitable for transport or constant handling.

As we have seen, there is no simple formula that can guarantee both the vessel's hardness and strength, and its resistance to thermal and mechanical stress. Some tempers are good, some are not so good, and it all depends on a number of parameters (the vessel's size, wall thickness, usage, cultural tradition). Some tempers will make the vessel plastic and prevent cracking upon drying, but on the other hand they will increase its thermal stress. Generally, as the temperature rises, the thermal stress resistance falls, so pottery fired at lower temperatures (such as cooking pots) feature higher thermal shock resistance. At the same time, lower firing temperatures will increase the vessel's permeability, so the potter needs to make another technological choice in order to improve the ceramics' properties (such as surface treatment). In all of this, the size of the grains and their quantity in the clay paste will play an important role.

Various tests of pottery strength have long been included in the analysis of ceramic vessels, and they depend on the field of interest. Given that pottery strength is a result of diverse processes taking place during the pottery's production, the analyses also go in different directions. In this area, a major role is played by experimental archaeology, which attempts to establish the importance of the influences of individual variables on the vessel's strength, such as type and quality of temper (Skibo et al. 1989; Cogswell et al. 1998), firing temperature, surface treatment, thermal shock resistance etc. (Schiffer et al. 1994; Pierce 2005; Maggetti et al. 2010; Rasmussen et al. 2012; Müller et al. 2014). When a vessel's strength is measured, one should take into consideration changes that occur in the pottery during its prolonged use, wear and exposure to high temperatures, the environment in which the vessel was discarded in the archaeological context (presence of salts, moisture, soil freezing) and the vessel's morphology (Neupert 1994).

A number of different tests have been used in archaeology to determine the strength of pottery sherds (Munz & Fett 2001: 125–136). Nowadays a relatively new method, *the ball-on-three-balls test* (B3B), is applied because of its simplicity and cost-effectiveness. The method involves putting a sherd on top of three identical steel balls, set at the same distance from the centre of the sherd and in contact with one another, and then placing a fourth ball on top of the sherd. The load on top of the sherd is increased in equal intervals until the sherd breaks. The time elapsed and the way in which the pottery sherd breaks under pressure is used to establish its strength (Neupert 1994; Danzer et al. 2007). This test has proven that grog-tempering, in comparison with sand-tempering, increases the vessel's strength by as much as 70% (Neupert 1994).

POROSITY

Porosity is one of the main properties of pottery, and can also provide useful information on the vessel's structure. Porosity depends on the sizes of pores and pottery vessel, that is, on the conditions which allow gases and liquids to pass through the vessel's porous body. Furthermore, the size of the clay particles and their distribution also affect porosity, as does the form of temper, forming technique and firing method (Velde & Druc 1999: 160).

Pores can be described using their shape, size and place of appearance, and they can also be closed or open to the vessel's external surface. The quantity of pores present in a pottery object determines its porosity. Other factors influencing porosity are the size, shape, grading and packing of particles, the specific constituents of the clay-body mix, and the treatment to which the material was subjected during manufacture (Rice 1987: 350–351). Vessels with polished surfaces and those treated with barbotine will hold liquids more easily, which means that they are impermeable. Vessels with a permeable external wall absorb moisture from the atmosphere; the moisture is retained by the external wall and it cools the vessels' contents. Such vessels are not suitable for storage or consumption of food which does not involve heat-treatment, because after a short period of time the liquids will leak from the vessels.

With a view to reducing their porosity and permeability, vessel walls are often treated with resins, waxes and plant juices (Rice 1987: 231; Schiffer et al. 1994). Chemical analyses have shown that vessels of the Vučedol Culture were also treated with beeswax, which will be discussed in the second part of the book (Chapter 15).

Many ethnoarchaeological investigations testify to the fact that a vessel's impermeability can be increased by a post-firing coating, usually applied to vessels fired at low temperatures. One such example comes from Ecuador, where potters have been coating vessels used for storing, cooking or serving food, to this day, with various organic liquids, such as resins, melted wax, and juices extracted from plant leaves (independently or in combination), with a view to reducing their porosity (Arnold 1985: 140). The Kalinga community of the Philippines (Longacre 1981: 60) coat their vessels with pine resin: they melt a piece of hardened resin on a hot vessel just removed from a fire. The process has been tested in an experiment, and the results have shown that the resin melts on the surface of a vessel removed from a fire at a temperature of 400°C. The melted resin slowly hardens on the vessel as it cools down (Schiffer et al. 1994). With the vessel's frequent use and washing, the resin loses its original function after approximately three months. Thereafter, the women of the Kalinga community stop using the vessel for cooking, because its increased permeability will not allow water to boil. Thus vessels which were originally used for cooking appear in archaeological contexts in their secondary function, when they are used primarily for foodstuff storage (Skibo 2013: 50).

The size and shape of pores, as well as their number, will strongly affect pottery strength: the higher the porosity, the weaker the vessel, which will also diminish its durability. However, sometimes pores may also help to prevent or delay vessel breakage by inhibiting the spread of incipient cracks (Sinopoli 1991: 13–14). This occurs if the pores are large, and a crack in the vessel stops at such a 'void.' This feature is reflected in the vessel's maximum resistance to thermal shocks, and the simplest way to obtain larger pores is by adding of organic temper, which burns up during firing (Rye 1988: 27). When the organic material present in the clay paste oxidizes, the space which was filled with remains of organic matter before firing is left empty, and the pottery becomes porous (Goffer 2007: 242). Furthermore, porosity affects the degree of resistance to disintegration and weathering, various mechanical and chemical changes, discolouration caused by fluids, etc. In addition, porosity increases absorption of carbon, which influences the pottery's black colour (Shepard 1985: 125–126).

TEXTURE

Texture is influenced primarily by clay temper: its quantity, shape and grain size, and by the clay's porosity. Variability of grain size depends on the nature of the tempering material and its preparation. Some materials are used in their natural condition, and others are crushed or pulverized (Shepard 1985: 117–121).

6 OPERATIONAL SEQUENCE IN THE POTTERY PRODUCTION PROCESS

We must remember that the fundamental source of every production process, which should also be the focus of our analysis, is the potters themselves; they are active agents who make the technological choices and perform the technical acts.
(Sillar & Tite 2000: 9)

TECHNOLOGY AND TECHNOLOGICAL CHOICE

The previous chapter makes it clear that the manufacture of every single vessel faces the potter with a whole range of technological choices, including the selection of raw material (clay) and tempers, tools, forming technique and firing method. Every potter, or group of potters, participating in the pottery production process in any way, influences the final appearance of the vessel. When making a ceramic vessel, they are all faced with several options, and, for certain reasons, they make conscious or unconscious choices (Sillar & Tite 2000). The task of an archaeologist is to analyse and interpret those technological choices, and investigate how they evolved, changed, and fitted into the wider social concept.

One of the best approaches is the reconstruction of the production process, examining each step in the operational sequence (*chaîne opératoire*): a series of technological operations which transforms a raw material (clay) into a usable product (vessel). This approach, applied in research on pottery technology since the 1970s, has allowed us to distance ourselves from a merely typological analysis of ceramic material, and it has opened up some new perspectives (Shepard 1985; Rice 1987; Rye 1988).

Ever since Matson's *Ceramic Ecology* approach was accepted (Matson 1965), an interest has been present in understanding pottery production and the reasons that stood behind its transformation over time (For an overview, see Tite 1999; Loney 2000). This processual thinking has attempted to establish how important the links are between certain parameters involved in pottery production and usage, and environmental features (availability and quality of raw material). In this respect, the consideration of the potter's technological choices focuses on environmental circumstances, rather than on social factors (Albero 2014: 129–130).

Today, the operational-sequence concept as applied in the research of pottery technology is unthinkable without ethnoarchaeology, archaeometric analysis and experimental archaeology, which together provide answers to the questions *why* the potter made a certain technological choice and *what* the consequences of his choice were, in terms of economics, society, and production. The research of pottery technology began with examination of the physical properties of clay, tempers, surface treatment and firing conditions, using various archaeometric analyses and emphasizing their importance (Tite 1999; 2008; Sillar & Tite 2000; Spataro 2002; Kreiter 2007; Miller 2007). In the middle of the 1980s, various experiments focused on questions as to how individual technological choices – such as the selected tempers and surface treatments – influenced final vessel properties (Bronitsky & Hamer 1986; Schiffer & Skibo 1987; Skibo et al. 1989; Schiffer et al. 1994; Schiffer 2004; Pierce 2005). Among other things, Skibo and Schiffer (Schiffer

1975; Skibo & Schiffer 2008) proposed the *behavioural chain* concept. In contrast to the operational sequence, which encompasses only the process of manufacturing a vessel (Lemonnier 1986), this concept follows the object: production activities and interactions, reuse, recycling and final discard. Although mutually related, the latter approach is particularly useful for the use-alteration analysis.

Ethnoarchaeological research has enhanced our understanding of the way in which past societies functioned, because such research provides an ideal framework for studying links between the past and the present, and it can also help us test some theoretical structures and interpretations (Kramer 1985; Gosselain 1992; Gosselain & Livingstone Smith 1995; Stark 1998; 1999; 2003; Stark et al. 2000; Roux 2003; 2011). A special contribution of ethnoarchaeology goes in the direction of defining production organization and craft specialization, helping us understand better to what extent pottery is a consequence of social interaction between potters or groups of potters (Arnold 1985; 1991; 2000; Stark 1991; Costin 2000). Such questions are rarely visible in the archaeological record, especially when it comes to the link between supply and demand, division of labour or distribution method. These issues will be discussed in more detail in the second part of the book (Chapter 17).

Pottery manufacturing, that is, the related operational sequence, can be divided into seven phases which are all interlinked and interact with the society in which the pottery is produced. A linear analysis is by no means sufficient, because each technological choice is caused by a range of social, economic, ideological and traditional factors that shape the cultural perception of what options are available (Sillar & Tite 2000) (*Fig. 2, p. 44*). Pottery technology is based on the selection and preparation of raw material, manufacturing technique, modification and vessel finishing, and surface decoration. It will depend on the type of clay and the skill, knowledge, habits and affinities of the potter (Banning 2000: 161).

PROCUREMENT AND PREPARATION OF CLAY

Procurement of raw material is the first of the technological choices a potter needs to make. It has long been established, by research on technological processes and changes, that clay was not extracted by chance, and that potters chose a specific clay deliberately and selectively, for specific reasons, and based on its properties (Costin 2000).

The clay's procurement depended on a range of factors, primarily on environmental features (geological and topographic characteristics of the landscape) and the vicinity of the available resources, on the potter's ability to recognize high-quality clay and his skill at turning it into a high-quality ceramic vessel which will serve its purpose. Other secondary factors that can influence raw-material procurement are associated with control over resources, restricted access to resources, the potter's social status, ideological and traditional beliefs, settlement organization, etc. (Arnold 2000; Costin 2000; Livingstone Smith 2000; Sillar & Tite 2000; Stark 1999; 2003).

The potter's various technological choices come together in the paste recipe, which regulates the process of pottery production. It is a result of the potter's knowledge and experience, a range of social norms and technological and traditional practices. Changes in pottery technology, which can also affect paste recipes, can be caused by social and environmental changes, method of learning frameworks and transfer of the knowledge, passed down from generation to generation, through time and space. On the other hand, many recipes have remained unchanged, as a result of social practices, experience and cultural traditions. Various steps in the pottery production are a direct consequence of the potter's technological choices.

The analysis of the clay recipe has become a standard methodology in the study of pottery material because it goes beyond the mere classification and description of ceramics and comes closer to the concept of technological choices that potters were making in their everyday lives (Albero 2014a).

The procurement of clay includes extraction and transport of clay to the location in which it will be processed, which is why clay was procured mostly from the settlement's close surroundings (Gibson & Woods 1997). Recent ethnoarchaeological studies have established that the average distance of clay exploitation (distance between the location of resource extraction and the location of vessel production) is 3-4 km. Based on extensive research into distances to sites of extraction of clays and tempers, three distinct thresholds of energy that potters use to procure their clays have been proposed. The procurement distance preferred by most communities is 1 km. The second threshold of energy used, that is, the distance the potter needs to cover, is 3 km for temper sources, and 4 km for clay sources. The longest distance lies at 7 km for both clays and tempers (Arnold 2000).

The vicinity of available and high-quality raw material makes it possible for the potter to invest the largest part of his energy in making and shaping vessels, rather than travelling to the location of raw materials. In cases in which the location was distant, potters could store their clays, because clay can be stored for between several months and as much as a year without losing the properties required for its processing. To be sure, clay must be stored in a proper way (it should be kept in a cool place, wrapped in plant fibres or some kind of textile), away from locations that are at risk of freezing. Such conditions allow the clay to remain relatively wet, even if it has not been previously prepared, and ready to be worked when the need arises (Albero 2014: 66). Ethnological studies carried out in Slavonia, in the village of Golo Brdo, near Požega, have revealed that old potters extracted clay in the autumn and spring and stored it in their cellars, while they produced their pottery in the summer. In this particular case, the raw-material location was very distant: the potters of Golo Brdo travelled no less than 18 km to procure high-quality clay (Lechner 2000: 297).

The results of ethnoarchaeological studies suggest that, at prehistoric sites, the distance a potter had to cross to procure raw material (clay) was minimal, and that clay was transported to settlements semi-wet. Some ethnoarchaeologial studies have demonstrated that, in areas in which alluvial clay deposits were present, clay was extracted in the immediate vicinity of settlements, cleaned of large gravel and organic-material inclusions on the spot, and transported to settlements shaped into balls, ready for forming (Rice 1987: 121). One such example comes from Laos, where extracted clay was left in the sun to dry, and then crushed and cleaned of diverse 'unwanted' inclusions and mixed with water (Shippen 2005).

Clay is extracted from vertical pits, where the humus layer which covers and contaminates the clay is removed first. In hilly regions, it is dug out directly from the profile, that is, from the slope of the hill. Pits can be 1-8 m deep. The preparation includes separation techniques, removal of organic and mineral substances naturally contained in the clay (> 5 mm), or tempering the clay with such materials to improve the paste properties (Albero 2014). The more clay modification is necessary to arrive at the final product, the more varied will be the methods of its preparation, and this will result in a wide range of paste recipes. The opposite is also true, of course (Roux

2011: 81). On the other hand, some clays require no modification before they can be prepared for processing (Knappett 2005: 678).

A number of ethnoarchaeological studies testify to the fact that some potters add no temper to their clay paste: for example, Kalinga potters in the Philippines (Longacre 1981: 54; Stark et al. 2000), potters in the eastern mountain ranges of Guatemala (Rice 1987: 121), and those in Japan (Velde & Druc 1999: 144). The only condition for a clay to be good is that it is plastic enough for further processing. However, in some communities in central Cameroon, the first criterion for further exploitation of clay is its colour (which can be white, green or brown), and then its plasticity. Each potter takes the clay on the basis of his own preferences and wishes, fires a test vessel made from the raw material he has collected, and only then decides if the clay is good enough for further exploitation (Gosselain 1992: 565). Some communities combine several types of clay to obtain the desired quality of paste. For example, in eastern Peru, three types of clay (white, red and black) and three tempers are mixed together for the production of jars and bowls (Rice 1987: 121), and at times only two (Velde & Druc 1999: 149). In Japan, traditional potters also combine several types of clay to obtain the desired results (Velde & Druc 1999: 144), while in Cameroon (Wallaert-Pêtre 2001: 477) and western Kenya (Dietler & Herbich 1989: 152) some communities also use two types of clay. In Guatemala, different types of clay are used for different purposes: yellow clay for making storage pots, and white clay for other kinds of vessels (Arnold 2000). A similar example has been recorded in Slavonia, where traditional potters in the village of Feričanci, near Osijek, used to extract three types of clay from three distinct sites, located 1–3 km from the settlement. The yellow clay, of the poorest quality, was used for all types of vessels but those that would be exposed to fire, and it was not tempered. The white clay was of the highest quality; it was not tempered either, because "it had its own rock in it", that is, it contained sand. The blue clay was used only for cooking vessels, and only this type of clay was tempered with sifted river sand, because the clay was 'lazy', which means that it was not 'stretchy' (Lechner 2000: 333–334). Therefore, the provenance of the clay, or procurement of the raw material, should not be taken for granted because, as shown above, the potter's choice is a function not only of the vicinity of the available high-quality resources, but rather of a range of mutually interrelated factors.

PROCUREMENT AND PREPARATION OF TEMPERS

Deliberate clay tempering with various admixtures (minerals, organic matter) aimed at improving the quality of the clay depends on the type of natural clay and the final shape and function of the prospective vessel. Diverse tempering increases porosity, reduces the vessel's shrinkage and deformations upon drying, eliminates micro-cracks and improves firing performances (Bronitsky & Hamer 1986: 90; Rice 1987: 74).

Deliberate tempering consists mostly of various types of non-plastic materials, such as sand (quartz, volcanic sand), gravel (diverse lithoclasts), organic material (leaves, crushed shells) and grog. The characteristics of the most frequently-used tempers were discussed in earlier chapters.

Once the potter has selected the clay and the material he will temper it with, he proceeds by mixing the tempered clay with water, to obtain a homogenous paste that will be plastic and workable.

SHAPING THE PREPARED PASTE INTO A SPECIFIC FORM

Before the clay was shaped into the desired form, the paste was carefully selected, to correspond to the function of the vessel-to-be. The potter was also guided by the tradition and needs of his community for a specific product (shape of the vessel). The demand for certain types of vessels depended on the time of year and the community's economic activities. It has already been said that technological choices, such as the selection of the type and quantity of tempering, can influence a number of other aspects, of both the production and the use of the vessel. For example, cooking vessels are made of heavily tempered clay, which makes their manufacturing much more demanding. Thus, the potter needs to find the best solution that will comply with all the requirements of the vessel.

Having prepared his paste, the potter begins to shape his vessel, using one of the three hand-building techniques:

a) pinching technique, suitable for shaping small vessels with oval or rounded bases. A thumb is inserted into a hand-shaped globular lump of paste, and the other hand is used to turn the paste. By turning and squeezing, the wall of the future vessel is shaped, and its height and thickness are defined (*Fig. 3, p. 48*).

b) coil-building technique, used to produce simple asymmetrical vessels with soft profiles. The coils are formed horizontally, by rolling the clay on a hard surface, or vertically, by rolling it between two hands (*Figs 4, 6, pp. 48, 49*).

c) slab-building technique, which was used to produce highly profiled vessels (Zlatunić 2005: 70-71) (*Figs 5, 7, pp. 48, 49*).

Each of these techniques leaves marks on the vessel's interior and/or exterior that allow us to identify how it was made. The complex forming process and its importance in the production of the pottery can be studied both microscopically and macroscopically, and, where possible, using a combination of the two methods. The microscopic analysis includes examination of thin sections of pottery, especially of the joints of clay slabs or coils, and identification of temper and pore orientation, which is another indicator of the forming technique (Albero 2014: 77–79).

The forming technique can also be identified on the basis of the way and place in which the vessel broke, i.e. where the fractures appeared (*Figs 6, 7, p. 49*). Although vessels usually break in the places which are most stressed, in places where pieces of clay of various degrees of plasticity were put together, fractures are particularly recognizable in vessels made using the slab-building and coil-building techniques (Albero 2014; Vuković 2014).

On some vessels, the forming technique is visible to the naked eye, while some others require more attention and analysis to identify the way in which they were made. One good example is a vessel recovered at the site in 8a Matija Gubec Street, where the coil-building technique was recognized only after a photogrammetric model had been made using the *Agisoft PhotoScan* software program. The final mesh model, which consists of 645,761 polygons, was made using the *MeshLab* program, which presented it from various angles. The picture thus obtained shows clear traces of forming, which could not be observed on the vessel under examination (*Fig. 8, p. 49*).

This phase of pottery production also includes removing imperfections before drying, or shape modifications. This step, which is often replaced by surface treatment, involves finalization of the vessel's shape and removal of imperfections on both the interior and the exterior sides (uneven walls, removal of excess clay, covering cracks, etc.). This phase of forming includes finishing the vessels when the clay is leather-hard, which means neither dry nor wet. It can be done by hand or using tools made of wood, stone (pebble) or wet cloth.

The use of the potter's wheel in vessel production is also recognizable and visible on the vessels' surface. A slowly rotating potter's wheel was used primarily for the final modelling of vessels that were hand-thrown, and whose shape was finished on a rotational device. One of the earliest records of the use of a rotational device, which could be obtained in four ways, is the coil-building technique, where the shaping was completed on a slow potter's wheel, and included thinning the walls and shaping a rim (Roux 1998: 749).

Shaping of vessels using a mould is yet another method of pottery modelling, and it can still be observed in traditional pottery-making communities. The mould can be concave or convex, depending on whether the clay is put over the mould or in it, and it can be used to shape the whole vessel or just one part (usually, the lower section). The moulds can be specially made of clay or wood, or created from pieces of broken ceramic vessels (Rice 1987: 126).

DRYING

Water must be added to the clay paste to obtain a paste that can be shaped into a vessel. The amount of water that clay can take usually varies between 15% and 50% of its weight (Albero 2014: 80). Drying is a rather sensitive process; it can cause cracking and deformation of vessels if it is not done properly. The majority of deformations that occur in pottery during its drying are caused by water. During the drying, the water which made the clay more plastic evaporates, and the clay particles come closer to one another and cause the vessel to shrink.

Different types of clay take different times to dry. Coarse-grained clays (such as kaolinites) dry much faster than those which are more plastic and fine-grained (montmorillonites). The drying time also depends on the size of the capillaries through which water reaches the surface and evaporates. Since vessels become smaller, or shrink, during their drying, deformations and cracks appear if one part of the vessel dries more quickly than another. Similarly, if pottery is dried in the sun, water will evaporate faster from the vessel's exterior than from its interior, and this will cause shrinkage of the exterior of the vessel. For this reason, pottery should be dried in a place which is not exposed to direct sunlight, at least in the initial phase of drying (Rye 1988: 21–24).

It can take between several days and several weeks for pottery to dry, depending on the clay properties, wall thickness, season and paste preparation (Albero 2014: 80).

SURFACE TREATMENT

Surface treatment is the last step before the vessel is fired, and it usually takes place at the end of the drying phase. In pottery production, this step actually includes two actions: surface treatment and decoration, where the latter is for purely ornamental purposes. Despite the popular view that the value of surface treatment is merely aesthetic, it has a strong impact on the pottery's performance and belongs among the potter's technological choices: it reduces permeability, and it increases heating effectiveness and resistance to mechanical damage (Skibo 2013: 47–51).

Experiments and analyses have shown that cooking vessels with treated external and internal surfaces feature greater resistance to thermal shock. On the other hand, textured surfaces negatively affect the heating rate in those cases in which vessels are highly permeable (Young & Stone

1990). The vessel's internal surface is usually smoothed, whereas its external surface is treated with deep textures, such as barbotine. The most frequent surface treatment is polishing, or burnishing, aimed at closing off surface pores and making the vessel less porous. This is achieved by rubbing a hard tool (most often, a pebble) over a ceramic surface when the clay is leather-hard, resulting in a high lustre of the vessel (Velde & Druc 1999: 85). Polishing causes minerals to compact and assume an orientation parallel to the vessel's wall, thus preventing crack propagation in the vessel's body. When their internal surface is treated, vessels become water-resistant, their heat effectiveness is higher, and they are more resistant to thermal shock. Therefore, it is not surprising that cooking pots were treated in this way in all geographical areas and in all periods of time (Skibo 2013: 52). As a rule, cooking vessels are fired at lower temperatures, so those whose internal surface has not been treated will be permeable, and their heat effectiveness will be lower, which is contrary to the purpose of such vessels.

Another surface treatment that was often applied to prehistoric pottery is barbotine or surface roughening technique. The barbotine technique consists of texturing the object's surface, before its firing, with semi-liquid clay or clay dissolved in water; the layer is applied by fingers dragged over the surface. Such application results in diverse high 'ridges' on the surface, depending on the thickness of the semi-liquid clay layer. The barbotine surface treatment is functional, rather than decorative, which puts a question mark over its traditional categorization into decoration techniques.

It has already been said, in the previous chapter, that texturing the external surface with barbotine increases pottery's resistance to thermal cracks and fractures, and to mechanical damage (Schiffer et al. 1994; Skibo & Schiffer 1995). This notion supports the fact that the surface of the majority of vessels of the Vučedol Culture, discussed in this book, which fall into the category of pots – vessels that were used for thermal preparation of food – was treated with barbotine. Due to their 'relief' surface, such vessels were easier to carry, because one's fingers fitted into the ridges left in the rough, uneven external surface after the firing.

Such vessels usually do not excite much 'enthusiasm' in archaeologists, because they are considered ugly, cumbersome and definitely uninteresting. However, it is precisely those vessels that reveal the potter's technological ability, or, as J. M. Skibo (1995; 2013) put it, his "technological sophistication". The production of cooking vessels, as emphasized previously, requires much more effort, knowledge, skill, time and technological awareness than of other vessels which might be more aesthetically pleasing to the eye. We could say that a special interest in cooking vessels, in those 'ugly' pottery sherds, is a key link between those archaeologists who endeavour to reconstruct pottery production through the study of other aspects besides just the traditional typological-chronological frameworks.

Pre-firing surface treatment also includes various slips. A slip is a liquid suspension of clay (and/or other materials) in water, applied in a thin layer to the whole vessel before its firing, and resulting in reduced wall permeability (Rice 1987: 149).

Various methods of decoration also belong to surface treatments executed before firing. In addition to their aesthetic function, decoration techniques can also have a practical utilitarian function, since certain kinds of decoration can modify the vessel's shape, more than its surface (Rice 1987: 144). Different techniques require clay in different conditions (soft, leather-hard, hard). The techniques applied to raw, unfired surfaces are: *incision, impression, application, modelling, incrustation* and *painting.* The incision technique can be further divided into several variants: grooving, fluting, regular incising, comb incising, furrowing, notching (deep incising) and puncturing. These techniques differ in the type and shape of tools used (round, pointed, angular), pressure exerted on the treated surface (at an acute or right angles), condition of the clay (soft, leather-hard, hard), and the potter's experience and preference (Horvat 1999: 29–30). The techniques listed below are only those applied on the material that will be discussed in the second part of the book.

Incision techniques:

Regular incising – A sharp-tipped implement is strongly pressed at an acute or right angle, so that it cuts the clay surface. The cross-section of the incised lines is shaped like a regular or asymmetrical letter 'V'. The effects obtained by incision vary significantly depending on the drying phase in which they were executed. Raised and irregular edges indicate that the surface was wet, while clean lines reveal that the incisions were made on a leather-hard surface, and very shallow, thin lines demonstrate that the surface was dry (*Fig. 9, p. 52*).

Furrowing – This is a combination of incision and impression techniques. Short lines are incised into a leather-hard ceramic surface using the blunt tip of an awl, and thereafter the awl is pulled back over the same line in short intervals. The result visible on the finished pottery is not incision marks, but lines with shallow or deep impressions, usually filled with incrustation. For this reason, this technique is often classified as an impression technique.

Grooving – A blunt-tipped implement is applied at an acute or right angle. The cross-section of incised lines has the shape of a regular or asymmetrical letter 'U'. The grooves are mostly deep and wide, although they can also be shallow and narrow.

Notching – This technique corresponds to the main criteria for an incision technique. A narrow implement is used to cut the object's surface, and then the surrounding surface is carved out, or cut out, to obtain the motif. The surface is then flattened, smoothed, or filled with incrustation. With this technique, clay is removed from the object (*Fig. 10, p. 53*).

Puncturing – Punctures are impressed into leather-hard clay using a tool with a blunt tip, which leaves various motifs on the pottery surface. The motifs differ based on the type and shape of the tool, and the angle and strength of pressure exerted on the treated surface. The most frequent motifs made using the puncturing technique are elongated, rectangular, circular and triangular shapes (*Fig. 11, p. 53*).

Impression technique:

Impressions interfere with the object's surface, by making the rest of the surface raised and relief. A tool is impressed into leather-hard clay and the negative image of the motif left in the clay is called an *imprint*. Impressions can also be made on an applied band. There is a wide choice of tools that can be used for impressions, from those easily accessible, such as fingers, nails, shells, seeds and stalks, to special instruments purposely made to produce motifs (*Fig. 12, p. 53*).

Appliqué technique:

This technique consists of semi-hard appliqués placed on leather-hard surfaces. Deformations, such as smeared clay, often appear along the appliqué's edges or around it (in the area of contact between the appliqué and the object's surface). The applied decoration can be both functional and decorative. There are several types of appliqués: various protrusions, bands, loops, rod-like projections applied to certain parts of vessels; they can be pulled out of the vessel's body, or made in a mould, and added to the vessel at a later stage (Horvat 1999: 37–38). Experiments have demonstrated that the potters who produced Bronze Age vessels of the Vinkovci Group applied conic boss-shaped appliqués directly from the mould to the vessel's wall, which left regular circular incisions (grooves around the bosses) (Kudelić 2015). Various types of appliqués on vessel walls were also functional, because they facilitated the holding and handling of the vessels.

Modelling technique:

Modelling refers to adding extra clay to a vessel already shaped, with a view to producing a three-dimensional decoration. The clay is added to a leather-hard surface and shaped with fingers or certain types of tools. The vessel's surface is modelled in parallel with the vessel's modelling. The applied decoration can be of diverse geometrical shapes, or in the form of anthropomorphic or zoomorphic figures (Rye 1988: 94; Horvat 1999: 39). The modelling technique is also used to produce various types of handles.

Incrustation technique:

This technique is never used on its own, but rather in combination with the furrowing and notching techniques, since the incrustation – which can be prepared from various materials – is inserted into a carved-out or incised surface (*Fig. 56, p. 121*). White incrustation was made of ground-up shells, limestone or animal bones, while a red colour was obtained using mixtures rich in metal oxides (for example, hematite). The archaeometric analysis of white incrustations on pottery of the Kostolac and Vučedol cultures and on Transdanubian Incrusted pottery has shown that the white colour was obtained from deer-antler powder and shells of fresh-water molluscs of the Unionidae family (*Unio sp.)* (Kos et al. 2013).

Painting technique:

Both fired and unfired pottery can be painted. Paints are made from iron-oxide compounds which oxidize during firing and result in various colours. For example, hematite will be red, manganese compounds brown, or, in combination with graphite, black (Horvat 1999: 41–42).

FIRING

Firing is the final step in pottery production, and the pottery's characteristics greatly depend on it. Given that this phase is irreversible, for a potter, this is the most important step in the production process. During firing, the material is subject to various physico-chemical changes which affect the vessel's properties and its final appearance. The two main factors which determine the final microstructural properties of a vessel are the paste and the firing method (Albero 2014: 87).

The purpose of firing is to subject the pottery to a sufficiently high temperature for a sufficiently long period of time to ensure complete destruction of minerals contained in the clay. High temperatures will enhance the pottery's hardness, colour and quality. The minimum temperature varies for different minerals, ranging between 500°C and 800°C. When heated to temperatures higher than this, clay acquires the properties of ceramics: hardness, porosity and resistance to various chemical and physical changes (Rye 1988: 96).

The changes that occur during firing depend on:

- *time* – the duration of the heat exposure necessary for chemical reactions;

- *temperature* – chemical reactions occur at a specific temperature, and if the temperature is above the optimal value, it can cause deformations and cracks in the pottery;

- *atmosphere* (during heating and cooling) – this depends on the quantity of air available during firing, which is necessary for a certain quantity of fuel to burn (Horvat 1999: 46).

When exposed to certain temperatures, various clays and clay minerals behave differently, depending on their chemical composition, and on the atmosphere, time and method of firing. Despite the differences, several common characteristics can be identified regarding changes and reactions occurring within the pottery's structure when subjected to heat:

- heating to 200°C – In the initial phase of firing, when pottery is heated from room temperature to 200°C, water evaporates from the paste in the form of water vapour. In general, vessels do not shrink in this phase.

- heating from 200 to 400°C – At these temperatures, organic matter present in the paste oxidizes. In combination with oxygen, the carbon contained in organic substances forms carbon dioxide, which is released into the atmosphere. As a result of oxidation, the space which was filled with organic matter before the firing is now empty, and the pottery is porous.

- heating from 450 to 600°C – This is the dehydration phase, during which water evaporates from the clay. At temperatures between 500 and 600°C, many materials included either naturally or secondarily in the clay disappear in the form of gases: carbon, salts, carbonates, sulphides. This causes shrinkage during the gradual drying, in which the vessel can lose more than 15% of its original pre-firing mass.

- heating from 430 to 850°C – In this phase, clay minerals are thermally broken down and synthetized, in that clay particles at temperatures this high begin to change, melt and combine among themselves. At temperatures above 900°C, clay minerals lose their structure completely and form new silicate minerals. The temperature must be above the threshold which will allow the sintering process to begin, and enough time should elapse for the process to be completed. The final result of sintering will be a harder, denser and less permeable wall. All products made of clay which were fired at such temperatures can be considered ceramic products. When analysing the approximate temperature of firing of 'archaeological' pottery, information about some minerals which can be found in clay either as primary or secondary inclusions can be helpful, since those minerals change their form at precisely specified temperatures: quartz (passes through three structural modifications: at 573°C, 867°C and 1250°C); calcite (740–800°C); kaolin (585°C); halosite (558°C); montmorillonite (678°C).

- heating from 750 to 850°C – Most of the organic material present in the clay will burn off in this phase. At temperatures above 700°C, most clays can be described as fired, and for many types of vessel the firing process ends at this stage.

- 950°C – At temperatures above 900-950°C, the process of melting, or vitrification, begins. It only occurs at such high temperatures, when silicate minerals and oxygen are so hot that they begin to melt into a liquid mixture, thus creating a glassy structure. Following vitrification, the fired clay is less porous and more compact, and is extremely strong after cooling. The process rarely begins at temperatures below 900°C, and it therefore cannot be identified on prehistoric pottery. At temperatures up to 900°C all the carbon will burn up, except for graphite, which can withstand heating to 1200°C.

- heating from 1050 to 1200°C – At these temperatures, feldspar begins to melt. Pores in the pottery walls are closed, and porosity is rapidly reduced.

- the firing process is terminated when no more new fuel is added, or when the remaining fuel burns away (Rice 1987: 102–104; Sinopoli 1991: 27–33; Horvat 1999: 50–52; Goffer 2007: 241–243).

Cooling is a very important step in the pottery production process, because it can cause cracking and change of colour. In the case of open firing, vessels can be cooled in two ways: gradually, which means that they are left on the fire until it is completely extinguished; and in the air, where they are taken out of the fire and left in the air, but in the immediate vicinity of the firing pit or fireplace. The latter process will cause changes in colour caused by contact with the air, resulting in red and/or brown patches on the vessel's surface.

Pottery-firing technology can be divided into two categories:

1. Open firing, without structure (in an open fireplace or in a pit), together with the fuel (*Figs 13, 14, p. 56*). This technique requires a lot of skill to be efficient. The maximum temperature that can be achieved by this firing method is up to 900°C (and it is usually between 500 and 900°C). Thus, the quality of pottery which contains shell or calcite temper, for example, will deteriorate at temperatures above 800°C. Once the firing is under way, it is impossible to control the atmosphere, the maximum temperature is reached very quickly, in less than half an hour, but the temperature peak is short-lasting (Tite 2008: 219; Albero 2014: 105–107).

The positions in which fuel and vessels are set before firing can influence the passage of air, but it is very difficult to maintain a real oxidizing atmosphere throughout the firing process. Due to the unbalanced and uncontrolled atmosphere, the pottery is poorly fired and more charred. While the fuel burns, the vessels are exposed to the air. Abrupt cooling can cause cracks in the rims of wide-mouthed pots, which is why they are often fired upside-down. When inverted, their rims heat up more slowly, and they are also insulated by ashes and embers during cooling. Firing in a pit is especially suitable for producing black pottery because of the lack of air, while oxidation can be achieved by exposing the vessel to the air while its temperature is still high (Rye 1988: 98). Under such conditions, pottery rich in organic material can achieve a reducing atmosphere within its walls (Albero 2014: 107).

From a practical point of view, open firing has certain advantages. Kilns are static, always in the same place, whereas open firing can be performed in different places, depending on the weather and spatial circumstances. In contrast to kiln firing, which belongs among spatially limited activities, open firing is a spatially flexible activity which enables potters to move the firing location, and they are often constrained to do so to improve firing conditions (Arnold III 1990). Such moves are prompted by constant and rapid changes in the direction of the wind, which causes uneven firing temperature, resulting in the cracking of vessels (Rye 1981; Rice 1987). The firing location cannot be changed only if the space available in the settlement is limited and the demand for products higher, which will also impact the organization of the production. For this reason, the selection of the location for open firing, and its spatial flexibility, depend on spatial and weather-related features, and only to a lesser extent on technological aspects (Arnold III 1990: 928).

2. Closed firing (or kiln firing), where the pottery is separated from the fuel. The advantages of kiln firing are: the ability to achieve temperatures in the range between 1000 and 1300°C, a controlled atmosphere and controlled duration of the temperature rise. The maximum temperature is reached within an hour, sometimes longer. However, that temperature can be maintained over a longer period, up to half an hour (Tite 2008: 219–220). The first kilns came into existence when protective structures and vaulting were raised above fireplaces. These made it possible to maintain the temperature and isolate the firing place from cold air. Later, the fireplace was separated off from the firing chamber, and when chimneys, exhaust ducts and partitioning grids were added, the draining of smoke from the firing chamber was improved, resulting in a full oxidizing or reducing atmosphere (Horvat 1999: 47–50).

Various archaeometric analyses enable us to establish the firing method and temperature, on the basis of structural changes which occurred in minerals at specific temperatures, and decomposition of other natural or deliberately added tempering (carbonates, clay minerals, organic substances etc.). In this field, the contribution of experimental archaeology has been significant.

POST-FIRING TREATMENT

The last phase in the pottery production involves the painting of vessels, using natural materials from the surrounding area, such as minerals resulting from the decomposition of iron oxides (hematite, magnetite). Diverse coatings should also be mentioned here, such as wax, resins and plant juices, which were applied to vessels to make them less permeable, as mentioned in the previous chapter.

An interesting example has been recorded in Slavonia, in the village of Novo Selo, near Požega, where potters fired *pokljuke*[1] and, immersed them, while they were still hot, in a liquid mixture of hot water, soot and wheat flour. Once taken out, they were additionally coated using a cloth dipped in soot, to obtain a high gloss and to cover places of unequal colour on the vessels. This procedure was called *farbanje (colouring)*, but also *kalaisanje (tempering)*, and since tempered vessels are considered stronger (Lechner 2000: 316–317), this procedure was probably traditionally associated with quality enhancement, and not only with the glossy-surface effect.

As we can see, various technological choices depend on the purpose or function of the vessel, and not only on its mechanical and thermal properties, and they are determined by whether the prospective vessels will be used for storing, cooking, serving or transporting. Different criteria will determine the pot's size and shape, its wall thickness, and the quantity and type of tempering.

Finally, it is worth emphasizing that, in the entire *chaîne opératoire*, the major role is played by the potter, whose technological choices shape the final vessel. His knowledge, experience and understanding of what is technologically achievable and socially acceptable profile his technology, depending on his social context and the geographical features of his environment (Sillar & Tite 2000; Tite 2008). In addition, there is a difference between individual choice and social choice (Sillar & Tite 2000: 9–10). The individual choice of each potter depends on his social background, perception, acquired knowledge and skills. However, even innovation requires an understanding and knowledge of previous technological processes, and it will also depend on the potter's skill to implement in practice what he has learned.

There have always been, and there always will be, potters who are better and those who are not, and their skill in pottery manufacturing will depend as much on the potter as on the vessel.

[1] Pokljuke are earthen lids (so-called 'bells'), which were used for baking bread and meat in the fireplace. Other names in Croatian are peka, pekva, cripnja, crepulja, sač (Lechner 2000: 304).

For some vessels, it will be necessary to invest more knowledge, skill and energy than for others (depending on how complex they are), and the so-called technological signature, or the technological understanding of each single potter, will leave its mark in the vessel's record.

Surely, it would be difficult to imagine a potter spending his days measuring, experimenting and 'compiling notes' on certain types of clay, proportions of tempering and sizes of grain, until he obtains an ideal paste. Still, there is no doubt that bad experiences with certain clays and tempers did occur and that potters made their technological choices with the goal of developing a recipe whose quality would be sufficient for a specific type of vessel and the function it should serve. As archaeological and ethnoarchaeological examples demonstrate, technological choices depended on a number of interrelated factors: the production's environmental, economic, social, political, ideological and traditional contexts.

7 PARAMETERS FOR THE PROCESSING AND TYPOLOGICAL CLASSIFICATION OF POTTERY FINDS

The archaeological literature proposes several approaches to excavated pottery, depending on the nature of the site or on a focus on a specific method which would satisfy set parameters. It is very important to start by selecting data that are relevant for our study and will provide answers to specific questions, and to select variables which will make it possible. These include the size, texture, shape, hardness, shaping method, surface treatment, firing method, decorative elements, use, depositional context etc. The next step in pottery processing is the choice of the most suitable method of analysing a particular variable. (For example, we can observe and analyse shape from the perspective of its morphological or functional properties). Bearing in mind that the parameters listed above are interrelated, it is important to know what we want to learn from specific pottery material and what the questions are that we seek answers to (Knappett 2005: 673–674).

Clearly, the information and documentation available about a site will, in most cases, determine the method to be applied and the parameters that will be set. The final result will provide relevant information which will enable us to arrive at an answer to the question posed at the beginning of the study. Various approaches to pottery study still lag behind those that focus on analysing vessels' shapes. Together with other pertinent information, discussed in previous chapters, this approach aims to establish sequences which allow us to sort the collected data. There are several approaches to pottery typology, but in all cases a number of aspects must be taken into consideration. Some of these will be presented in the following chapters.

WHY TYPOLOGY?

This tool is designed for the reconstruction of culture history in time and space. This is the beginning and not the end of the archaeologist's responsibility.

(Ford & Steward 1954: 52)

The above heading is a question typically asked of me by students in my lectures year after year. The question is a reflection of flawed understanding of typology, resulting from the traditional perception of pottery processing, whereby typology is used only to establish chrono-cultural sequences. Seeing typology as an obsolete method leads to a loss of critical thinking and understanding of objects which are part of the material culture. Two dimensions are central to typologies – time and change. Given that typologies are essentially about changes, they are therefore about time, too (Sørensen 2015: 90). In the present era of various analyses that are available to us, typology is no longer merely an instrument used to put pottery finds in relative chronological order; it is much more than a time indicator. At this moment, there are probably thousands of practical typologies used by archaeologists every day, because each find must be placed in a matrix of space and time before those data can be used for a different purpose (Adams & Adams 1991: 9).

Typology is an archaeological instrument which has no expiry date: it has been done, it is being done, and it will be done for a very simple reason, because it is one of the basic tools we use to create and order and direct archaeological data (Sørensen 1997: 179). However, if the typology is random, and if it is not connected to the object itself (its production, meaning etc.), then the order being introduced is void of almost all meaning (Sørensen 2015: 91).

For this reason, typology is the first step in the processing of pottery material, and what makes it different from the typologies done several decades ago is that now this step is by no means the last one – actually, it is the beginning!

Archaeologists will always need typology to collect all the data on pottery sherds and divide them into the categories they have created. In doing so, their goal is to process the data that will help them read all those pieces of information hidden in a pottery vessel. In order to process such information, first we need to summarize it, place it within a set framework in line with the parameters we have created and clearly defined. Such a data system, which is both intuitive and rational, is what makes a typology.

Within this context, the focus of interpretation is not only describing pottery sherds, or placing artefacts in relative chronological order, but providing answers concerning the social lives of the people who produced those artefacts, their position within the community, production organization, product distribution, technological choices and adaptation to the environment, traditional elements, religiosity of the community, etc. Questions can be asked from various perspectives, depending on the affinities of the person devising the typology. Thus, the first step in the development of any typology must be defining its purpose, which means asking the questions we want answered.

In practice, in the initial phase, typology is always intuitive, and affected by our reading and acquisition of literature on the pottery of a particular period, and by our first encounter with the pottery being processed. Gradually, our concepts change either consciously or unconsciously, as we begin to differentiate between various types of pottery material and place them in frameworks we have created. As we become more experienced with the processing of pottery material, our concepts will also change, and this will yield continual feedback between the pottery artefacts and our ideas about them. This process will not stop as long as there is new pottery material that needs to be processed (Adams & Adams 1991: 19).

For this reason, approaches to typological classification of pottery are always diverse – and they should be diverse – primarily as a result of scientists' different preferences, different types and physical properties of the material, different methodologies and other technical and documentation conditions. Our perceptive abilities, our interests, our social, economic and cultural backgrounds all affect the questions we ask and the answers we receive, and thus two archaeologists will never produce identical interpretations of any archaeological phenomenon. Instead, each archaeologist's interpretation simply becomes a 'target' for other archaeologists to re-evaluate or discard (Banning 2000: 8).

For archaeologists, data-publishing is still a problem, which is reflected in publications that list all the collected data, resulting in countless pages of very little interpretative value. This brings us to the issue of typology and its purpose. A typological analysis of pottery should meet at least four requirements. The first two have been presented in the works by Carla Sinopoli (1991), and those are: *verifiability* – at any moment, data should be statistically verifiable, and *replicability* – data should be replicable, which means that anybody applying the same criteria can obtain the same results. The other two requirements should be *consistency* and *intelligibility*. Consistency implies that whoever produces the typology should define their parameters, variables and attributes clearly, irrespective of the selected method of typological classification, and give consistent attribution to pottery material within the set criteria. Intelligibility is perhaps the most important criterion of any typology and the most difficult one to satisfy. It requires all typologies to be clear, adjustable and open to further analysis. If a typology serves no purpose, this is because the typologist has neglected to specify what its purpose should be (Gardin 1980: 81), but it is almost impossible to have a typology which would be meaningful only for the person who had developed it. This simply means that the typologist does not comprehend the purpose of their typology.

Classification involved in the development of a typology can serve various purposes. Adams & Adams (1991: 157–168) mention three main categories: basic, instrumental and multiple purposes, where each of them can be further divided into several subgroups. The basic-purpose classification can be divided into descriptive, comparative or analytical, and the last of these categories can be further subdivided into intrinsic, interpretative or historical. Descriptive typologies are mostly morphological and closed typologies. Comparative typologies are used to compare material from different sites, periods and regions, and they must be open. Intrinsic classification is made for those archaeologists whose primary interest is objects, and not the people who made and used those objects. It focuses more on the features of the objects than on the social and economic contexts in which those objects were made. The interpretative purpose is used primarily in the field of prehistoric archaeology, and in the focus of its interest are the people who produced and used an object, information concerning the technology (shaping technique, firing method etc.), economy and social organization. Historical purpose aims at studying the development and change over time and space. The instrumental-purpose typology focuses primarily on the relative dating of artefacts, ethnic identification and reconstruction of the social organization. A multiple-purpose typology, as its name suggests, serves several purposes, be it intentionally or not. It often happens that the archaeologist becomes aware of a secondary purpose of his typology during the study of his material, or once it is over. On the other hand, multiple purposes can be envisaged right from the beginning of a typology development. This approach causes problems during typology development, and one of the possible solutions to this problem is taxonomy, which will be discussed in the following chapters.

The purpose of typology is the first and most important in a range of steps which define the type formation. Therefore, each practical typology should have a clear purpose from the start, and thus avoid a situation in which the typology is an end in itself.

Typologies are generally considered to be archaeologists' subjective creations, rather than reconstructions of categories that were important to those who produced or used them (Trigger 1989). This problem is noticeable in traditional typology, still in use today, where the definition of types is the only form of analysis and interpretation, and pottery sherds are not studied as objects which were actively involved in people's social life, but rather as passive pieces of fired clay. Every vessel was produced for a reason, each one had its purpose, and they all carry their stories. Fortunately, there are various ways in which traces can be read (macroscopically and microscopically) from the vessel, ranging from the method of its shaping through use-alteration analysis to its final disposal, and our role is to reconstruct its use-life (Skibo 2013). Typology is there to help us classify data sets on pottery material, and structure them in a way which will serve a purpose. As early as 1983, Braun wrote one of the much-quoted phrases, "*pots as tools*", which contains the very core of what should be borne in mind when processing excavated pottery.

HISTORICAL OVERVIEW OF THE TYPOLOGICAL CLASSIFICATION OF POTTERY MATERIAL

The typological phase of the processing of archaeological material was introduced around 1880, when Pitt-Rivers developed a typological approach to studying the material excavated in his excavations. At the same time, Flinders Petrie came up with his own model of seriation and chronological ordering of graves dug during excavations in Egypt (Orton et al. 1993: 8–13; Trigger 1989; Renfrew & Bahn 2004: 27–36). In the 1920s and 1930s, a great number of typologies were developed in relation to various materials, and most of those used today were probably formulated during that period. Between 1920 and 1950, many theoretical discussions and debates focused on this topic. (For an overview, see Adams & Adams 1991). In the beginning of this typological-chronological phase, the main goals were a vertical (chronological) and regional distribution of pottery finds. The methodological approach was based on seriation and development of cultural chronology on the basis of quantitative data, obtained by simple counting of pottery sherds. Only in the contextual phase did the idea mature that some other measurements could be used as indicators of quantity of pottery material (weight, vessel capacity etc.). Chronological sequences were created on the basis of types which Gifford (1960) described in the middle of the 20th c. as "specific kinds of pottery embodying unique combinations of recognizably distinct attributes." In time it became clear that such a single-layer division is insufficient, and its elaboration into types and type variants has been widely accepted.

Many papers and scholarly debates have been devoted to this 'phenomenon' and its application during the study and analysis of pottery material (Phillips 1958; Wheat et al. 1958; Smith et al. 1960; Ford 1961; Sabloff & Smith 1969; Smith 1979). In the 1960s, several circumstances contributed to a new scientific momentum in archaeology, and also in typology.

The contextual phase, which began around 1960, was marked by the work of Anna O. Shepard. It was a turning point for pottery analysis and the development of foundations for a number of practical and theoretical analyses. Her 1956 work addressed all aspects of pottery analysis: chronology (type identification), distribution (identification of raw material and trade sources) and technological development (physical properties of vessels). We could say that, as a result of her work, pottery analysis developed in all possible directions. One of those was the integration of ethnographic studies, scientific methods and technological analyses.

The scientific methods which were introduced into pottery analysis in the 1960s influenced the study of excavated pottery in three important areas: dating, origin of the raw material and identification of the pottery's function. Furthermore, their contribution was also felt in the study of pottery technology and manufacturing methods, and the processes of its shaping. Authors interested in the technological aspect of pottery have developed their studies in two directions. One of them was the study of technology as an indicator of social progress (For an overview, see Loney 2000), while the other includes chemical and physical analyses of pottery and considers them from a viewpoint influenced by ethnography.

The development of the typology and classification of pottery material, and its supplementation with new knowledge and approaches, began in the late 19th century and continues to this day. Over time, computers and various statistical methods have improved data layout and transparency, and facilitated data manipulation. Typological analysis of pottery – as of any other archaeological material – depends primarily on the repertoire, on data representativeness. The method of data collection (stratigraphic excavation, field survey or the study of material kept in a museum collection) will have a clear impact on the interpretation of the material studied (Sinopoli 1991: 47).

Much has been written about the definition of the vessel type and approaches to typological analysis, and these works have contributed to a number of constructive discussions in which various scientists involved in the study and typological analysis of pottery have participated. Thus, typological analysis of pottery has involved scholars from various fields of interest: philosophy, mathematics, anthropology, ethnology, information technology, biology, linguistics. If we add to these those scientific disciplines that participate in the analysis of the composition and source of clay used as the raw material, and various dating methods, we can say that pottery analysis is the best example of interdisciplinarity, without which we could not imagine today's archaeology as a scientific discipline.

POTTERY CLASSIFICATION

Classification of pottery into types is the first of the steps necessary if we wish to use data on pottery for further, more detailed, analysis. How much information we can gather and present through typological classification – that question is still open and causes many a debate among archaeologists.

There is no formula, mathematical equation or standardized method which we can use to select correct or right information from the vast quantity of data offered by pottery. The choice will depend primarily on the material excavated from a site and its general features. Thus, if all the pottery under examination is black, colour will evidently not be useful or relevant in dividing the pottery inventory into subtypes or groups. On the other hand, if the colour of the pots is different from the colour of the bowls, and if it varies from black to light grey, colour will be a useful parameter for establishing a range of variables by which we can determine the frequency and importance of this phenomenon (Sinopoli 1991: 43–44). Our decision on variables that can be recorded for a pottery sherd will follow the same direction. Some of the variables will be more important and useful than others, depending on our interests. For this reason, when data are interpreted, it is of utmost importance that we start the analysis by setting a conjecture that can be tested, and then selecting measurements and data which will lead us to credible conclusions (Kingery 1981: 463). This approach requires the archaeologist to know his pottery inventory before he begins to study it and define certain variables.

Establishing pottery types can be approached in two ways. One includes recording objective facts about the vessel's shape on the basis of pottery sherds, while the other is based on assumptions, that is on the already established knowledge of vessels and their shapes as pertaining to a certain period or culture (Orton et al. 1993: 77–78).

Before we set the basis for typological classification, it is very important to decide which samples we will collect for analysis, and which data we wish to collect. Generally, there are two techniques: random sampling and judgment sampling. As far as pottery goes, random sampling means that any sherd is of the same value and can be selected for analysis, and it does not depend on other sherds selected from the pottery inventory. Judgement sampling is based on the knowledge and experience of the archaeologist, who will choose and select pottery sherds relevant for the analysis depending on his field of interest. This choice is much simpler, but some relevant data can be omitted in the final interpretation (Sinopoli 1991: 46–49). The choice of a sampling method will depend on a range of parameters (the stratigraphy of the site, documentation, type and quantity of available material, etc.).

Once we have selected the method to be used in sorting the excavated pottery, the next step in our study will be classification. There are three kinds of typological classification: intuitive or traditional typology, type-variety typology, and quantitative or statistical typology.

Before we describe each of these classifications, we should emphasize the difference between a typology and a classification, between variables and attributes. Typology is actually a particular kind of classification; it is not meant for categorizing and labelling items, but rather for their separation into smaller groups which correspond to categories and labels in our classification. The process is called 'sorting', and the groups of categories into which items are sorted are called 'types'. To put it briefly, a typology is a special kind of classification, made for sorting entities, or objects. Unlike many other classifications, typology is always experimental to a certain extent, at least in its early phase. In contrast to other kinds of classes, a type is also a sorting category. Thus, classification is the act of creating categories, and sorting is the act of putting things into categories after they have been created. One is a process of definition, the other of attribution (Adams & Adams 1991).

Types are created to serve a useful purpose. Therefore, as far as typology goes, subjectivity is unavoidable and necessary. The goal of the classifier is to dictate the selection of variables and attributes that are to be considered in the typology, and to have that selection determine the nature of the resulting types.

An attribute is a definable aspect of each particular variable, and while variables are conceptually independent, attributes are not. In each type, there can be only one attribute for each variable. For example, the variable is the colour of the vessel, and its attribute is red. Each attribute is exclusive, which means that one attribute precludes others. Thus, a sherd cannot have walls that are both thin and thick, or a rim which is both inverted and everted. Variables are criteria of meaning, and attributes are criteria of identity. Variables can be characterized as dimensions of variability. They specify properties that are manifest in all of the types in a typology, but now always in the same way. For example, every vessel has properties such as shape, weight, colour and texture, but those properties can be manifest in different ways.

Generally, there are four grades of decision-making underlying the formulation and use of typology. These are the selection of variables and attributes for type formulation, the labelling and designation of types, and the sorting of entities. The majority of material which is the subject of our pottery analysis and study consists of sherds, and thus our entities are sherds, rather than entire pottery vessels. Nonetheless, our types are not types of sherds, but types of entire vessels. Thus, when sorting entities, it is important to compare as many attributes as possible, and not just diagnostic sherds which can be attributed with certainty to a specific type, because the type is defined not by a single attribute, but by a combination of attributes (Adams & Adams 1991).

TYPES OF TYPOLOGY

When discussing types of typology, we should start with the earliest and simplest of them: the *traditional typology*. This denotes sorting sherds into groups of more or less similar sherds. Such a typology can be very successful if the archaeologist who is processing the material has a lot of experience with pottery. However, this method of typological processing depends exclusively on our perception, on our ability to detect patterns even though we cannot always explicitly define what factors contribute to the patterns we perceive (Sinopoli 1991: 50).

The traditional typology has matured and evolved over time, as numbers of archaeological excavations, pottery inventories and scientific interest have increased. Robert Whallon (1972) attempted to move away from the traditional typology by introducing a hierarchical method of attribute evaluation, identifying those attributes that were primary and more important than others when sorting vessels into groups. Thus, to define a type of vessel, a single variable was necessary, defined by two opposing features (attributes). The traditional typology has its limitations, and it is difficult to replicate; it is suitable for certain issues relating to relative chronological changes, but it is not satisfactory for the interpretation of technology, style or production (Sinopoli 1991: 49–52).

Type-variety classification of excavated pottery is the most widely spread typology; it emerged in the 1960s as a response to the large quantity of pottery material excavated in the American southwest (Wheat et al. 1958). In its early days, the proponents of this typology were not particularly concerned by what a *type* really was or by its possible definition. A type was determined by a very small number of diagnostic traces, and it was defined by the period of time and the area in which it appeared. During the subsequent development of this kind of typology, classification of finds went in the direction of solving specific questions and problems.

Orton, Tyers & Vince (1993: 76–79) differentiate between two methods of *type-series* classification where each type represents a series of vessels, assumed to be of a more-or-less similar shape. The unstructured way consists of singling out a pottery sherd, which is labelled Type One. The next sherd is compared with it, and, if different, it is labelled Type Two. The method continues until the whole pottery material has been studied. The advantage of this approach is its simplicity and potential to increase the number of types, as well as the ability to start with a small amount of material which can be expanded at a later stage. It is very suitable for processing material from extensive and long-lasting excavation campaigns.

The structured approach goes in a different direction, and requires initial knowledge about the overall pottery material before its classification. The pottery is first divided into groups on the basis of vessel shapes, for example, Type I – bowls, Type II – plates, Type III – pots, etc. Then each group is subdivided into subtypes (I.A, I.B...) on the basis of shape, style, decoration, dimensions or any other attribute. Finally, individual types within a group can be numbered (I.A.1, I.A.2...), resulting in a clear typological classification, open for further analysis (Orton et al. 1993: 77–79). It remains the typologist's responsibility, as he defines the types, to take into consideration some other features of the material (for example, the technological aspect) too, with a view to specifying the purpose of his typology.

The *quantitative typology* involves creation of a typology and its interpretation using various statistical methods, with an important role played by defining variables. Flinders Petrie was a pioneer of seriation, which he used to determine the relative dating of Egyptian graves back in 1899; that was a paper-based precursor of statistical seriation. In the early days of archaeological statistics, in 1953, Albert Spaulding wrote: "statistics are never a substitute for thinking, but statistical analysis does present data which are well worth thinking about" (according to Lock 2003: 127). Thanks to the computerization which ensued after the 1970s, in modern archaeology statistical methods are applied as regular tools for data summarizing and interpretation.

Counting is a normal part of the archaeologist's work. We count pottery sherds, stones, bones, layers, samples and everything that is entered into archaeological records. Although archaeology belongs to the humanities, archaeologists often have to use various statistical methods. Not because they want to, but because they need to quantify the data collected. Statistical methods are there to assist us and enable us to filter the multitude of data which we have measured (the height of the vessel, the thickness of the walls, the diameter of the rim, the thickness of the bottom, etc.). The creation of a database in which quantitative data are entered opens up possibilities of comparison and establishing patterns which we cannot perceive while studying a mass of potsherds. Thus, statistics poses a range of new questions which are open for testing. Some archaeologists shrink from statistics, considering it boring and incomprehensible, while some others use it when presenting their data in tables and graphs, but never calculate standard deviations, medians or correlations between attributes and variables.

As has been said about the creation of typology, statistics and quantification are not the end of pottery processing, but rather its beginning. These tools help us identify, filter, test and present, more easily and in a transparent way, similarities, differences and patterns in a processed set of data (VanPool & Leonard 2001): in our case, in pottery sherds. Quantitative methods and statistics are applied to the data, and the data consist of our observations and measurements of a certain pottery sherd, stone tool or bone (Drennan 1996; Shennan 2001; VanPool & Leonard 2001; Lock 2003). What shapes the data are our theoretical and research questions, and parameters set clearly at the beginning of the study.

It has been said above that there are no rules or mathematical formulae which would dictate the method and scope of collecting data. The data will be simply what we make them be! Clearly, every archaeologist possesses a certain level of previous knowledge of the issue under consideration, and it is likely that he will include in his study the considerations that are key to the interpretation of a problem or question. The first step will be to set variables for the data, and each perceived quality is a variable. The selected variables can involve diverse measurement methods, depending on the interest of the person studying the pottery. For example, technological variables will encompass those parameters which are linked to the raw material (clay), production and firing methods, and mechanical changes in the vessel. The variables which make it possible to measure the size and shape of pottery vessels are interrelated, and include the diameter of the orifice, the vessel's size, its maximum diameter, the diameter of the bottom, the thickness of the walls, etc. The vessels are divided into groups depending on their shape (bowls, plates, pots...), and additional measurements can be used to establish more detailed divisions within those groups. This approach can be used to identify chronological and stylistic variations. Variables relating to decorative features and surface treatment include the pottery decoration techniques described previously, and identification of colour. The recording of decoration present on a vessel will consist of its position (on the rim, neck, belly) and the technique employed (pointing, incising, impressing etc.) (Sinopoli 1991: 53–67). The purpose of this method is to use statistical methods to obtain data which can then be formed, grouped and searched in various ways.

Archaeological analyses most often employ descriptive statistics, which allows data summarization in either numerical or graphic form. Numerical values include the typical and main features of the collected data, and a sum of average or medium values. Graphs enable us to present the collected data visually, be it in tables, histograms or other kinds of graph (Drennan 1996). All things considered, we do not even merely select facts from an infinite quantity of data we have collected, or we could collect, but we order them on the basis of our solely subjective perception, on the basis of how we see them and how we will categorize them (Banning 2000: 7–34). There are questions which always remain open: Have we collected sufficient data? Have we made a proper selection? Which data will be presented during interpretation? These questions form part of the overall processing of pottery material, and there is hardly any archaeologist who does not ask them while studying excavated pottery. The response lies in the decision on the degree of processing, analysing or measuring at which one has to stop, and this is true especially when it comes to data summarizing and final interpretation. All the data are filtered through the subjective prism of the person processing the pottery. Collecting more data, by measuring a number of variables on the pottery, can result in an enormous quantity of data which will be presented, but have no interpretative value, if in the final phase they are not properly filtered. This does not mean that all those data should not be considered and measured; they should just be properly evaluated.

It is worth emphasizing that pottery material excavated and recovered from a site can never paint a complete picture of inhabitation of the site or the period. Proper sampling (whether using random sampling or judgement sampling) will provide us with a representative sample, in terms of a general range of pottery material found at a specific site.

Regardless of the way and method selected for analysing excavated pottery, it is important that they be based on some previously set parameters which will provide answers to the questions already raised. Only if we follow this approach can our answers be relevant indicators of what we are trying to learn from the numerous variables offered by the pottery.

MORPHOLOGY OF POTTERY VESSELS

The morphology of a pottery vessel can be described and classified in a number of ways, and it is up to the archaeologist to choose the appropriate way to analyse his pottery material. P. Rice (1987: 224–226) highlights four main characteristics relating to pottery morphology: capacity, stability, accessibility (of the vessel's contents) and transportability. Although there are other characteristics linked to the vessel's function, those listed above relate only to the vessel's morphology.

Before we set parameters for a typological classification of pottery, it is important to be aware of the anatomy of pottery. Pottery anatomy has been accepted and used all over the world, and its main parts correspond to parts of the human body. Each vessel can be described or characterized in many different ways, with reference to particular parts and their proportions. To put it simply, a vessel has three primary parts: orifice, body and base (*Fig. 15, p. 67*). These components are important in terms of the vessel's construction, function and possible decorative elements, and their relative proportions determine its shape category (Rice 1987: 212). Secondary shape attributes include various kinds of handles, grips, spouts and feet attached to an already shaped vessel (Horvat 1999: 80). The primary and secondary parts of the vessel constitute the vessel's morphology, the starting point for the classification and analysis of the main shapes of pottery vessels.

PRIMARY PARTS OF THE VESSEL

Orifice – The main characteristic of the vessel's orifice is its relation to the maximum diameter of the vessel. This component is linked primarily to the vessel's function, and it is relevant to the accessibility of the contents.

Body – This has been defined as the portion between orifice and base, which includes the maximum diameter of the vessel or the region of the greatest enclosed volume. The size of the body also affects the vessel's height, a component associated with its capacity.
Base – This is the bottom part of the vessel, responsible for its stability (*Fig. 15, p. 67*).

Not all vessels have such simple shapes, though; they are often much more complex, and their structure can be divided into several more parts (Horvat 1999) (*Fig. 16, p. 68*):

1. LIP/RIM - *ORIFICE*
2. NECK
3. SHOULDER } *BODY*
4. BELLY }
5. BOTTOM
6. FOOT

The ***lip*** is the upper edge of the vessel, and its transition to the neck is not angular, but vertical. The lip can also be profiled so that it leans towards the vessel's inner or outer side.

The ***rim*** is a part of the vessel which is specially shaped or elaborated, and its contact with the vessel's wall is angular or truncated. The lip and rim together form the vessel's orifice. Some authors use only the term *rim*, without additional distinction, which is also a common way of classifying the main elements of pottery vessels.

The ***neck*** is the part which restricts the vessel's orifice and turns into the vessel's upper part (shoulder).

The ***shoulder*** is the upper part of the vessel, below its neck.

The ***belly*** designates the lower part of the vessel, which turns into the base (bottom/foot). Together, the shoulder and belly constitute the vessel's body.

The foot is usually attached or applied to a vessel already shaped, that is, to its base or bottom. Smaller feet can be modelled together with the vessel, or pulled out of the vessel's body (for example, in the cases of bowls with four stubby feet and bowls with cross-shaped, ring-shaped or cylindrical foot (Pls 11, 12, 17, 18).

SECONDARY PARTS OF THE VESSEL – HANDLES AND GRIPS

Types of handles and grips and their working techniques will be discussed only within the framework of the processed Vučedol material, rather than with a view to all the prehistoric cultures. The only purpose of handles is functional, that is to facilitate the lifting and carrying of vessels. Handles are attached to the vessel's external wall, which can be specially prepared for their attachment. The preparation involves impressing the wall so that the lug end of the handle can cling to the vessel as firmly as possible. The end of the handle is additionally smeared over the wall for better adhesion (*Fig. 17, p. 69*). The handle can also be simply fixed to the wall with additional smearing and elaboration. The main classification is based on the method of fixing handles, and on their position on the vessel's body, as well as on their shape, section, orientation and contour (Horvat 1999: 100–101).

Based on the position of the handle, we distinguish between tunnel handles and strap handles. The tunnel handle is set horizontally to the vessel's wall, and its cross-section can be concave, convex, saddle-shaped (*Fig. 18, p. 69*) or elliptical (*Fig. 19, p. 70*).

Large, thick handles were positioned mostly where the shoulder turns into the belly, while small ones could also be set in the area between neck and shoulder. Handles of this shape are most frequently found on pots whose size demands larger and thicker handles, with a view to facilitating the pot's handling. In the majority of cases, these were pots used for food preparation, and handles were a necessary part of their morphology, since they made it possible to lift such pots and place them over a fire. A large quantity of pottery hooks, used to suspend vessels above a fire, have been recorded in nearly all the sites of the Vučedol Culture, including those at Ervenica and Damića Gradina (*Fig. 26, p. 75*).

Tunnel handles on pots were often decorated by grooving (*Fig. 20, p. 70*). Such a decoration could have a dual function: aesthetic and functional. Grooved tunnel handles could have been deliberately shaped in this way to facilitate pot handling, because fingers attach better to the grooved hollows, which thus prevent the pot from slipping out of the hand. As a rule, such grooved handles can be found on pots (*Fig. 21, p. 70*).

Strap handles are set vertically to the vessel's wall. Their cross-section can be elliptical, concave or convex. Generally, the upper end of the handle is located at the rim, while the lower one ends on the vessel's shoulder or belly. Such handles can be found primarily on bowls (*Fig. 22, p. 71*), jugs and cups (Pl. 30).

Just like handles, grips also differ on the basis of their position, orientation, section, contour and forming technology. Grips can be attached or smeared onto the vessel's wall, pulled out of the vessel's wall or modelled. Their purpose can be more or less functional. A grip can be used for holding the vessel, as a prop that facilitates lifting and moving the vessel from one place to another.

The position of the grip varies depending on the vessel type. On low bowls, grips are located immediately below the rim or at the vessel's widest part (*Fig. 23, p. 71*). Grips can also feature a small loop used to hang the vessel (*Fig 24, p. 72*), and they very often appear together with handles.

TERMINOLOGICAL PROBLEM

Terminology is of key importance for anybody wishing to acquire specific knowledge of the science to which it relates, and it depends on the quantity and quality of previously acquired knowledge (Erdeljac & Willer Gold 2009). Unfortunately, the majority of professional literature in Croatia discussing archaeological pottery does not use a uniform terminology, resulting in an endless number of labels and phrases used to indicate both primary and secondary parts of vessels and the methods and styles of their decoration. For example, grips are still named only on the basis of how they are visually perceived, and thus we distinguish among those that are nipple-like, rod-like, heart-shaped, pointed, button-like, horn-like, nose-like, tongue-like, cork-shaped and saddle-shaped. They are often described as applications, extrusions, plastic attachments, protrusions, humps or handles. The situation is similar in the definitions of the shapes (pear-shaped, semi-globular, globular, paunchy) and primary parts (brim, recipient, throat) of vessels. This terminology still relies on the traditional archaeology of the 1960s and 1970s. Although the terminology relating to pottery morphology has been generally accepted and used in the majority of professional publications dealing with pottery-material analysis, it would appear that we prefer the *copy-paste* method. Contemporary archaeological science has evolved significantly over the past several decades, especially as regards new technologies and the interdisciplinary approach, which has become an integral part of the interpretative tools used for evaluation and deliberation, and also as regards accepting certain terminology and analytical approaches.

Two main problems can be observed when terminology and interpretation of excavated pottery are discussed. As already pointed out, in the majority of cases pottery material is still seen as a 'useful tool' for reconstruction of typological and chronological sequences, without any additional analytical dimension that would involve a reconstruction of socio-economic issues, technological changes and innovations, resource exploitation etc. The second problem is the meaning of the terminology used to describe pottery shapes, decoration and surface treatment techniques, parts of pottery vessels, etc.

Tracing written evidence of certain terms used to name a decoration technique or a vessel shape in order to get to an explanation in the form of a picture or drawing is a very interesting exercise. Different variants of linguistic structures or words which do not correspond to the rules of today's Croatian have survived the long journey and become the main link in the dissemination of knowledge. Some terms keep emerging in scholarly papers and catalogues like ghosts from the past, and there is hardly anyone who can tell or explain their true meaning (for example, *subcutaneous loops*). As though they belonged to some kind of common law that cannot be tramped down. I do not believe that I am wrong in saying that the archaeologists who introduced those terms never anticipated how much awe they would inspire, and they probably never expected them to remain in use for eternity. Reading scholarly texts – written words through which we absorb and transfer new scientific ideas and understanding, critically deliberate scientific problems and create new theoretical frameworks and methods – should entice us to continue with our deliberations, and not hold us back.

8 METHODOLOGY OF POTTERY PROCESSING

A number of publications dedicated to typological classification of pottery are focused primarily on defining vessel type. One of the most important such publications is the book by A. Shepard (1985) mentioned above, whose first edition was published in 1956. To this day, it remains the starting point for many archaeologists when they describe their pottery material, and everybody dealing with pottery analysis makes reference to it. When it comes to defining individual vessel shapes, several approaches are possible, and Shepard mentions three of them: *functional, aesthetic and taxonomic*.

FUNCTIONAL ASPECT

The vessel's function has always attracted the interest of researchers, because its purpose can indicate what the customs and activities of a community were like. However, the relationship between shape and use is not always unique. The same shape could be used for various purposes, just as vessels of various shapes were used for the same purpose.

Defining a vessel's function can be approached from two directions, one of which is in the focus of interest of those archaeologists who are involved in analysing the functional component. One approach is based on the vessel's shape as chosen by the potter, with a view to satisfying a particular purpose. For example, a vessel used for cooking had to be resistant to thermal shocks resulting from quick cooling and heating. Furthermore, it had to be big enough and have a wide orifice for putting in and taking out food and it had to have handles or grips to allow its easier lifting from a fire. As discussed in previous chapters, outer-surface treatment with heavy textures such as barbotine, and a polished inner surface, would ensure that the vessel was impermeable and strong (*Fig. 25, p. 74*).

The second approach focuses on the search for traces in the vessel which would uncover its actual use – because, at the simplest level, the primary utilitarian function of the vessel coincided with its contents. Again taking a cooking pot as an example, many traces can be identified and analysed from the external and internal changes on the pot. The vessel's bottom can be oxidized where it was directly exposed to flame, it can present traces of food in the interior or chemical traces of food that were absorbed into the wall (Banning 2000: 179–180). Oxidation discoloration on the outside indicate that the vessel was directly exposed to fire, but such traces can also reveal the position of the vessel in relation to the source of the fire. Furthermore, cooking pots often display traces of soot on their bases, which is a consequence of their exposure to fire, or traces such as remains of food on the inside. However, a lack of oxidation discoloration from a sooted surface is a sign that the vessel was not in direct contact with the fire, but was hanging above it (Hally 1983). This thesis is supported by the pottery hooks mentioned above, used to hang vessels, many of which have been discovered at the Vučedol Culture sites (*Fig. 26, p. 75*).

Pottery is a very satisfying material for analysis because it preserves a number of physical and chemical traces which can indicate its actual use. One of the approaches to the functional analysis includes use-ware and use-alteration analysis. The first works and studies that followed this direction emerged in the 1970s (For an overview, see Vieugué 2014), and they intensified in the 1980s (Hally 1983; Schiffer & Skibo 1989; Skibo 1992).

Traces on pottery can appear in two ways. They can be consequences of mechanical contact between the vessel and the tools used during food preparation (stirring, grinding, scraping), or cleaning or storing of the vessel; such contact causes scratches and various deformities of the vessel. Other traces are caused by chemical reactions in the food contained in the vessel (fermentation, water evaporation, salt crystallization), which enters the vessel's pores and causes flaking (Skibo 1992; 2013; Arthur 2002; 2003). The archaeological literature usually describes them as abrasive and nonabrasive processes. Such processes are largely affected by the properties of the pottery, especially its hardness, porosity, temper (its size, type, quantity, distribution and orientation), the vessel's shape and surface treatment. Thus, polished surfaces are more resistant to abrasion than those that are heavily textured and porous. Organic temper burnt out during firing leaves pores in ceramics and causes high porosity, making such vessels more susceptible to abrasion (Skibo 2013: 120–121). However, we have already seen that organic temper, if large-grained and sparse, will ensure the vessel's resistance to breakage and mechanical impact (Skibo et al. 1989).

Analysis of use-alteration traces on pottery is particularly important because:

a) it allows a much more precise determination of the vessel's use;

b) the intended use does not always equal the actual use;

c) it allows determination of the vessel's secondary use (Skibo & Schiffer 1995).

It is worth mentioning that, when determining a pottery vessel's utilitarian function, all the parameters previously discussed should be considered together, because they could lead to an incorrect conclusion if analysed separately. One of the reasons for this is that a vessel could have been multifunctional, which means that it could have served several purposes, which would not have been unusual. Thus, a vessel used to cook meat or vegetables during the day could be used at night for some ritual or other symbolic activities (Skibo 2013). The traces of those activities can also be identified on pottery. On the other hand, some vessels were used exclusively for a single purpose, and were intended for preparation of only one type of food.

Ethnoarchaeological research on the Kalinga community in the Philippines has shown that rice is cooked in only one type of vessel, while dishes based on meat and vegetables are prepared in vessels of an entirely different type (Skibo 2013). The same is true of milk-cooking vessels, as evidenced by the tradition of the Dalmatian hinterland. There, milk used to be cooked in a special type of bowl with a wide orifice, which was called *lopuža.* It was never put in direct contact with the fire, but hung above the fireplace. After a certain cooking cycle, it would be cleaned by scraping the remains of the encrusted milk from the vessel's inside using a spoon, rather than by washing (*Fig. 27, p. 76*).

We should also bear in mind that some vessels were used for secondary purposes or recycled. Within the fields of archaeology and anthropology, such studies have evolved into a specialization called *fragmentation*, which has developed intensively over the past few decades (Chapman 2000; Chapman & Gaydarska 2007). Archaeologists often see broken material remains only as the results of accidental processes and unintentional actions (Chapman & Gaydarska 2007). Our perception is limited to the passive role of the object, rather than the active role it played in a society. In this respect, fragmentation as a separate scientific specialization endeavours to widen our knowledge of the object, to perceive it not as an isolated find or sherd, but in its wider context of social relations, ritual activities or symbolic meanings.

Secondary use of vessels is common in today's traditional communities, just as it probably was in prehistoric societies. Once a vessel has been used in its primary function, it can be used for something else, and thus its uselife can be exploited to the maximum. For example, once a cooking pot loses its water-resistance, it can be used for storing ingredients (Skibo 2013). Given that the uselife of cooking pots is the shortest, ranging from several months up to a year, according to some ethnoarchaeological research (Longacre 1985; Tani & Longacre 1999), most of them had a secondary function before they entered an archaeological context. Pottery recycling has a long traditional record, and, according to ethnoarchaeological investigation, secondary use and recycling can frequently be seen in traditional societies (Hally 1983a; Hayden & Cannon 1983; Deal & Hagstrum 1995; Senior 1995; Deal 1998; Wilson & Rodning 2002; Skibo 2013). On pottery sherds, secondary use can be identified by repair marks, that is, by intentionally-drilled holes in places of breakage. Such holes would be tied together by some kind of organic material which we cannot find in archaeological contexts, due to the nature of the material. Ethnoarchaeological research has shown that these were primarily leather strips or plant twine (Senior 1995: 101). In their secondary function, such vessels could be used for storing and keeping dry foods, such as cereals, seeds and herbs (*Fig. 28, p. 77*).

As discussed previously, one of the 'best-known' recycling methods was crushing broken vessels into grog, to be used as a temper. Other recycling options included turning broken pottery into various tools (scrapers for the processing of pottery and other materials, spoons), loomweights and weights for nets, which have often been found at prehistoric sites. Recycled pottery sherds have also been found in construction elements, for example in the tiling of pottery kilns (Balen 2005) and ovens (Đuričić 2014; Vuković 2015). Broken vessels were also used as moulds for making new vessels (Rice 1987) and as baking platters (Wilson & Rodning 2002).

Ethnoarchaeological research into ceramic uselife began in the 1960s, when ethnographer G. M. Foster (1960) realised the potential for archaeological interpretation of data contained in ceramics about its uselife. In the early days, the research was based on interviews with potters, but as early as the 1970s, investigations that were methodologically more systematized were carried out, and encompassed the uselife of each vessel in a household, to obtain the mean value of functional classes (David 1972; DeBoer 1974). Nowadays, research on pottery uselife is the subject-matter of many scientific papers and studies, analysed through the vessel's function, frequency of use, mechanical strength etc. (Longacre 1985; Tani & Longacre 1999; Sullivan 2008).

This overview makes it clear that, in order to determine a vessel's function, a range of analyses and comparative studies need to be made:

a) archaeological context of the find (houses, graves, waste dumps, religious contexts);

b) the vessel's shape, including its stability, capacity, accessibility, and transportability;

c) surface treatment (especially important in terms of impermeability and resistance to mechanical damage);

d) use-alteration and use-wear traces on the vessel (soot, oxidation stains, nonabrasive processes);

e) organic remains in the vessel's walls (lipids of plant and animal origin);

f) decoration (the vessel's role in the socio-political life of the community or in a ritual context).

As early as 1956, A. Shepard was the first to point out the importance of analysing metrical values when defining pottery shapes, pointing out that the uses of the vessels can tell us about the activities and customs of the community which used them. Rice (1987: 207) also emphasizes that "morpho-technological characteristics – their attributes of shape and technology – are closely related to their suitability for a particular activity."

Generally, in their everyday roles, vessels were used for food preparation, storage and transport (Rice 1987: 208-210). The technological choices included, among other things, the size and shape of the vessel, to satisfy the requirements posed by its intended use. The orifice diameter was important when choosing the vessel's shape. If the orifice is the same or approximately the same as the maximum diameter of the vessel, it is described as an unrestricted orifice; this category comprises primarily bowls. If the orifice is smaller than the maximum diameter of the vessel, it is a restricted orifice, typical of pots (Rice 1987). Thus, for example, a vessel used for storing liquids will have a restricted orifice to prevent spillage, while a cooking pot will have an unrestricted orifice to allow for easier stirring, putting the ingredients in and taking them out of the vessel.

Hard as it is to specify a vessel's use in prehistory, it is worth noting that all the indicators should be taken into consideration during the final interpretation. It is not enough to analyse just the shape or organic remains in the vessel, because, as discussed above, a vessel could have had several purposes, and it could have had a secondary use. The same is true of studying only traces left on the vessel or any other element. Archaeologists often interpret a pottery function which is based solely on their subjective observations, acquired terms and comparisons with modern, historical and ethnological examples.

It is very important to see the vessel's function as a complex parameter, which is not as legible as it might seem at first sight. What matters is that we approach the interpretation cautiously, taking into consideration all relevant and available analyses that we have carried out: the archaeological context of the find, archaeometric studies, use-alteration traces, organic remains, the vessel's morphology and other evidence of human activity in the same environment.

AESTHETIC ASPECT

The aesthetic component regards the vessel's shape and its proportions, while an analysis of its stylistic features can help us determine its social, economic, religious and artistic components, as well as its relative dating.

TAXONOMIC ASPECT

The taxonomic component regards proportions, or measurements, recorded for descriptive purposes. This leads to the development of classification and terminology relevant to specific shapes, such as bowl, jug, plate etc. (Shepard 1985: 224–225). Taxonomy can be used to classify nearly everything, and in archaeology the term is used to indicate a classification system with a hierarchical structure: that is, a system in which basic types are either clustered into larger groups or split into smaller ones, or both (Adams & Adams 1991: 202). Pottery analysis often begins and ends with taxonomical data designed to organize a large quantity of archaeological material and allow its comparison with other published finds. Type-variety analysis is one of the dominant taxonomic techniques (Neff 1993: 24–25).

With a view to avoiding the creation of distorted data groups during pottery analysis, one possible approach is to identify shapes on the basis of geometric parameters. The credit for ge-

[2] http://hjp.novi-liber.hr/index.php?show=search

neral acceptance of this approach goes to A. Shepard, who champions the geometric criterion in pottery analysis and classification, because our perception focuses directly on the proportion and contours – that is, silhouette – of the vessel. Such an approach has been employed in the majority of literature dedicated to studying pottery types, and it has also been used in classifying the excavated pottery presented in the second part of this book. Proportions are easily calculated, while contours are slightly more difficult, and they have been approached in two ways: by analysing the general characteristics of the contour, and by comparing the shapes to geometric bodies. The basic concept of the analysis of vessel contour, introduced by Birkhoff in 1933 (Shepard 1985: 226), is useful in drawing vessel forms and in their classification and description. Birkhoff considered the point of the vessel's contour on which the eye rests. There are four types of these characteristic points:

1. *end points of the curve at the base and lip* (EP) – these are the extreme points at the vessel's orifice and base (*Fig. 29, p. 80*)
2. *points of vertical tangency* (VT) – there are two kinds of tangent point: the outer point of vertical tangent (OPVT), which determines the maximum diameter of a globular shape, and the inner point of vertical tangent (IPVT), which determines the minimum diameter of vessels of hyperbolic shape (*Fig. 30, p. 80*)
3. *inflection points* – these are points where the curvature changes from concave to convex or vice versa (IP). Shapes containing points of inflection are mostly S-profiled shapes (*Fig. 31, p. 81*).
4. *corner points* – these are points where the direction of the tangent changes abruptly, resulting in a sharp change in contour (CP). In pottery, corner points are typical of vessels with biconical profiles (*Fig. 32, p. 81*).

Using characteristic points, we can easily calculate the vessel's dimensions and determine the contour type and the degree of its representation. Each of the points specifies a main shape class (Horvat 1999: 58). On the basis of characteristic contours, we can specify parts of a vessel, and thus the primary elements of a vessel can be described using the vessel's characteristic contours (*Fig. 33, p. 82*).

The geometric approach is based on similarity between certain vessel types and geometric bodies. Thus, we distinguish between spherical, cylindrical, elliptical and hyperbolic shapes, which can be divided further into simple, complex, composite and inflected vessel shapes (Shepard 1985; Horvat 1999: 74–79). Simple forms can have walls that are straight or curved, and their contours are characterized by a lack of inflection points or corner points. Vessels that have composite contours feature a corner point. Inflected forms are those with just one inflection point, while complex contours feature two or more inflection points or corner points (Horvat 1999: 190). In the pottery classification that is used in the Croatian archaeological literature, 'simple' shapes include conical and curved shapes, 'composite' refers to those with biconical profiles, and 'inflected' are those with S-profiles, while 'complex' shapes belong to vessels with either biconical or S-shaped profiles that are somewhat more developed (*Fig. 34, p. 82*).

The broader classification of the main pottery shapes provided by Shepard (1985), and accepted by other authors, takes into consideration several parameters that have to be selected on the basis of their properties and importance (Shepard 1985: 224–247; Horvat 1999: 57–79).

These are:

Symmetry	When defining the main vessel shapes, symmetry is not considered separately; the starting point is the assumption that the shapes of the vessel under examination are symmetrical.
Contour points	The contour points and contour silhouette, as well as changes in the contour line, should be taken into consideration.
Structure	The distribution of the vessel's parts and their mutual relations are important for the vessel's structure.
Contour type	The corner point and the point of inflection provide the basis for classifying the vessel's contour, which can be simple, composite, complex or inflected.
Similarity with geometric shapes	The vessel's shape can be compared to a geometric form, or a combination of different geometric shapes. The points of tangent and corner points on the contour mark spots in which two parts of the vessel come together, and each of those parts can be compared to a geometric shape or one of its parts.
Proportionality	The stability of every vessel depends on its proportionality, which is in turn related to its function and contour.
Establishing basic shapes, subgroups and shape groups	Establishing basic groups of pottery shapes, based on the properties of those shapes and their proportions.

Considering the extensive range of opportunities and information provided by archaeological pottery, we can recall the statement by Flinders Petrie, who said that "pottery is the greatest resource of the archaeologist" (Petrie 1904: 15-16). The amount of pottery excavated at archaeological sites, its indestructibility and resilience, offers innumerable and very important indications of the cultural, social, economic, religious and technological achievements of a community and the period in which it emerged. We also cannot ignore its chronological importance within relative or absolute dating.

In our attempt to summarize the main parameters of the analysis of archaeological pottery, we should emphasize that the selection of data we wish to analyse and obtain from the material is the first and foremost step in our determination of an analytical method. The reliability of the data obtained will depend on the selection of those features. Parameters to be analysed should be selected within the numerous previously-discussed variables offered by pottery material: shape, size, texture, hardness, strength, colour, decoration and surface treatment, choice of material, forming technique, firing atmosphere and method, and stratigraphic context. In addition, various archaeometric studies can analyse clay and temper compositions and the origins of raw materials. Naturally, the selection of parameters will depend on the nature of the site and pottery repertoire, and also on our own preferences. If our interest goes in the direction of trade and cultural contacts, our selection of parameters to be analysed will include the sources and composition of the clay. Physical properties will be the main parameter for a study that focuses on technological achievements, while a stylistic analysis can provide us with indirect chronological evidence and information about social, ideological or religious components. The parameters we will choose if we are interested in the vessel's function are not only those linked to physical properties, but also those resulting from various analyses of traces present on the pottery vessel.

It is important to note that the selection of the method and parameters for analysis is not always correlated with what we, as archaeologists, would like to learn from pottery material. Incomplete documentation of the site, including a lack of information about the stratigraphic context, or insufficient samples necessary for analysis, will significantly limit what we can do. If the stratigraphic picture of the site is unknown, it will be much more difficult to establish the order in which various types of vessels were deposited. Similarly, the use of a vessel can be much more easily specified if it is determined by a stratigraphic context. However, even if we do not know anything about the vessels' depositional context, they can still serve as a source of information, which will be discussed in further detail in the second part of the book.

At the end of this chapter, it is worth emphasizing that the task of archaeologists is to distinguish between what we know and what we can imagine about a ceramic vessel – which is, of course, also true of all other objects that belong to the past material culture of mankind.

SECOND PART

9 PROCESSING AND ANALYSIS OF EXCAVATED POTTERY FROM THE SITES OF ERVENICA AND DAMIĆA GRADINA

APPROACH AND METHODOLOGY

The typological classification of the pottery assemblage from the sites of Ervenica, in Vinkovci, and Damića Gradina, in Stari Mikanovci, was based on quantitative and qualitative data collected from the whole sample, with the data processed using descriptive statistics in the *SPSS* (*Statistical Package for the Social Sciences*) program. The first division into types was based on morphological data. Thus the main functional shapes were obtained, present at both sites: A – bowl, B – pot, C – cup, and D – jug. Three additional shapes have been identified at Damića Gradina: E – strainer, F – bottle, and G – lid (*Figs 35, 36, 37, pp. 91-92).*

Although the definition of the main vessel sha*p*es and types depends on the pottery material under examination, which means on the type of site and the period it belongs to, classifications of vessel shapes are always based on the vessels' height and maximum diameter, and on the kind or size of orifice (Rice 1987: 215).

There are several classifications of vessel shapes, the best-known among them being the German and French. During the processing of the Vučedol Culture material, a combination of both these classifications was used to specify pottery shapes. A bowl was defined as a vessel which generally has no neck, although that is not a rule, and its height varies from being 1/3 of the vessel's maximum diameter to being equal to it. A pot is a vessel with or without a neck, with a restricted orifice, and a height which is usually greater than its maximum diameter. A cup is a vessel, with a handle, whose diameter is in most cases equal to its height. A jug is a necked vessel, with a handle, whose height is greater than its maximum diameter (Rice 1987: 216; Horvat 1999: 86).

When types were classified into groups, the structural approach was applied, which makes it possible to expand and complement the typology without limitations. It has been explained in detail in Chapter 7. New shapes that might emerge at another site of the Vučedol Culture can be introduced into this typology, which would thus be expanded, while those shapes that are the same can be compared to the existing ones. Each of the types featuring very specific characteristics (for example, type A – bowls), was further divided into subtypes (Type A 1) which feature very similar characteristics, but can be distinguished and classified on the basis of four typical points on the vessel's contour (e.g. Type A 1 comprises all bowls whose contour includes two extreme points on the rim and on the base). Such division into subtypes makes a typology less subjective, and, in addition, the division into subgroups is less prone to potential mistakes on the part of the person creating and defining the typology. Within each subtype, individual types have been identified and numbered (Type A 1a), on the basis of interlinked variables which allow measurement of the size and shape of pottery vessels (rim and base radius, height, wall thickness).

During the processing of the pottery assemblage, the large quantity of data was divided into several categories. Morphological data involved establishing the vessel's type, subtype and variant, type of rim, base, handle and grip; metrical data encompassed measurements of rim radius, base radius, vessel height and wall thickness; for decorated vessels, data were recorded about the decorating technique, the motif and its position on the vessel; technological data included the identification of the external and internal colours of the sherd and the cross-section colour, which identified the firing atmosphere, and the external and internal surface treatment.

Due to the specific nature of the sites investigated, random sampling was applied at Ervenica, while the method selected for the site of Damića Gradina was judgement sampling. There are several reasons for the selection of different sampling methods, which support the fact mentioned above that every site demands a different approach to the processing of its pottery. In this case, our options were limited due to the incomplete stratigraphic context of the material. Such a situation should by no means result in a decision not to process sites of this kind, because excavated pottery can help us reconstruct some other processes – technological, economic and symbolic – as well as models which can reveal traces of social organization or specialization.

Although both the sites were investigated within the scope of rescue archaeological excavations, the site of Ervenica was investigated in 2007, and the Damića Gradina site in 1980. The methodology and documentation of archaeological excavation – the most important aspects of the archaeological profession – have developed over time, and the digs carried out today cannot be compared to those made 30 or more years ago. Nowadays the available technology and data enable us to process the sites faster, better and more precisely. The difference concerns not only the quality of excavation, but also the quality of data recording. The site of Damića Gradina was explored more than 35 years ago, on a limited excavation surface, where the positions of finds and layers were established in relation to the foundations and trenches (2 and 4 metres wide) which were dug for the local elementary school (*Figs 42, 43, p. 102*), which did not permit the establishing of an overall horizontal stratigraphy.

Given that the stratigraphic context was disturbed by the very excavation surface, during the processing, excavated material had to be checked several times in order to put together pieces which belonged to the same vessel. An additional complication was caused by the fact that the position of Damića Gradina had been inhabited from the period of the Sopot, Baden, Vučedol, Vinkovci and Bosut cultures, through to the late phase of the Middle La Tène period. It is virtually impossible to distinguish the coarse pottery vessels of the Vučedol Culture from those of the Vinkovci Culture (especially those whose bodies had been treated with barbotine), unless the stratigraphic context is clear. For this reason, and with a view to obtaining a chrono-cultural definition of the excavated pottery that would be as precise and reliable as possible, only those fragments which could undoubtedly be attributed to the Vučedol Culture were taken into consideration. This also determined the method of sampling.

Although efforts were invested in reconstructing vessels to the maximum extent possible, in the final interpretation, the approach based on specifying the minimum number of vessels would result in a deviant and unreliable picture of the pottery assemblage. Thus, after examining the pottery excavated at both sites, and putting together fragments of the same vessel, at Ervenica it was possible to specify the minimum number of vessels (MNV) using random sampling, whereas this was not possible at Damića Gradina. There, the maximum number of vessels was determined using judgement sampling.

Once the classification (which is descriptive) and the analytical purpose (which is interpretative) were defined, we had the basic requirements and guidelines which made it possible to reconstruct the activities of the Vučedol society on the basis of processed pottery assemblage.

The following chapters present the results of the analyses made; but, before that, let us look at the geological and geographical features of the landscape, positions and characteristics of the sites, and some general features of the Vučedol Culture.

10 GEOGRAPHICAL AND GEOLOGICAL FEATURES OF THE LOCALITY

GEOGRAPHICAL FEATURES

Eastern Croatia has recognizable geographical specificities, which have resulted in its division into the regions of the East-Croatian plain, and the Slavonian Sava Basin with the Požega Valley. This open lowland consists mostly of young fluvial deposits and loess sediments (Sić 1975: 123–125).

A detailed geographical division of the East-Croatian plain into six geographical units puts Vinkovci and Stari Mikanovci in the geographical area of the Bosut Valley – a naturally well-delimited and distinct section of the East-Croatian plain (*Fig. 38, p. 93*). It is closed off to the north by the marked edges of the Đakovo-Vukovar loess plateau, and to the south by the River Sava. On the western side, it is bounded by the central Sava Basin and its narrow valley along the River Sava with the hilly hinterland, while its eastern boundary is the lowland part of the Fruška Gora region in Syrmia.

The Bosut Valley covers an area of 2355 km² – and, in view of the structure of its landscape, it is a homogeneous unit. The largest part of this prominently lowland region is covered by woods, with an occasional wetland. Such wood-and-marsh landscape functions as an isolator, limiting human settlement to the peripheral parts of the plateau. Within the large network of watercourses, the most important role is played by the Bosut: together with its tributary, the Biđ, it extends over 186 km, and its basin covers 3025 km², much more than the surface of its valley. A direct link between the Sava Basin (the Bosut catchment area) and the Drava-Danube Basin (the Vuka catchment area) went along the Ervenica brook (Barica) (Bognar 1994: 25–48). The Biđ-Bosut and other significant watercourses had very small gradients, and they were winding and shallow, which contributed to their flooding the surrounding area at times of high water, and forming natural distributaries. The same is known to have happened at the bifurcation of the Bosut and Vuka across the Ervenica brook, filled in by later works.

The great importance of water has been reflected in the features of vegetation and land, while the environmental circumstances have influenced the development and strong expansion of humid lowland woods of pedunculate oak in the Bosut Valley. It is generally believed that this region contains the largest surface area covered by such wodland in Croatia, and probably also in Europe (Sić 1975: 175–180).

This specific geographical background was originally an inhospitable space, due to its marshland and frequent flooding. Today's Bosut Valley, like all of the landscape around us, is very different from what it was in prehistoric times. This is particularly true if we take modern infrastructure and roads into consideration, and the plains, woods and marshes which were hardly passable prior to modern-day melioration. Geographical maps of Croatia, produced by the Austro-Hungarian Empire in the 18th and 19th centuries, which feature all the details such as roads, bridges, brooks, plains, swamps and forests, can give us an idea of what the landscape looked like, at least several centuries ago. In those maps, distances are marked in hours of walking, based on the assumption that it takes 1 hour to make 6000 paces (Buczynski et al. 1999: 7–8). Thus, Vinkovci is 2 hours and 15 minutes away from Ivankovo, 45 minutes from Mirkovci, one hour from

Cerić and Nuštar, one hour and 15 minutes from Jarmina, two-and-a-half hours from Privlaka. A wooden bridge led across the Bosut, and in this part the river was winding and it was 80–90 paces wide. It was possible to ford it only in summer, and only in certain places. The brook of *Erbenica* came down through the forest and ran into the Bosut. In the vicinity of the town, where the banks were higher, the river was 50–85 paces wide. There, it was 5–6 feet deep, while in other areas its depth was 2–3 feet. Its bottom was silty along most of its course, and it could only be crossed over two wooden bridges.

Another brook flowing into the Bosut is called *Nijerkuša*, and it runs from the marsh of *Ivankovački Rit*. This brook was not fordable either, and its bottom was also silty. The water from the Bosut and these two brooks could only be used for watering livestock (Buczynski et al. 1999: 110–111, Section 17). The town of Vinkovci was surrounded by woods, with several additional woody areas in their immediate vicinity (*Topolovica* and *Crni Gaj*). Ponds surrounding Ivankovački Rit, which extends through to the area of Vinkovci, would occasionally dry off and thus become passable, but the marsh itself was never passable.

The map indicates that Stari Mikanovci was half-an-hour away from Novi Mikanovci, two hours and 15 minutes from Đakovo, and just as much from Ivankovo. Several small brooks ran through this area in a southward direction, towards the nearby ponds of *Jelas*, *Grajensko* and *Kaluđer*. There were bridges across the brooks, but during normal water level they could also be forded in several places. With their water, the ponds filled a number of deep, muddy ditches which criss-crossed the large forest and emptied into the River Biđ, which passed through the forest. Together with the Biđ, those ditches could cause extensive flooding throughout the forest during the rainy season and in spring, when the snows melted (Buczynski et al. 1999: 104–105, Section 16). According to calculation by hours, the distance between Stari Mikanovci and Vinkovci was 4 hours on foot.

GEOLOGICAL FEATURES

The geological composition of the region undoubtedly played an important role in the selection of the location for settlement throughout prehistory. The structure of the relief consists primarily of river sediments (sand, gravel, clay and loam), and accumulations of loess and loess sediments (Roglić 1975: 18). These loess sediments are characteristic of the soil in the south-eastern part of the Pannonian Plain (Roglić 1975: 18), and loess and its derivatives cover 35.7% of the territory of Croatia (Galović et al. 2009). During the glaciations of the Middle and Late Pleistocene, strong north-western winds blew in dust from the Alpine region. The dust deposited on lake and river terraces formed loess and created loess plateaus, the main feature of the geography of eastern Croatia (Hećimović 2009).

In the Holocene, temperatures rose and the quantity of water gradually fell. Rivers began cutting their courses in the sediment, thus creating diverse fluvial forms (terraces, meanders etc.). The wider Vinkovci area is made of Quaternary sediments, which can be divided into those originating in the Pleistocene and those created in the Holocene. The Pleistocene sediments are represented by loess and pond-and-land loess, while those of the Holocene consist mainly of pond sediments (Hećimović 2009: 98; Basic Geological Map L 34–98). Loess is a non-stratified, unbound and porous sediment. The fauna shows that it was deposited in cold and dry climates, and also that the climate was variable during the last ice age (Würm). Based on its grain size, loess is silt with admixtures of sand or clay. An important feature is its porosity, usually at a level of 40–60%. Its main mineral component is quartz, which can constitute up to 70% of its composition. In addition to quartz, loess also contains feldspar (up to 20%), muscovite, clay, chlorite, limonite etc. (Herak 1990). The loess layer thickness can vary, and is usually up to 20 m thick, but occasionally also as much as 50 m (the Erdut Hill).

The pond-loess sediments were deposited primarily in low areas, mostly on river terraces. The main mineral component of the pond loess is quartz (up to 60%), while the proportion of calcium carbonate varies (0–30%). Its thickness can be up to 10 m, and in markedly low parts of the terrain it can be as much as 30 m thick (Hećimović 2009: 98–99). Pond sediments were created in the Holocene, and they are tied to the earlier slow water flows or standing waters, which turned into marshland in the lowest areas. There, clays and clay silts were deposited, and those sediments are rich in organic content and up to 3 metres thick. Alluvial sediments were deposited in the valleys of today's rivers. They consist of gravel, sand, silts and clays, and their thickness can vary significantly, although it rarely exceeds10 m (Hećimović 2009: 100–101).

Besides settlements on hilltops, those erected on loess terraces represent a typical form of settlement of the Vučedol Culture. The loess elevations are actually plateaus, whose composition and somewhat higher altitude make them drier, naturally more fertile and environmentally more favourable. The Đakovo-Vinkovci loess plateau has remained between the Danube-Drava and the Sava catchment areas, with an altitude that is 10–15 m higher than the surrounding terrain. At its ends it spreads out, especially towards the slopes of the Fruška Gora mountain, where the thickness of the sediment is greater and can reach 20 m (Roglić 1975: 11–23). In the Bosut Valley, real dry or land loess can be found only in a few places (in the Vinkovci and Gradište surroundings, and between Otok and Nijemci).

11 VUČEDOL CULTURE

The Vučedol Culture is the most interesting of Late Aeneolithic phenomena, and its recognizable pottery shapes and stylistic expressions clearly reflect the spirit of the time in which it emerged. It originated from the region of Slavonia and Syrmia, and from there it later spread to all four corners of the world. The period of the unique Vučedol Culture finished at the very end of the Aeneolithic, after which its core area slowly lost its importance and opened up space for new cultures which were present in this region during the Early Bronze Age.

Although the Vučedol Culture is an easily recognizable prehistoric culture, the scope of the published results of investigations of its sites indicates that they have been underexplored, and that the living conditions and habits of their populations and the characteristics of its settlements are little known. Unfortunately, with the exception of the systematic excavation of the site of Vučedol, other published data are mostly the results of rescue archaeological excavations, which makes it impossible to obtain a comprehensive stratigraphic picture of the sites of the Vučedol Culture and the characteristics of its settlements. Of 63 registered Vučedol sites only 13 have been investigated (19.11%), while others have been registered on the basis of field survey or chance finds kept in museum collections (Balen 2010). Another problem, equally non-negligible, regards the fact that movable archaeological artefacts have not been published, and those are the best indicators of everyday life and the social and economic changes taking place in Vučedol society at the end of the third millennium BC.

Ever since the first data on the Vučedol Culture were published 140 years ago (Deschman 1875), a number of authors have addressed various aspects of the Vučedol Culture: from its origins, through the general characteristics of its settlements and material culture, and its geographic distribution, to its chronological division into the preclassic, early-classic, classic and late settlement phases (For an overview, see Miloglav 2012). The most important feature of the Vučedol Culture might be that it accepted external influences and innovations as much as it maintained some old traditions, which were adjusted to the new times and ways of life. Its pottery repertoire clearly displays influences of the Kostolac and Baden cultures – and, indirectly through them, also of the Sopot and Vinča cultures. Having accepted influences from its predecessors, the Vučedol Culture would also leave its mark on many cultures of the Early Bronze Age that it came into contact with. At that time, its previous unity broke up into a range of regional variants over a wide geographical region.

An inspection of the topographic maps of some of the most important Vučedol sites already clearly suggests that the Vučedol population, when erecting their settlements, abided by certain rules. Surely, one of the most important factors in selecting locations for settlement were naturally prominent and elevated places, located in the vicinity of rivers or brooks. Such locations were a logical choice: they were important both strategically and in terms of communication, while the need to fortify the settlements, once built, depended primarily on their surroundings and the natural configuration of the land. Loess sediments are porous and non-stratified; water passes through them easily and dilutes lime components along its way. The porous loess, with its dry surface, contributed to the creation of fertile soil suitable for pasture, and for this reason this region has always been attractive for human settlement (Miloglav 2012a).

The high number of fortified settlements indicates that the Vučedol population felt the need to live quietly and more permanently in one spot, and to use locations that had previously been occupied and then abandoned, and which could easily be fortified. Generally, they positioned their settlements at spots previously occupied by members of the Starčevo, Sopot, Baden and Kostolac cultures (Vučedol, Sarvaš, Gomolava, Borinci, Damića Gradina, Vinkovci). By putting up settlements on high loess plateaus by rivers, especially the Danube, they protected them from flooding. Thus the first prehistoric settlements in the area of Vinkovci were located on the high left bank of the Bosut, whose elevation, at 88 m above sea level, is much higher than that of the right bank, which also made it better protected from frequent flooding and suitable for settlement.

Topographic features played an important role through all the prehistoric periods, in that settlements simply adapted to the environment in terms of both the economy and settlement organization. The strategic aspect became an important factor only in the Late Aeneolithic, when the settlements were additionally fortified with ditches and palisades. In the new uncertain times, it was evidently necessary to provide settlements with additional protection.

Fortified settlements and permanent presence in a single location suggest that the population engaged in farming, which does not make the Vučedol economy much different from those of the Baden and Kostolac cultures. A need to stay in the same place and be connected with an area reflect a way of life that can be followed continuously from the Late Neolithic, when settlements were grouped into small villages, or hamlets. The long-term presence in a location is perhaps best recorded, from an archaeological point of view, by renovated house floors and the existence of several settlement horizons in the same place within a settlement, and this can be seen at Vučedol, too (Dimitrijević 1979: 283; Durman 1988; Forenbaher 1995: 20; Balen 2005a: 31), as well as in Vinkovci, Sarvaš and Borinci (Dimitrijević 1979: 283). The same situation has been ascertained at the sites of Ervenica and Damića Gradina.

Before the emergence of the Vučedol Culture, in the Carpathian Basin elemental copper had already been forged, and it had been known that copper could be melted and then forged into shape. It was cast in single-piece moulds using the lost-wax (or *cire perdue)* technique (which means that, for each cast object, a prototype had to be made in wax). A novelty which appeared in the Late Aeneolithic was the two-piece mould, which made it possible to produce several moulds from a single prototype. This marked the emergence of the serial production of two-piece moulds, and hence the serial production of copper objects (Durman 1983: 23–31). A large quantity of copper axes and moulds discovered in hoards or as individual finds (at Vinkovci, Vučedol, Sarvaš, Borinci), and evidence of metallurgical activity that can be traced at various sites from the earliest phase of the Vučedol Culture onwards, testify to the important role metallurgy played in Vučedol society.

The Aeneolithic period was marked not only by an understanding and use of copper as a raw material, but also by a new outlook and way of life. In terms of the economy, it meant that animal husbandry had prevalence over land cultivation, as it produced surpluses faster and thus enabled more intensive exchange and trade.

In addition to land farming and animal husbandry, in settlements by rivers, fishing must have had an important role. In contrast to the Vučedol region, the Vinkovci area is rich in woods, its geological base consists of loam, and it is located by the Bosut, a river which does not offer, to the population living in its vicinity, nearly as much as the Danube. Given the circumstances, in this region the Vučedol settlements simply adapted to their environment both in terms of their economy and topography. An analysis of fauna in the 'Streim Vineyard' position at the site of Vučedol has shown that, during the Baden and Kostolac cultures, shellfish were present in greater quantities, while snails were predominant during the Vučedol Culture. The reason for this change is unknown, but there is no doubt that fish, shellfish and snails played a major role in the diet of Aeneolithic cultures living along the banks of the Danube (Paunović & Lajtner 1995). This goes to show that the vicinity of rivers and river courses has always been a natural and logical choice for settlement location, as it ensured subsistence and enabled communication.

The economic strategy of the Vučedol population included land cultivation, animal husbandry, hunting and metallurgy; as a consequence, the society was stratified, with a richer social class standing apart from the remainder of the population. From a social point of view, the formation of strongly-linked patriarchal clan and tribal communities left the Neolithic way of life behind (Težak-Gregl 1998: 111). The social hierarchy is best reflected in burial rituals and indicators present within the concepts of housing and settlement organization. The 'married couple's grave' in the position of Gradac at Vučedol suggests that members of the ruling class of the clan's nobility were buried, and reveals traces of social differentiation, reflected also in the selection of burial location (Dimitrijević 1979).

Burials in graveyards located outside the settlement have not been discovered at any of the Vučedol sites. The sites of Ervenica and Damića Gradina fit perfectly into the general picture of life in the Late Aeneolithic, and the results of analyses carried out in respect of the economic and social facets of those settlements will be discussed in more detail in the following chapters.

12 SETTLEMENTS OF THE VUČEDOL CULTURE IN VINKOVCI AND STARI MIKANOVCI

ERVENICA IN VINKOVCI

Due to its favourable geographical position, the Vinkovci area has provided ideal conditions for settlement ever since prehistory. One of the best-known archaeological sites in this area is the site mentioned in the literature under the name of *Tržnica tell* or *Vinkovci-Hotel*. It is located in the very centre of the town of Vinkovci, on the higher, left bank of the River Bosut; this position has provided ideal conditions for settlement, which can be traced back to the period of the Starčevo Culture. The first finds were discovered at this site in the second half of the 19th century (Brunšmid 1902: 118), while a large rescue excavation at the location of the Hotel Slavonija was carried out in 1977/78, on a surface of 2170 m² (Dimitrijević 1979: 267–341). The stratigraphic record shows that this settlement was inhabited during the Starčevo, Vučedol and Vinkovci cultures, and material was also found which belongs to the Lasinja-Sălcuța and Bodrogkeresztur cultures.

During the urban development of Vinkovci in the second half of the 1970s, and through archaeological rescue excavation carried out intensively in the town over the past 50 years, around 12,000 m² of the Vučedol settlement has been uncovered. The settlement spread over two plateaus, on the left and right sides of the Ervenica brook, while it was enclosed by the Bosut on its southern side (Gale 2002; Miloglav 2007; 2012a). Thanks to some old military maps (Chapter 10), it is possible to identify the course of the Ervenica, filled in within the territory of the town in the middle of the 20th century (*Fig. 39, p. 99*). Today, the only indication of the former brook is a natural depression in Matija Gubec Street, where there is an elevated plateau which drops down towards the Bosut on one side, and towards the former bed of the Ervenica brook on the other side.

The area of Ervenica is located on an elevated plateau to the south-east of the town's main square. It has been mentioned in the archaeological literature for a long time. At the beginning of the 20th century, Josip Brunšmid wrote that the lower part of the Ervenica street (nowadays Matija Gubec Street) was settled as early as the Stone Age (Brunšmid 1902: 120). Here, the first test-pit excavations were carried out by Slobodan Dimitrijević in 1957, and they resulted in the discovery of settlements of the Starčevo and Sopot cultures and a Celtic settlement (Dimitrijević 1966: 6, 36). Dimitrijević recorded finds belonging to the Vučedol Culture only in the position of Poljski Jarak, a ditch, near the eastern perimeter of Ervenica, which was used for draining water overflow from the street. In this part of Ervenica, Matija Gubec Street connects to the Bosut (Dimitrijević 1956: 413, T. III: 1; Dimitrijević 1979a: 138, Map II/3).

From an archaeological point of view, the area of Ervenica is very interesting; unfortunately, the modern urban development prevents systematic exploration which could complete our understanding of inhabitation in this location. Small-scale rescue excavations have been carried out over a number of years, because Ervenica is within a protected archaeological zone. Such excavations are always complex and demanding, because of the modern-day urban infrastructure which makes archaeological and geophysical investigations difficult. In addition, the disturbed stratigraphic picture and limited surface that can be excavated make it impossible to obtain a comprehensive picture of the settlement. On the other hand, rescue excavations are the only method available for recording and documenting archaeological sites located under modern-day towns, and they offer an opportunity to record grids and the appearance of past settlements.

Since the 1990s, archaeological investigations at Ervenica have been limited to small surfaces excavated when new residential and business facilities were built in Matija Gubec Street. Thus far, traces of a Vučedol settlement have been recorded at street numbers between 4 and 19 (Krznarić Škrivanko 1994; Gale 2002; Miloglav 2007; 2012a) (*Fig. 40, p. 100).* According to the investigations carried out to date, traces of inhabitation at the time of the Vučedol Culture have not been identified further to the east of the locations in the vicinity of street numbers 14 and 19. For the time being, Dimitrijević's finds made at the position of Poljski Jarak remain the only chance finds that cannot be archaeologically interpreted.

The site discussed and presented in this book was excavated in 2007, at 14 Matija Gubec Street in Ervenica. It comprised a surface area of 250 m² (Krznarić Škrivanko 2008). The stratigraphic record of the site showed remains of the Sopot Culture, several settlement phases all belonging to the late-classic Vučedol Culture, traces of settlement during the Late Iron Age and a badly damaged and disturbed layer belonging to the Roman period. Although the site consists of several layers, the biggest mark has been left by the Vučedol Culture. In total, remains of the floors of six residential houses were recorded, set in a NE-SW direction, consisting of a yellow packed-loam base and traces of upper house daub. In addition, there were also 14 pits and holes for posts. Unfortunately, due to the small excavation surface, none of the identified house floors has been excavated in its entirety, because each of them extends, at least in part, into the profile. Based on their width of around 4.5 m, they correspond to the regular width of the houses excavated at the site of Vučedol (Forenbaher 1994). The pits were oval, between 0.5 and 2 m in diameter. Traces of floor renovation, and also radio-carbon dates (*Table 1*), demonstrate that this site was settled in two phases, probably within one or two generations (Miloglav 2012) (*Fig. 41, p. 101).* As far as house-floor renovation goes, a similar situation has been recorded at the neighbouring position of the Hotel Slavonija (Dimitrijević 1979: 283).

DAMIĆA GRADINA IN STARI MIKANOVCI

The site of Damića Gradina (the *Damić Hillfort*) is located in the very centre of Stari Mikanovci, on the southern slopes of the Đakovo-Vinkovci loess plateau, which gradually descends towards the south and turns into a plain by the River Sava. The hillfort has been named after its former owners, the Petričević family, known in the village by their nickname of 'Damići' (the *Damićes*). In the archaeological literature, the site was first mentioned in the early 18th century by the travel writer Marsigli (Virc 1979). He also provided a drawing, ground plan and cross-section of the settlement, with clearly visible remains of a fortification system, consisting of a ditch and earthen rampart, and the location of a late-mediaeval defence tower in the southern section of the hillfort. Josip Korda mentioned the site in 1954, remarking that "the 'Damić hillfort' rises in the centre, and remnants of the Neolithic and La Tène (Celtic) period have been identified there" (Korda 1954: 81). In 1980, when the foundations for the elementary school were built, archaeologists of the Vinkovci Town Museum carried out an extensive rescue excavation (Iskra-Janošić 1984) (*Fig. 42, p. 102*).

The excavation ascertained continuity of settlement during the periods of the Sopot, Baden, Vučedol, Vinkovci and Bosut cultures. The final phase of inhabitation in this hillfort was the fortified settlement in the late phase of the Middle La Tène period, in the second half of the 1st c. BC (Dizdar 2001; Potrebica & Dizdar 2002). Since the plan envisaged the construction of the school building in the eastern half of the hillfort, excavations were carried out there, in five trenches 2 and 4 m wide *(Fig. 43, p. 102).*

The results have shown that the hillfort was enclosed by an earthen rampart – fired at two levels, built in the period of the Sopot Culture – and by a ditch, which was probably linked to a small brook flowing to the east of the hillfort. The hillfort plateau is circular, between 117 and 125 m in diameter, while the diameter at the base of the hill is about 170 m. It descends gradually to the south, from a relative height of 8 m, while its height in the north-eastern part of the plateau exceeds 9 m (Iskra-Janošić 1984: 149).

To the east of the hillfort there was a brook which filled the ditch with water. Nowadays it can still be seen on the north-eastern, northern and north-western sides of the hillfort. The entrance to the hillfort was on its most accessible, south-eastern, side (*Fig. 44, p. 103*).

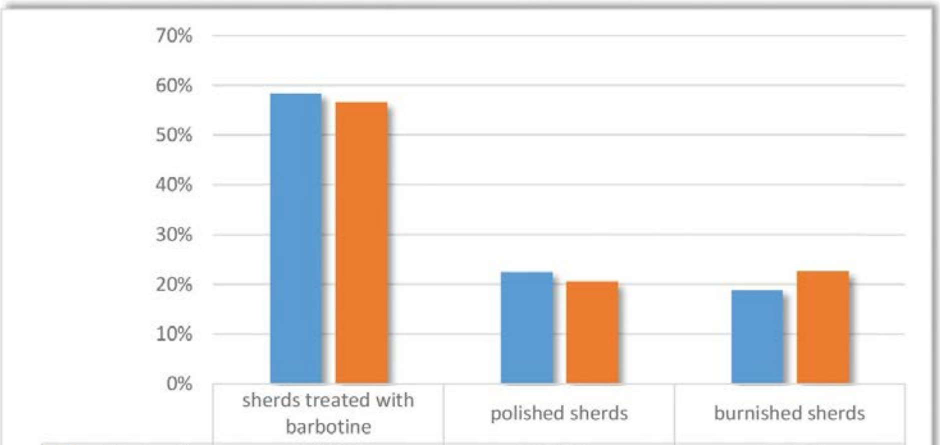
According to the excavation records, house floors which were renovated in the same spot (*Fig. 45, p. 103*), and radio-carbon dates (*Table 1, p. 104*), the Vučedol population of Damića Gradina also lived in this location over several generations.

At both sites, two settlement horizons (or two levels of house floors) have been processed. It can be assumed that the houses were renovated by new generations, which means that several generations lived in the same location – a common occurrence during the Aeneolithic. This assumption could explain the wide range of dates obtained and the pottery material, which displays no major or important differences in diverse stratigraphic units. The 'plateu' in the calibration curve in the period 2900–2600 BC ought to be taken into consideration, too.

13 TYPOLOGICAL-STATISTICAL ANALYSIS

RESULTS OF TYPOLOGICAL-STATISTICAL ANALYSIS

The methodology of pottery processing has been described in detail in chapter 9, and here we will only present the results of typological-statistical analyses concerning both sites. The types were created on the basis of characteristic points established on the vessel's contours, with the aim of reducing the subjectivity of the material's classification. As noted above, different sampling methods were applied at the two sites, resulting in a minimum number of vessels obtained at the site of Ervenica, and a maximum number at the site of Damića Gradina. For some sherds, neither the functional shape nor the type of vessel they belonged to could be established. These were counted and classified into three categories on the basis of the technological criterion, that is, on the basis of the treatment applied to their external surfaces. The large presence of sherds treated with barbotine comes as no surprise, since the majority of these belong to big vessels, which were much more fragmented, due to the vessels' size (*Fig. 46*). Polished and burnished sherds belong primarily to bowls and cups.



	sherds treated with barbotine	polished sherds	burnished sherds
Damića Gradina	58.42%	22.64%	18.94%
Ervenica	56.71%	20.62%	22.67%

Fig. 46 – Comparative figures for sherds of unidentifiable types, according to surface treatment, in the whole sample originating from both sites

In total, 37.95% of the diagnostic sherds from Ervenica were processed, and 31.80% from Damića Gradina, of the total sample (rim, base, handle, decoration). Of these, for 43.17% of the sherds from Ervenica, and 37.87% from Damića Gradina, functionality could not be established due to the small number of relevant parameters. These were primarily small fragments of rims, decorated parts of vessels, and fragments of bases or handles. Such sherds were processed, but they were not taken into account in statistical calculations. The same applies to those sherds whose type could be established (A, B, C etc), but not their variant. Such sherds were processed according to several parameters which put them into a certain category. These parameters are wall thickness, rim and base radius, height and surface treatment. For statistical calculation of percentages of individual types, a total quantity of functionally-identifiable types was taken into consideration, given that the types other sherds belonged to could not be established with certainty. At Ervenica, this amounted to 15.77%, and at Damića Gradina 13.39%, of the total sample (*Table 2*).

	Total number of sherds processed	Typologically unidentifiable sherds	Diagnostic sherds	Sherds for which only type could be identified	Sherds with type and variant
Damića Gradina	5780	3944	1838	1142	**774**
%	100.00%	68.24%	31.80%	19.76%	**13.39%**
Ervenica	1813	1125	688	105	**286**
%	100.00%	62.05%	37.95%	5.79%	**15.77%**

Table 2 – Statistical overview of sherds processed

In previous chapters, it has already been said that the rim is a very important morphological feature, especially relevant for the classification of pottery shapes. The rim has been defined as the margin of the vessel's orifice, and its shape is specified in relation to two features: its direction in respect of the vessel's wall, and its thickness (Shepard 1985: 245). Based on the first parameter, a rim which follows the general line of the wall and represents the vessel's upper extreme point is called a 'direct rim' or 'mouth' (Horvat 1999: 94). The rim can also deviate from that line: it can be everted, inverted or horizontally everted, and it can display various profiles on the edge of the mouth.

Three kinds of rim have been observed in the material processed: straight, inverted and everted, the latter being the most typical shape of a vessel's orifice among the material processed (*Fig. 47*).

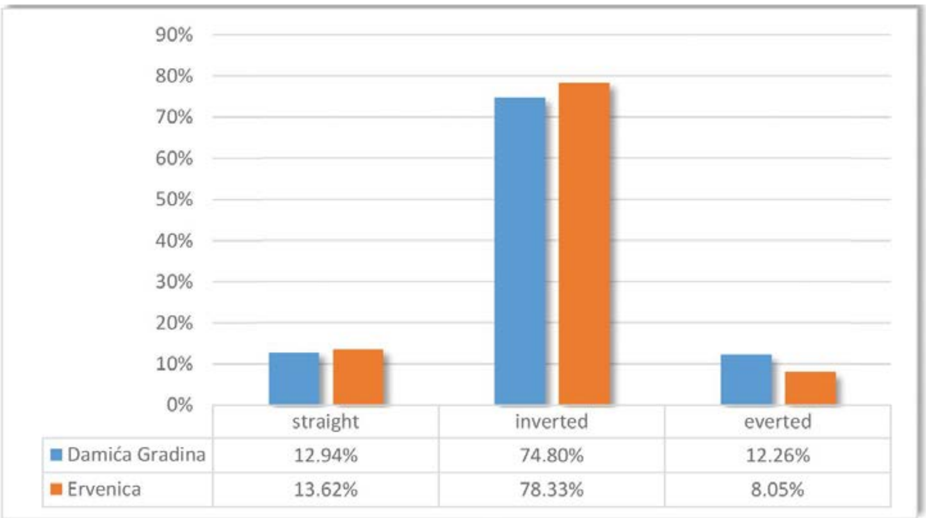


Fig. 47 – Types of rims in the whole sample

Four kinds of base have been identified, on the grounds of their forms: simple/flat base (present in the majority of types), base with a profiled edge, slightly rounded, and *omphalos* base. The latter is characterized by the pushed-in central part of the base, and the name derives from the Greek word *omphalós,* meaning navel. This shape of base appears only in bowls of type A 2. Profiled bases are characteristic primarily of pots, while rounded bases appear primarily on bowls (*Fig. 48*). Handles and grips (*Fig. 49*), as secondary vessel parts, have been described in detail in chapter 7.

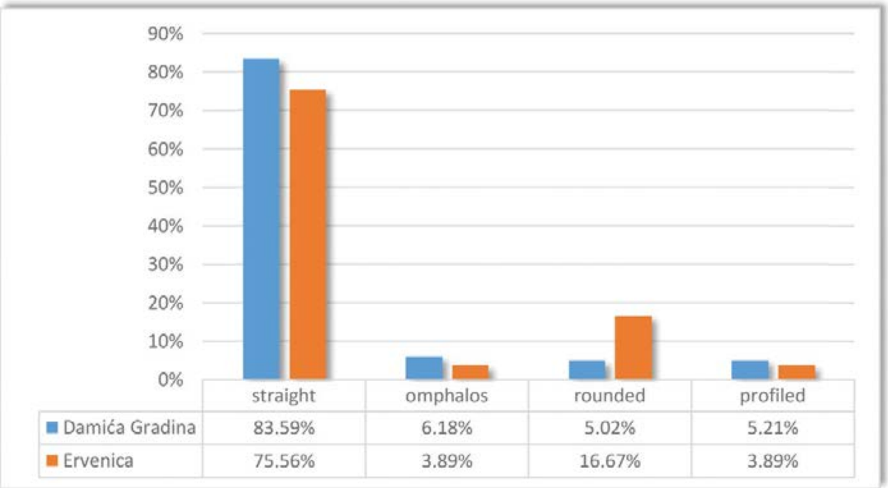


Fig. 48 – Types of bases in the whole sample

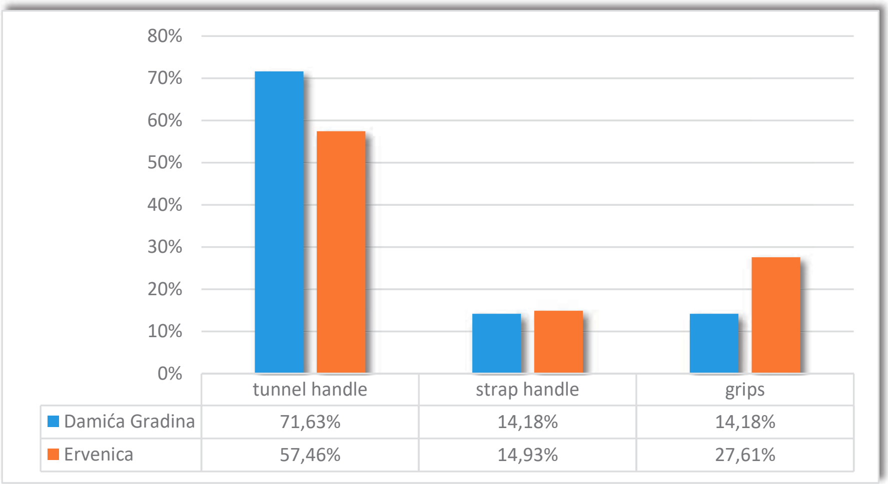


Fig. 49 – Types of handles and grips in the whole sample

The firing of the Vučedol vessels was done mostly in a reducing atmosphere, or under the circumstances of an incomplete oxidizing firing, as presented in *Table 3*. The secondary factors that can influence the colour of the pottery sherd are results of the vessel's exposure to the fire during cooking, and they can be noticed frequently on pottery sherds; however, they can also appear as a consequence of firing in an incomplete oxidizing atmosphere. The Vučedol pottery was fired in an open fireplace or in a pit, given that no kiln has been recorded at any of the investigated sites of the Vučedol Culture.

Oxidizing firing		Reducing firing	Incomplete oxidizing firing	Reducing firing	Reducing firing
			The firing process finished too soon	Secondary factors	Long exposure to fire
DG: E:	n=23 n=34	n= 927 n=353	n=500 n=187	n=55 n=8	n=280 n=74
DG: E:	0.98% 4.72%	39.40% 49.03%	21.25% 25.97%	2.34% 1.11%	11.90% 10.28%

Table 3 – Firing atmosphere according to colour of cross-section of pottery sherds

The tables present mean values for each variant, secondary part of vessel, decoration, and treatment of external and internal surfaces for the material from both sites (DG = Damića Gradina; E = Ervenica). Four kinds of surface working or treatment were identified on the material examined. The data were recorded separately for the internal and external surfaces, in view of the technological importance of this information, and the tables present data for the kind of surface treatment with the greatest presence. The category of *roughened-surface* sherds includes all those sherds whose external surface was treated with barbotine, or deliberately made rough or coarse. *Smooth* treatment implies that the vessel's surface was not treated, or that the treatment was of poor quality. *Polished* surface means that the surface treatment was of a very high quality, resulting in a shiny surface on the vessel. The technique has been described in more detail in chapter 6. The category of *burnished* surface includes all vessels treated using the same technique, but not well enough to obtain a high-quality shine.

In the tables below, the kinds of surface treatment are marked as follows: RS – roughened surface; S – smooth; PO – polished; BU – burnished.

Three categories of vessel size were determined on the basis of the radius of the orifice: small (1-8 cm), medium (9-13 cm) and large (14-22 cm). The distribution into the three categories has been done on the basis of the statistical data regarding frequency of, and deviation in, the orifice radius. Values that could not be measured have not been included in the tables.

A - BOWLS

The following parameters have been used to define the *bowl* functional shape: this shape can have a profiled rim, it usually has no neck – although this is not a rule – and its height varies from 1/3 of the vessel's maximum diameter to being the same as the diameter. Bowls make up the most numerous functional shape at both sites: at Ervenica, they constitute 65.03%, and at Damića Gradina 69.51%, of the total number of functionally identifiable shapes. Six types have been identified at Ervenica, and nine at Damića Gradina, with several subtypes for each of the shapes. Fig. 50 shows the proportions of individual types, and therefore the data will not be repeated in the continuation.

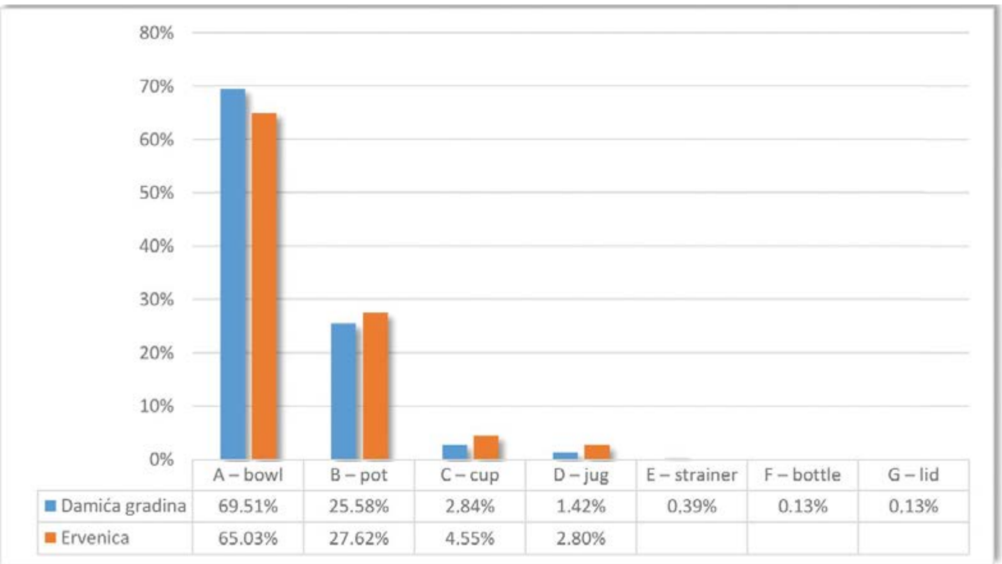


Fig. 50 – Compartive figures for functional types

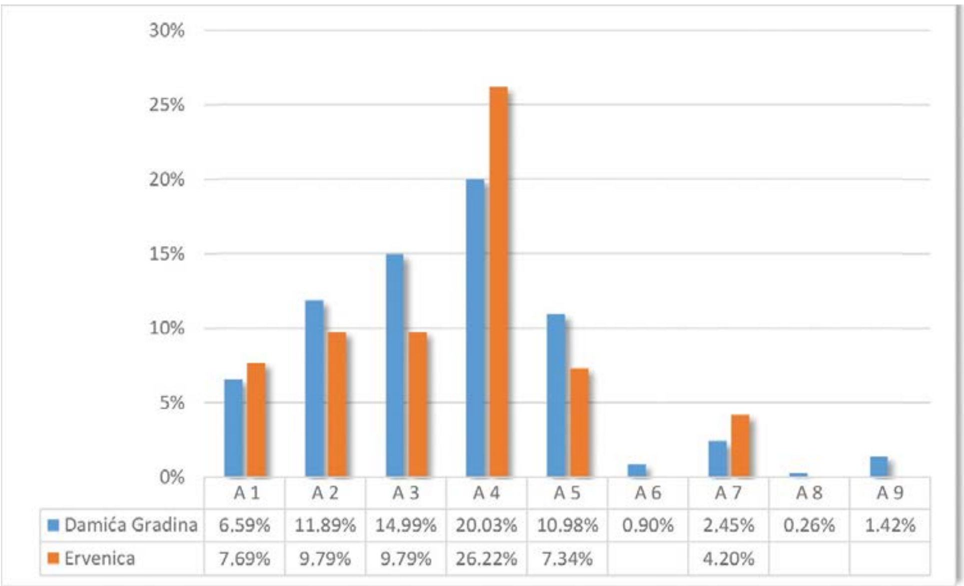


Fig. 51 – Comparative figures for type A

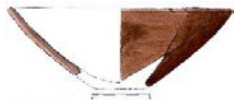
Type A 1		**A 1a**	**A 1b**	**A 1c**	**A 1d**
					
Contour		2 EP			
Percentage of total	DG:	1.29%	1.16%	1.42%	2.71%
	E:	1.75%	2.80%		3.15%
Height (cm)	DG:	5.58	2.60	6.05	13.23
	E:	5.18	5.90		-
Orifice radius (cm)	DG:	10.03	2.66	6.46	7.50
	E:	10.90	5.50		11.87
Wall thickness (mm)	DG:	12.73	6.21	7.25	8.44
	E:	12.09	6.59		7.96
Grips		+	+	-	+
Handles		-	-	-	-
Surface treatment (ext./int.)		S/S	S/S	S/S	S-BU/S-BU
Decoration		-	-	-	-
Size		M	S	S	M, L
Plate/Fig.		Pls 1, 2; Figs 29, 30, 34, 75	Pl. 3: 1, 2	Pl. 3: 3, 4	Pl. 3: 5, 6

Table 4 – Illustrations of variants A 1a, 1c and 1d – Damića Gradina; A 1b – Ervenica

Type A 2		A 2a	A 2b
			
Contour		1 EP + 1 CP + 1 IPVT	1 EP + 1 OPVT + 1 IPVT
Percentage of total	DG:	4.65%	2.97%
	E:	3.85%	2.45%
Height (cm)	DG:	13.67	4.20
	E:	-	3.36
Orifice radius (cm)	DG:	9.24	8.94
	E:	8.74	8.74
Wall thickness (mm)	DG:	6.25	6.52
	E:	7.00	7.00
Grips		+	-
Handles		-	-
Surface tre-atment (ext./int.)		PO-BU/ PO-BU	PO-BU/ PO-BU
Decoration		+	+
Size		M, L	S, M
Plate/Fig.		Pl. 4; Figs 32, 34, 75	Pl. 5; Figs 1, 28: 2

Table 5 – Illustrations of variants A 2a – Damića Gradina; A 2b – Ervenica

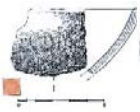
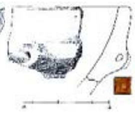
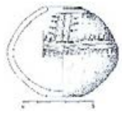
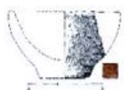
Type A 3		A 3a	A 3b	A 3c	A 3d	A 3e	A 3f
							
Contour		2 EP + 1 OPVT					
Percentage of total	DG:	10.98%	2.20%	1.16%	0.26%	0.26%	0.13%
	E:	9.79%					
Height (cm)	DG:	7.37	4.12	-	4.90	4.33	3.70
	E:	-					
Orifice radius (cm)	DG:	13.91	4.60	9.57	1.75	3.35	3.10
	E:	11.10					
Wall thickness (mm)	DG:	7.96	5.44	7.29	4.74	5.42	7.50
	E:	7.55					
Grips		-	-	+	-	-	-
Handles		-	-	-	-	-	-
Surface tre-atment (ext./int.)		PO-BU/PO-BU	S/S	S-BU/S-BU	S/S	S/S	S/S
Decoration		-	-	-	+	-	-
Size		M, L	S	M	S	S	S
Plate/Fig.		Pl. 6	Pl. 7: 1, 2	Fig. 24	Pl. 7: 3	Pl. 7: 4	-

Table 6 – Illustrations of variants A 3a – Ervenica; A 3b - 3f – Damića Gradina

Type A 4		**A 4a**	**A 4b**	**A 4c**	**A 4d**	**A 4e**
						
Contour		2 EP + 1 CP+ 1 IPVT				
Percentage of total	DG:	4.26%	1.42%	12.40%	1.68%	0.26%
	E:	13.64%	3.15%	8.39%		1.05%
Height (cm)	DG:	7.9	-	-	-	5.81
	E:	9.20	-	6.9		-
Orifice radius (cm)	DG:	11.51	11.38	12.56	-	6.16
	E:	11.46	14.88	13.58		-
Wall thickness (mm)	DG:	6.58	7.37	6.96	7.85	7.25
	E:	6.88	6.91	7.03		7.17
Grips		+	+	+	-	-
Handles		-	-	-	+	-
Surface tre-atment (ext./int.)		PO-BU/BU-PO	PO-BU/BU-PO	PO-BU/PO-BU	BU/S-BU	PO-BU/PO-BU
Decoration		-	-	+	+	+
Size		M, L	M, L	M, L	-	S
Plate/Fig.		Pl. 7: 7; Fig. 23	Pl. 7: 5, 6	Pls 8-10; Figs 28: 3- 4; 58, 74, 75, 81, 83	-	Pls 11, 12

Table 7 – Illustrations of variants A 4a - 4c – Ervenica; A 4d and 4e – Damića Gradina

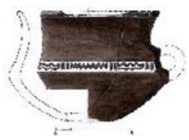
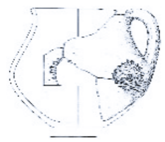
Type A 5		**A 5a**	**A 5b**
			
Contour		2 EP + 1 OPVT + 1 IPVT + 1 IP	
Percentage of total	DG:	3.10%	1.29%
	E:	1.05%	0.70%
Height (cm)	DG:	11.78	12.00
	E:	12.00	-
Orifice radius (cm)	DG:	6.87	5.50
	E:	5.50	5.98
Wall thickness (mm)	DG:	6.32	5.91
	E:	6.88	6.08
Grips		-	-
Handles		+	+
Surface treatment (ext./int.)		PO-BU/BU-PO-S	PO-BU/BU-PO-S
Decoration		+	+
Size		S, M	S, M
Plate/Fig.		Pls 13, 14; Figs 19, 30, 56, 57, 73	Pl. 15; Figs 22, 31

Table 8 – Illustrations of variants A 5a and 5b – Damića Gradina

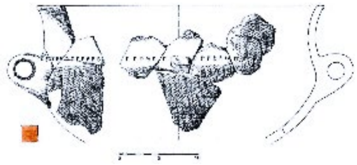
Type A 6	**A 6a**	
		
Contour	2 EP + 1 OPVT + 1 IPVT + 1 IP	
Percentage of total	DG:	0.90%
Height (cm)	DG:	-
Orifice radius (cm)	DG:	14.30
Wall thickness (mm)	DG:	9.14
Grips	-	
Handles	+	
Surface treatment (ext./int.)	RS/BU	
Decoration	+	
Size	L	
Plate/Fig.	Pl. 17: 1, 2	

Table 9 – Illustration of variant A 6a – Damića Gradina

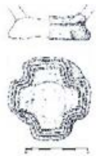
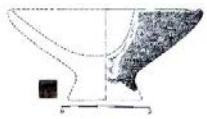
Type A 7		**A 7a**	**A 7b**	**A 7c**
				
Contour	2 EP + 1 CP			
Percentage of total	DG:	0.13%	0.39%	0.39%
	E:	0.35%	1.05%	0.70%
Height (cm)	DG:	-	4.25	-
	E:	-	5.00	-
Orifice radius (cm)	DG:	-	4.50	-
	E:	-	6.00	-
Wall thickness (mm)	DG:	8.37	5.77	6.69
	E:	9.30	6.56	4.91
Grips		-	+	-
Handles		-	-	-
Surface treatment (ext./int.)		PO/PO-BU	PO-BU/BU-S	PO/PO-BU
Decoration		+	-	+
Size		-	S	-
Plate/Fig.		Pl. 17: 3; Fig. 75	Pl. 18: 1, 2	Pl. 18: 3, 4, 5, 7

Table 10 – Illustrations of variants A 7a - 7c – Damića Gradina

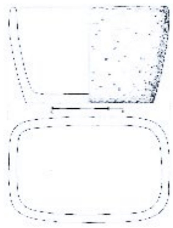
Type A 8		**A 8a**
		
Contour		2 EP
Percentage of total	DG:	0.26%
Height (cm)	DG:	7.40
Orifice radius (cm)	DG:	5.20
Wall thickness (mm)	DG:	6.56
Grips		-
Handles		-
Surface treatment (ext./int.)		S/S
Decoration		-
Size		S
Plate/Fig.		Pl. 21: 1

Table 11 – Illustration of variant A 8a – Damića Gradina

Type A 9		**A 9a**	**A 9b**	**A 9c**
				
Contour		2 EP + 1 IPVT + 1 OPVT + 1 IP	2 EP + 1 CP + 1 IPVT	2 EP + 1 OPVT + 1 CP
Percentage of total	DG:	0.52%	0.13%	0.78%
Height (cm)	DG:	4.90	-	8.40
Orifice radius (cm)	DG:	2.70	3.80	4.12
Wall thickness (mm)	DG:	4.23	4.57	5.76
Grips		-	-	+
Handles		-	-	-
Surface treatment (ext./int.)		PO-S/S-BU	PO/BU	S-BU/S
Decoration		-	-	+
Size		S	S	S
Plate/Fig.		Pl. 21: 2, 3	-	Pl. 21: 4, 5

Table 12 – Illustrations of variants A 9a - 9c – Damića Gradina

B - POTS

A pot has been defined as a vessel, with or without a neck, whose height is usually greater than its maximum diameter. At Damića Gradina, this type accounts for 25.58% of the total number of sherds of identifiable type, and at Ervenica for 27.62% (*Fig. 52*).

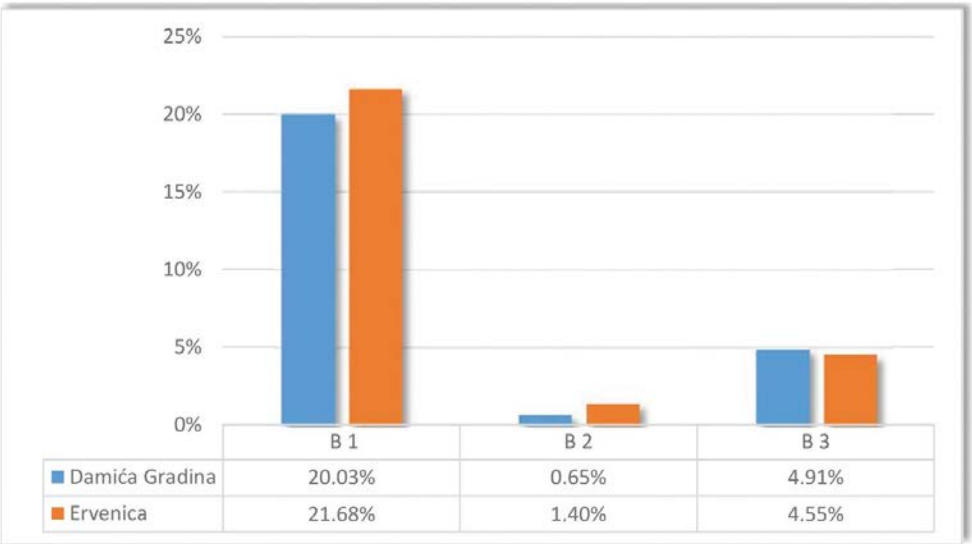


Fig. 52 – Comprative figures for type B

Type B 1		**B 1a**	**B 1b**	**B 1c**	**B 1d**
					
Contour		2 EP + 1 OPVT + 1 IPVT + 1 IP			
Percentage of total	DG:	11.37%	7.49%	0.90%	0.26%
	E:	10.14%	3.50%		2.10%
Height (cm)	DG:	34.91	22.40	-	-
	E:	-	-		-
Orifice radius (cm)	DG:	10.74	7.22	13.12	9.00
	E:	9.30	6.50		6.10
Wall thickness (mm)	DG:	8.82	6.98	8.76	9.05
	E:	8.03	6.18		7.19
Grips		+	+	+	+
Handles		+	+	+	+
Surface tre-atment (ext./int.)		RS/BU	RS-S/BU	RS/BU	RS/BU
Decoration		+	+	+	+
Size		M, L	S, M	M, L	S, M
Plate/Fig.		Pls 22-24; Figs 25, 75, 78	Pl. 25; Fig. 79	Pl. 26	Pl. 27

Table 13 – Illustrations of variants B 1a - 1c – Damića Gradina; B 1d – Ervenica

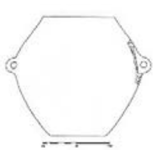
Type B 2		B 2a	B 2b	B 2c	B 2d
					
Contour		2 EP + 1 OPVT			
Percentage of total	DG:		0.13%	0.39%	0.13%
	E:	1.40%			
Height (cm)	DG:		10.50	-	-
	E:	-			
Orifice radius (cm)	DG:		3.00	-	6.00
	E:	-			
Wall thickness (mm)	DG:		5.95	6.96	7.10
	E:	5.14			
Grips		+	-	-	+
Handles		+	+	+	-
Surface tre-atment (ext./int.)		PO-S/S	PO/S	PO/BU	PO/S
Decoration		+	+	+	+
Size		-	S	-	S
Plate/Fig.		Pl. 28: 3	Figs 15, 30	Pl. 28: 1	Pl. 28: 2

Table 14 – Illustrations of variants B 2a – Ervenica; B 2b - 2d – Damića Gradina

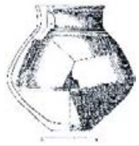
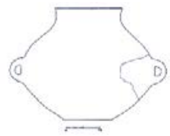
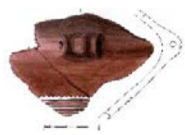
Type B 3		B 3a	B 3b	B 3c	B 3d
					
Contour		2 EP + 1 OPVT + 1 CP			
Percentage of total	DG:	0.13%	1.94%	0.39%	0.13%
	E:	0.35%	3.50%	0.70%	
Height (cm)	DG:	8.70	31.10	-	-
	E:	11.40	-	-	
Orifice radius (cm)	DG:	2.24	6.50	-	-
	E:	3.10	7.99	-	
Wall thickness (mm)	DG:	4.24	8.37	7.33	6.64
	E:	4.94	9.97	8.14	
Grips		-	+	+	-
Handles		-	+	+	+
Surface tre-atment (ext./int.)		PO/BU	PO-S/S	S/S	BU/S
Decoration		+	+	+	+
Size		S	M, L	-	-
Plate/Fig.		Fig. 55	Pl. 29; Figs 21, 80	-	-

Table 15 – Illustrations of variants B 3a and 3c – Ervenica; B 3b and 3d – Damića Gradina

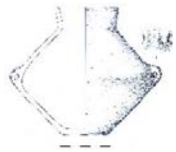
Type B 3		B 3e	B 3f	B 3g
				
Contour	2 EP + 1 OPVT + 1 CP			
Percentage of total	DG:	0.13%	0.13%	0.26%
Height (cm)	DG:	12.20	-	-
Orifice radius (cm)	DG:	3.10	8.00	-
Wall thickness (mm)	DG:	5.06	10.07	5.47
Grips		-	-	-
Handles		+	+	+
Surface treatment (ext./int.)		PO/BU	RS/S	PO/BU
Decoration		-	+	+
Size		S	S	-
Plate/Fig.		Figs 16, 33	-	-

Table 16 – Illustrations of variants B 3e - 3g – Damića Gradina

C – CUPS

The cup has been defined as a vessel with a handle, and whose orifice diameter is usually the same as its height. Three types of cups have been identified, and their relative quantities are shown in Fig. 53.

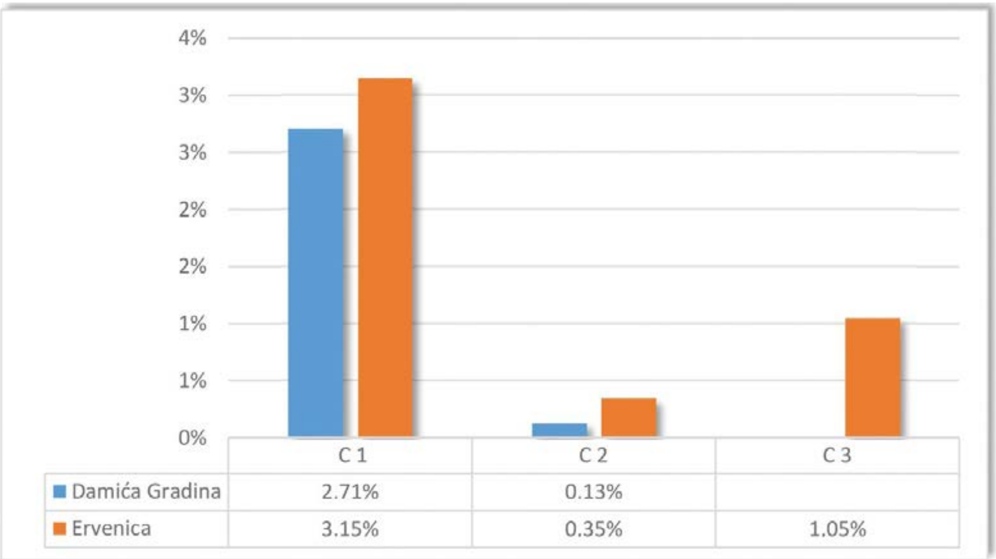


Fig. 53 – Comparative figures for type C

Type C 1		C 1a	C 1b
			
Contour	2 EP + 1 OPVT + 1 IPVT + 1 IP		
Percentage of total	DG:	2.71%	
	E:	2.45%	0.70%
Height (cm)	DG:	10.50	
	E:	8.00	-
Orifice radius (cm)	DG:	3.83	
	E:	3.90	-
Wall thickness (mm)	DG:	5.99	
	E:	4.75	6.36
Grips	-		-
Handles	+		+
Surface treatment (ext./int.)	PO-BU-S/S-BU		PO/S-BU
Decoration	-		+
Size	S		S
Plate/Fig.	Pl. 30: 1-2; Figs 75, 76		-

Table 17 – Illustrations of variants C 1a – Damića Gradina; C 1b – Ervenica

Type C 2 – C 3		C 2a	C 3a
			
Contour	2 EP + 1 OPVT + 1 CP		2 EP + 1 IPVT + 1 CP
Percentage of total	DG:	0.13%	
	E:	0.35%	1.05%
Height (cm)	DG:	-	
	E:	8.05	8.16
Orifice radius (cm)	DG:	-	
	E:	4.00	4.25
Wall thickness (mm)	DG:	5.48	
	E:	5.45	5.12
Grips	-		-
Handles	+		+
Surface treatment (ext./int.)	S/S		PO-BU/S-BU
Decoration	-		-
Size	S		S
Plate/Fig.	-		Pl. 30: 3

Table 18 – Illustrations of variants C 2a and C 3a – Ervenica

D – JUGS

The jug has been defined as a vessel with a neck and a handle, and whose height is greater than its maximum diameter.

Type D 1 – D 2		D 1a	D 2a
			
Contour		2 EP + 1 OPVT + 1 CP	2 EP + 1 OPVT + 1 IP
Percentage of total	DG:	0.13	1.29%
	E:	0.35%	2.45%
Height (cm)	DG:	-	-
	E:	14.00	-
Orifice radius (cm)	DG:	-	6.00
	E:	6.60	6.25
Wall thickness (mm)	DG:	4.68	7.08
	E:	4.95	7.80
Grips		-	-
Handles		+	+
Surface treatment (ext./int.)		S-BU/S-BU	S-BU/S-BU
Decoration		-	-
Size		S	S
Plate/Fig.		Figs 75	-

Table 19 – Illustrations of variants D 1a – Ervenica; D 2a – Damića Gradina

E – STRAINERS

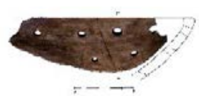
Type E 1 – E 2		E 1a	E 2a
			
Contour		2 EP + 1 OPVT	
Percentage of total	DG:	0.13%	0.26%
Height (cm)	DG:	7.50	-
Orifice radius (cm)	DG:	9.00	6.50
Wall thickness (mm)	DG:	6.50	7.65
Grips		+	-
Handles		-	-
Surface treatment (ext./int.)		PO/PO	PO/PO
Decoration		-	-
Size		S	S
Plate/Fig.		Figs 75, 77	Fig. 75

Table 20 – Illustrations of variants E 1a and E 2a – Damića Gradina

F – BOTTLE

Type F		F 1a
		
Contour		2 EP + 1 OPVT + 1 CP
Percentage of total	DG:	0.13%
Height (cm)	DG:	21.5
Orifice radius (cm)	DG:	2.95
Wall thickness (mm)	DG:	5.02
Grips		-
Handles		+
Surface treatment (ext./ int.)		PO/BU
Decoration		+
Size		S
Plate/Fig.		Pls 31, 32

Table 21 – Illustration of variant F 1a – Damića Gradina

DECORATION

Decoration, or style, regards the visual component which is specific for a particular period and place, and which conveys information about the identity of the community which developed it and about the place in which it emerged (Rice 1987: 244). There are several approaches to the analysis of decorative styles which, since the 1960s, have departed from the attribution of style as a merely chronological parameter and its classification into cultural groups (Shepard 1985; Rice 1987). Without going into these analyses, recording of decoration present on pottery should be detailed enough to serve those who will engage in decoration analysis, or in comparing one style with another. The formal aspects of decoration include its adaptation to the vessel's shape, its composition, use, symmetry and colour, and it was up to the potter to choose the area of the vessel which would feature the decoration (Shepard 1985: 255–261).

The decorative style and techniques, and the rich repertoire of very precisely rendered motifs, set the Vučedol Culture apart from all other pottery styles of prehistoric communities. Decoration has become a Vučedol *brand*, a feature that has made this culture recognizable, and it has become the first association that comes to mind when the Vučedol Culture is mentioned. In the classic phase of development of the Vučedol Culture, a special repertoire of shapes and ornaments was developed, stylistically highly recognizable. Although decorative techniques, some motifs and shapes were taken over from earlier cultures, the skill and style developed by the Vučedol potters sets Vučedol pottery production apart as a highly distinct phenomenon.

On Vučedol vessels, motifs were rendered by furrowing and notching, applied on their own or in combination with simple incising and puncturing, with carved-out motifs filled with white – and more rarely red – paste or incrustation. These techniques have been described in greater detail in Chapter 6.

Filling the motifs with incrustation had been known before, but for the Vučedol Culture this technique was very important (*Fig. 55, p. 120*). The incrustation was of exceptionally fine texture, and it was applied very precisely into carved-out motifs (*Fig. 56, p. 121*), which were present on some vessels to such a large extent that they covered almost the entire vessel's surface. Analyses have shown that the mixture was obtained from the shells of fresh-water molluscs (Chapter 16).

The pattern in which the motifs appear indicates that specific ornaments were 'reserved' for certain types of vessels. Thus, the motif of clepsydra appears on nearly all decorated vessels but types A 5 and A 7, while the solar motif is present only on types A 5 and A 4e.

The ornament can most often be found on the transition from the shoulder to the body, and in combination with decoration under the vessel's rim, but types A 7a, A 7c and A 4e are decorated all over their internal and external surfaces (Pls 11, 12, 19, 20). Tunnel handles are almost always decorated, often with the motif of the St. Andrew's cross (*Figs 56, 57, p. 121*), which is also very common on bowls of the A 4c type (*Fig. 58, p. 121*).

The decoration present on finely-worked vessels that belong to the functional type of bowls is characterized by the so-called architectonic style, typical of the classic phase of the Vučedol Culture, which is phase B-2 according to Dimitrijević (Dimitrijević 1979); the archaeological sites discussed in this book belong to that phase. Characteristic of this method of decoration is its pronounced tendency to geometrize the surface, and its wide repertoire of diverse motifs, ranging from simple zig-zag lines, triangular and rectangular motifs, and the very frequent motif of clepsydra, through to some more complex combinations such as rhombuses inserted into rectangular fields, St. Andrew's crosses and chequerboards (Pls 9, 10, 16, 31, 32). The whole surface of the vessel is divided into regular friezes containing motifs filled with white, and more rarely red, incrustation (Pl. 18: 6; *Fig. 60, p. 122*).

Furrowing is the predominant decoration technique applied to bowls (*Fig. 59, p. 122*), used either on its own or in combination with simple incising and notching.

Large notched surfaces filled with incrustation are most typical of type A 5. Motifs rendered in this way leave the impression of being three-dimensional, due to the marked contrast between the black surface of the vessel and the white or red motif (*Figs 56, 60, pp. 121-122*). In view of the large surface necessary to apply this technique, where the clay has to be removed from the carved-out motif, it could not be executed on other types of bowls where the surface on which the technique would be applied was limited.

Decoration on vessels with roughened-surface, which belong to the functional type of pots, was rendered by puncturing, usually on the transition from the neck to the shoulder, and under the vessel's rim. The motifs executed by this technique show that the most widely-used implements had circular cross-sections, followed by tools leaving square, triangular and elongated motifs (*Fig. 61, p. 123*); there were also motifs made by unusual tools (*Fig. 62, p. 123*). The implements used were most often made of organic materials, and for this reason they have rarely been found in archaeological contexts. Most often, they were wooden and bone tools, used either in their natural form or modified to obtain a desired shape, depending on the potter's preference.

The second-most frequent decoration technique used on pots is impression, most often applied using fingertips or nails, and tools that leave elongated lines. This technique was used to decorate the vessel's rim, transition of the neck to the shoulder, and applied bands (*Fig. 63, p. 124*). The grooving technique was used only on tunnel handles and cannot be found on other morphological elements of vessels (Pl. 24; *Fig. 20, p. 70*).

The precisely executed and rich motifs are yet another element of the Vučedol ceramatology, which demonstrates that the potters were highly skilful, knowledgeable and experienced. Those less skilful can be recognized by unfinished or asymmetrical motifs, while some others have left their personal 'mark' on the vessels (*Fig. 64, p. 124*).

There is no doubt that specific shapes of vessels, and the motifs present on them, carried special social or religious meaning for the community, and that they were used for special occasions, as an indication of power or hierarchical relations which can be distinguished in the Vučedol Culture, and for burial customs. However, an analysis of style, and especially of the symbolism of specific motifs and their compositions, would require a particular approach and methodology which go beyond the topic of this book.

14 AGRICULTURAL AND ECONOMIC ASPECTS OF THE VUČEDOL SETTLEMENTS

ARCHAEOBOTANIC ANALYSIS

Research into the environment people had lived in began with the pioneering work of Graham Clark in the post-war period, and was expanded to include analysis of the landscape and climatic conditions in which the people had lived. With his work, Clark prompted great scientific advance, with laboratory examinations of biological remains (such as animal bones and plant remains recovered during archaeological excavations), together with their interpretation in the light of economic and environmental aspects, developing into specializations such as zooarchaeology, palaeoethnobotany and bioarchaeology (Trigger 1989).

One of the main goals of archaeobotany is the research of the history of plant cultivation, or the study of the link between man and vegetation. In contrast to pollen analysis, archaeobotany primarily studies remains of those plant species that are linked exclusively to human activities (Price 2007: 350). Remains of archaeological structures which testify to human activity – such as cultural layers, waste pits and houses – contain evidence that makes it possible to reconstruct and identify fossil plants, and links between man and his environment. These links can help us visualize a complete picture of cultural and natural changes occurring over time, the way in which man exploited his environment, how much he adapted to it, and how much he influenced the changes in his surroundings.

Nowadays, when archaeology has undoubtedly become an interdisciplinary science, archaeobotany is a discipline without which it would be impossible to imagine reconstruction of the landscape, the degree of land cultivation and the dietary habits of the population in any archaeological context. The remains of fossil plants allow us to identify agricultural activities of past populations, that is, the sorts of plants that were grown and used for everyday nutrition.

Archaeobotanic analysis has been done on four samples from the site at 14 Matija Gubec Street. One was taken from pit SU 49/50, and the remaining three from pit SU 47/48. The analysis was performed by Dr. Kelly Reed of the University of Leicester (Reed 2012; 2016). The separation

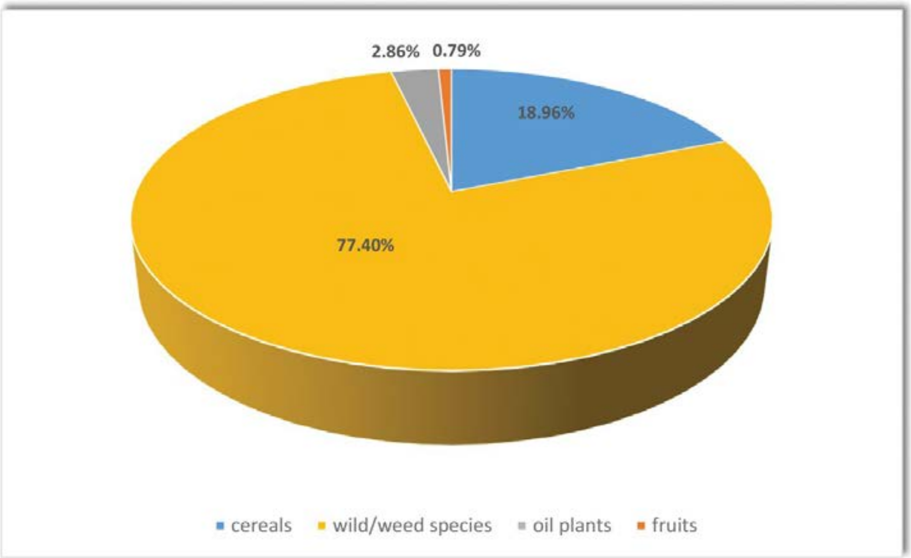


Fig. 65 – Total frequency of plant remains

of carbonized plant remains collected during the archaeological excavation was done through soil samples being washed off using a flotation device. Plant remains that can be identified after they have been dried, and after other material (earth, recent weeds and grasses) has been removed, are in very good condition, because they are not prone to bacterial and fungal contamination. The large number of identified plant species at the site of Ervenica, and two samples consisting of over 384 plant remains, suggest that samples are better preserved at sites that have been inhabited intensively and over a long period of time (Reed 2016).

The results of the analysis have shown higher presence of wild-plant species (77.40%) over cultivated plants, especially cereals (18.96%) (*Fig. 65*).

The best-represented cereal is wheat, primarily emmer (*Triticum dicoccum*), followed by einkorn wheat (*Triticum monococcum*), spelt (*Triticum spelta*) and bread wheat (*Triticum aestivum/durum*). The next best-represented cereal is barley (*Hordeum vulgare*) and hulled or naked barley (*Hordeum vulgare var. nudum*). A single case of rye (*Secale cereale*) has been recorded, which does not mean that rye was grown deliberately – it could have been present in fields sown with wheat. In central Europe, rye began to be grown as a 'secondary crop' only in the Late Iron Age, and it had come here as a weed present in wheat and barley (van Zeist 1974–78: 13). Only two specimens of broomcorn millet (*Panicum miliaceum*) have been recorded (*Table 22*).

CEREALS	N. of macrofossils	%
Cereals (Cerealia indet.)	16	5.13%
Wheat *(Triticum* spp.)	51	16.35%
Emmer (*Triticum dicoccum* L.)	125	40.06%
Einkorn *(Triticum monococcum* L.)	53	16.99%
Triticum mono/dicoc	32	10.26%
Bread wheat *(T. aestivum/durum* L.)	16	5.13%
Hulled barley *(Hordeum vulgare var. nudum* L.)	9	2.88%
Barley *(Hordeum vulgare hulled* L.)	7	2.24%
Rye *(Secale cereale* L.)	1	0.32%
Broomcorn millet (*Panicum miliaceum* L.)	2	0.64%
Total	312	100.00%

Table 22 – Total number of cereal macrofossils

Glume wheat chaff has been found to be rare, while flax seeds (*Linum usitatissimum*) have been recorded in numbers higher than at other sites from the same period (Reed 2016).

Tasty, vitamin-rich fruits of several wild fruit species could be gathered in the nearby woods: cornelian cherry (*Cornus mas*), elderberry (*Sambucus sp.*) and Chinese lantern (*Physalis alkekengi*). Some wild fruits could also have been used for medicinal purposes. The fruit of Chinese lantern has pronounced curative properties, while cornelian cherry is a deciduous shrub of which only the fruits are used for medicinal purposes. Remains of these wild species have also been found at the nearby archaeological site of Sopot (Krznarić Škrivanko 2015). The samples also contained a relatively large number of wild-plant and weed species, including a high concentration of grass species (*Bromus* sp.), white goosefoot / fat hen (*Chenopodium album*), grasses (*Gramineae*), corncockle (*Agrostemma githago*) and two samples of viola (*Viola* sp.) (*Table 23*).

WILD PLANTS AND WEED SPECIES	N. of macrofossils	%
Agrostemma githago L.	2	0.16%
Asteraceae	1	0.08%
Gramineae	230	18.05%
Bromus sp.	381	29.91%
Lolium sp.	1	0.08%
Sambucus ebulus	3	0.24%
Phleum sp.	10	0.78%
Chenopodium sp.	108	8.48%
Chenopodium album L.	513	40.27%
Cyperaceae	1	0.08%
Dasypyrum/Secale sp.	1	0.08%
Galium aparine L.	2	0.16%
Hypericum sp.	1	0.08%
Polygonum sp.	2	0.16%
Potentilla sp.	1	0.08%
Teucrium sp.	2	0.16%
Verbena officinalis L.	1	0.08%
Viola sp.	2	0.16%
Small-seeded legumes	12	0.94%
Total	1274	100.00%

Table 23 – Total number of macrofossils of wild-plant and weed species

In agriculture, weeds are understood to be simple, wild plants which grow in our arable fields against our will, together with the agricultural crops, thus causing damage that is reflected in the yield. They usually emerge in places in which human activity is present. Weeds can be divided into those associated with the vegetation of summer crops, and those associated with winter crops. Of the weeds associated with summer crops (class Chenopodietea), remains of white goosefoot (*Chenopodium album*) and pale persicaria (*Polygonum lapathifolium*) have been recorded at Ervenica. Also related to such fruits are ruderal plants, which grow by waste deposits, along the edges of woods and paths, and on ruins, while some of them also spread to agricultural

Presence of wild/weed species associated with summer crops	Total n. of macrofossils	%
Chenopodiaceae	108	8.48
Chenopodium album L.	513	40.27
Polygonum sp.	2	0.16
Presence of wild/weed species associated with winter crops		
Bromus sp.	381	29.91
Wild/weed species in total	1274	100.00

Table 24 – Comparative figures for weeds associated with summer and winter crops

land. For this reason, it is difficult to draw a line between the two plant communities (Kučan et al. 2006: 66). Weeds that are specifically found in conjunction with winter crops (class Secalietea) are represented only by the species of brome grasses (*Bromus*). Based on their proportions, the assumption can be made that cereals were grown primarily as summer crops (*Table 24*). Emmer (*Triticum dicoccum*) and broomcorn millet (*Panicum miliaceum*) were grown as summer crops, while einkorn (*Triticum monococcum*) was grown as a winter crop. Barley (*Hordeum vulgare*) features the highest adaptability to the conditions in its habitat, and thus it could have been grown as either summer or winter variety (Kučan et al. 2006: 66).

Wild plants were probably used as replacements for cereals during periods of shortage, and as herbs or greenery for some kind of soup (Hršak 2009). Recent research suggests that many weeds discovered by archaeological excavation were used as the first vegetables in human nutrition. This category includes seeds of white goosefoot (*Chenopodium album*) and pale persicaria (*Polygonum lapathifolium*), plants that can be found as weeds among spring cereals and in vegetable gardens, which grow in moderately warm climates and in nitrogen-rich habitats (Kučan et al. 2006: 66). At Ervenica, a large number of white goosefoot seeds have been identified (40.27%), while the presence of pale persicaria was not significant (0.16%). The question remains open whether the Ervenica population collected white goosefoot and used it in their diet as a vegetable (due to its fleshy leaves). A similar situation has been recorded at the Neolithic site of Okolište (Kučan et al. 2006).

The great quantity of wild-plant and weed species could indicate the possibility that the cereals had not been cleaned, and the species present could also point to the vegetation which grew in nearby meadows and gardens, and in the settlement's surroundings. The information about the presence of wild-plant and weed species is undoubtedly a very valuable piece of information on the prehistoric environment, vegetation, and usability of nearby meadows and pastures.

The cereals recovered from the site of Ervenica paint a familiar picture of the tilling economy of the Aeneolithic period in central and south-eastern Europe, as evidenced by the results of archaeobotanic analyses done at various sites in the region (van Zeist 1974–78; Bankoff & Winter 1990; Jovanović 2004; Gyulai 2010). The archaeobotanic analyses of prehistoric sites have shown that the majority of plant remains belong to einkorn wheat (*Triticum monococcum*), emmer (*Triticum dicoccum*) and barley (*Hordeum vulgare*), confirmed to be the oldest domesticated plant species. In addition to these, peas, broad beans, lentils and oats were also grown, but their remains have not been found at Ervenica.

Wheat and barley marked the beginning of food production, which eventually set the foundation of Neolithic agriculture and became the main wheel of its successful spread. Before those species were cultivated, wild cereal fruits were gathered and used as food. Einkorn wheat and emmer, as well as barley, were the core agricultural crops grown in prehistoric times. The einkorn yield was poorer, but it survived and spread because it could be grown on poorer soil. Emmer provided a better yield and a higher quality of bread. The production of these two species fell towards the end of the Iron Age, and nowadays they are present only as relics. In parts of central and south-eastern Europe the predominant crop was emmer, and in this respect the Ervenica settlement fits into the existing framework.

However, the archaeobotanic analysis done at the site of Vučedol has shown that there the predominant crop was einkorn, followed by emmer. It has also revealed a larger proportion of cereals (91%) over wild-plant and weed species (7%) (Reed 2012). The same situation has been recorded in other settlements of the Middle/Late Copper Age (Đakovo-Franjevac, Tomašanci-Palača, Slavča, Čepinski Martinci-Dubrava) (Reed 2016). At Ervenica, the picture is entirely different, and wild-plant and weed species are dominant over cereals. The reason for this difference could lie in different economic priorities, or in different predispositions and usability of the environments. This could mean that the population of Ervenica was less involved in tilling land, and more in herding animals, and that they left more land available for pasture. Still, it is worth noting that the proportions of cereals and weeds at Ervenica are not necessarily the basis for any concrete conclusions regarding its economy. The archaeobotanic sample should be greater and collected from more of the Vučedol sites at Ervenica, and from various types of deposits (pits, houses, surroundings of houses).

A very interesting comparison of the total figures for plant species in specific pits is given in *Fig. 66*. Pit SU 49/50 contained a somewhat greater proportion of cereals (51.46%) than wild-plant and weed species (45.63%), while the situation in pit SU 47/48 was the opposite, because there wild-plant and weed species were dominant (79.52%) over the total share of cereals (16.79%). Several factors can influence the proportions of plant remains discovered in pits, relating to cereal origin and the activities associated with their use. These include the state of preservation of the settlement, manner of discarding and disposing of waste created during harvest, and distribution of seeds within the settlement caused by wind gusts and rain.

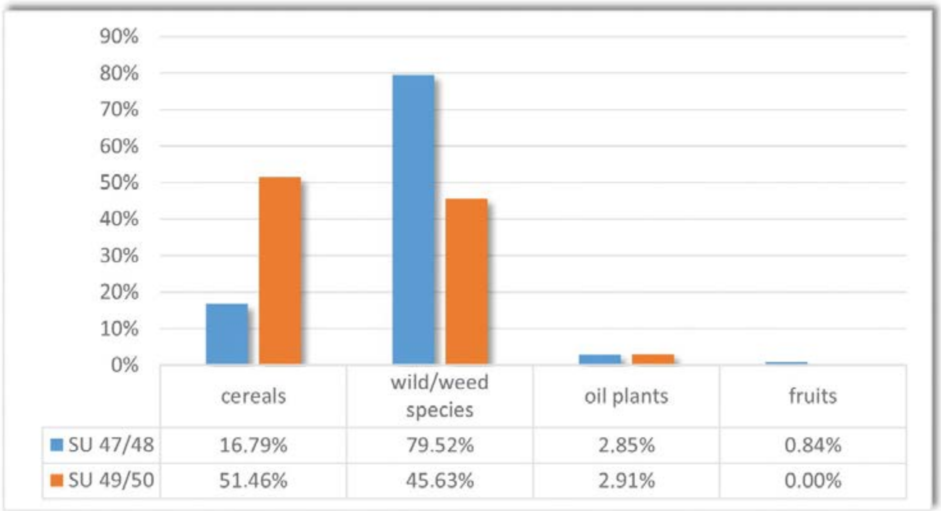


Fig. 66 – Comparative figures for plant species in pits SU 47/48 and 49/50

Another cereal crop that has been used ever since earliest prehistory is barley. Barley played an important role in the cultivation of land in Europe, and therefore it is not surprising that it was used in the Vučedol tilling economy. The species grows well even when the land is of poor quality, and thus it has persisted to the modern day. Even in the Neolithic, barley was used to make bread and porridge, and also beer, and to feed domestic animals. This cereal's resistance to diverse temperatures, its short growing period and high adaptability make it a very gratifying species (Gyulai 2010: 42).

Cereals have played an important role in the domestication of animals. These agricultural crops grow on open arable land (preferably on hard, fertile loam), their life cycle lasts less than a year, and they can be stored over a long period of time (Zohary & Hopf 1988: 10–22). Cereal-based nutrition introduced significant changes into the everyday diet, given the calorific value of cereals. Generally, their nutritional value is high, they are rich in hydrocarbons, and wheat also contains proteins and gluten.

OSTEOLOGICAL ANALYSIS

Archaeozoology is a scientific discipline which studies animal remains recovered from archaeological sites, or places which were created and inhabited by people at some point in the past (Lyman 1982). The purpose of archaeozoology is to contribute to a better understanding of the relationship between people and their surroundings, primarily animal populations in their surroundings, and to identify changes in the way animals were used over time and space (Reizz & Wing 1999).

The analysis of animal bones from the site at 14 Matija Gubec Street at Ervenica has included 526 remains of bones, teeth and antlers. The analysis was done, and its results were interpreted, by Dr. Tajana Trbojević Vukičević of the Institute of Anatomy, Histology and Embryology of the Faculty of Veterinary Medicine of the University of Zagreb. The number of fragments identified from the skeletal and taxonomic points of view was 243 (46.20%) (*Fig. 67*).

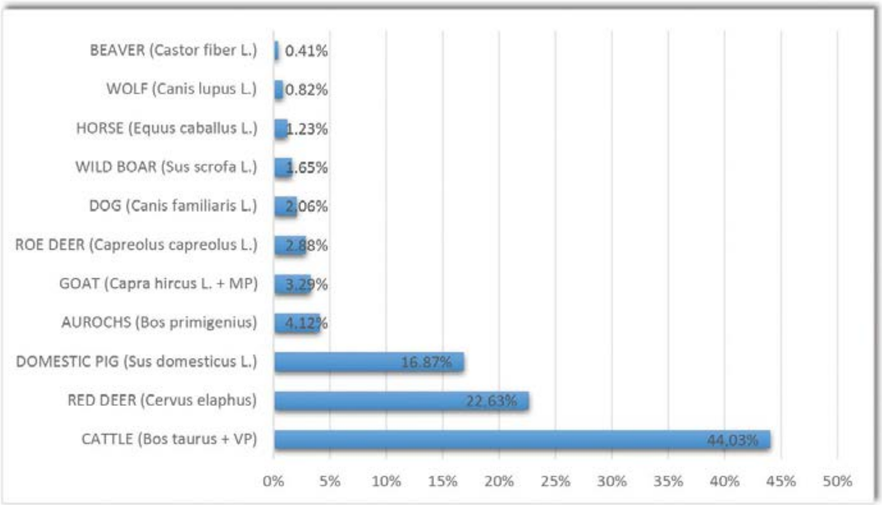


Fig. 67 – Percentages of identified specimens (% NISP)

Due to highly-fragmented samples, especially those of long bones and individual teeth, accurate identification of specific species has been very difficult. Thus the record of some skeletal elements of goat (*Capra hircus* L.) has been supplemented by bones belonging to a small domestic ruminant, for which the lack of important elements of anatomy has prevented more precise identification as to whether they belonged to a goat or a sheep (*Ovis aries* L.). For the same reason, the record of skeletal elements of cattle has been supplemented with bones from a large ruminant, where it could not be specified whether the bone element belonged to an ox (*Bos taurus* L.) or a red deer (*Cervus elaphus* L.).

On the basis of the osteometric analysis of long bones (humerus, femur and metapodial bones) of cattle, and comparison with a similar study of the Aeneolithic cattle of the Vučedol Culture period recovered from Vučedol, it has been established that no fewer than 10 bone elements belonged to the wild cattle, the aurochs (*Bos primigenius* L.). The differentiation between dog (*Canis familiaris* L.) and wolf (*Canis lupus* L.) is difficult, even when complete and recent skeletons (and bones) are available, making the taxonomic identification of damaged and incomplete archaeological samples nearly impossible. Some small and mostly subjective morphological differences can be observed on some other bones and skulls, and those carnivores have been classified on the basis of this criterion.

In the sample analysed, cut marks are visible on red-deer antlers, but only those left by the separation of the antlers from the rest of the skull, while other marks possibly left by further working with a view to producing an implement (or weapon, or jewellery etc.) have not been observed). One long-bone fragment, which cannot be identified in terms of either skeleton or taxonomy, reveals marks left by its being worked to produce, most probably, an awl. On several bones of cattle and red-deer tarsus, there are cut marks suggesting that bones were separated from joints, and those are treated as marks left by butchering, that is, separation and cutting of meat into smaller parts suitable for consumption. A pig's occipital bone has been cut through the middle, which is also indicative of butchering and an attempt to reach the brain (Trbojević Vukičević 2011).

The results have shown that the presence of domestic animals was higher (67.49%) than that of wild animals (32.51%).

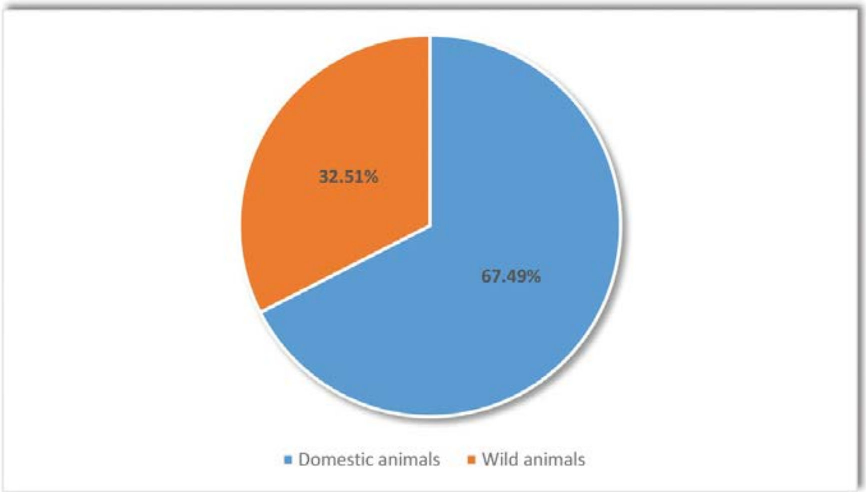


Fig. 68 – Comparative figures for domestic and wild animals (% NISP)

The most dominant of the domestic animals was cattle (*Bos taurus* L.), which during the Aeneolithic became the basis of animal herding. Wild cattle, or aurochs (*Bos primigenius* L.), were also present, but their numbers started to decline in the late Aeneolithic.

The domestication of cattle began in the middle Neolithic, when the need emerged to expand the herds; this gradually resulted in the domestication of local wild animals such as boars and aurochs. In the late Neolithic, cattle was already the most numerous of domestic animal species, and this situation remained unchanged throughout the Aeneolithic. In the early Bronze Age, the domestication of cattle was completed, the aurochs became rare, and as far as hunting is concerned, its role was taken over by red deer (Bökönyi 1971). Another important domestic animal was the pig (*Sus domesticus* L.), while goats and sheep are ranked last in this list (*Fig. 69*).

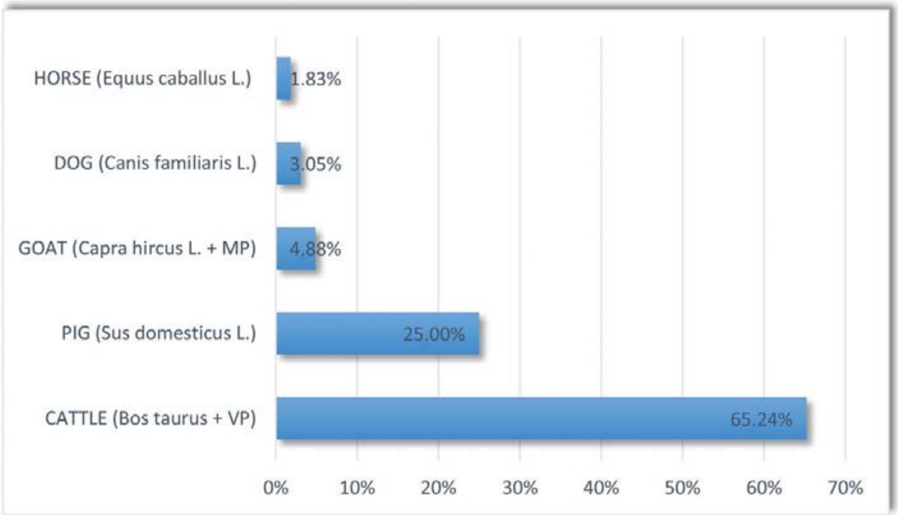


Fig. 69 – Comparative figures for domestic animals

The most widely-present wild animals were red deer (*Cervus elaphus* L.), aurochs (*Bos primigenius* L.) and roe deer (*Capreolus capreolus* L.) (*Fig. 70*).

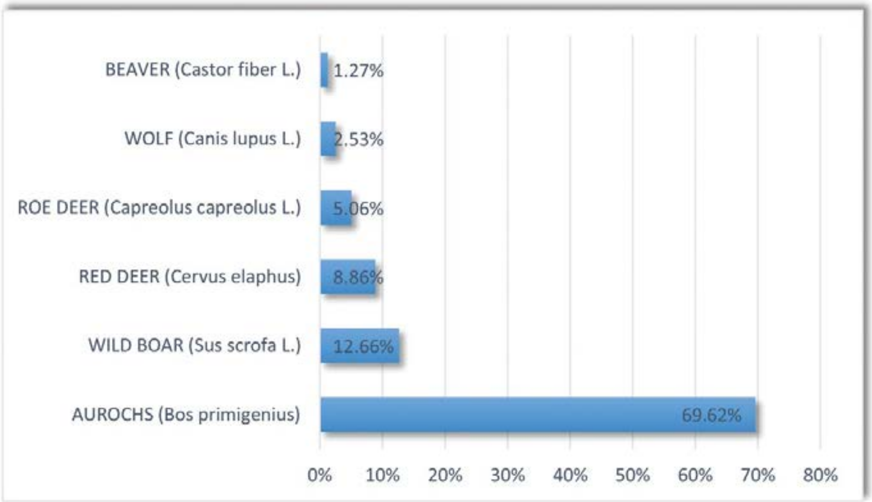


Fig. 70 – Comparative figures for wild animals

Although the red deer has been hunted in all periods primarily as a source of meat, it is also known that its hide was probably used to produce footwear, its intestines for sewing, and its bones and antlers for the crafting of tilling and household tools (Trbojević Vukičević et al. 2006). A large quantity of hoes with shafting holes, made of deer antlers, which were used for working the land, have been found at both sites (*Figs 71, 72, pp. 132-133*).

The animal bones analysed allow the conclusion that the economy of the Ervenica population was primarily based on animal herding, in which cattle played the predominant role, followed by pigs and, to a lesser extent, goats/sheep. Besides being used as a source of food, cattle could also be used to assist in tilling the land. It is well-known that the Baden Culture was the first in Europe to introduce four-wheel wagons. Among the objects frequently found at Vučedol sites there are small and large weights shaped like wheels (Pls 34: 1–3; 35: 3).

The analysis of animal bones recovered from the neighbouring site of 'Tržnica' tell has resulted in a higher share of wild animals (52.50%) than domestic (47.50%). However, the remains of animal bones from Ervenica are more similar to those from the site of Vučedol (the position of the 'Streim Vineyard'), where domestic animals dominated (78.20%) over wild ones (21.80%) (Jurišić 1988: 25).

Animal remains found at the site of Damića Gradina could not be analysed, due to disturbed stratigraphic layers, but the osteological analysis of one animal burial has revealed that the remains, absolutely dated to the period between 2630 and 2470 BC, belonged to a cow and a fawn (Chapter 12, Table 1).

The results of archaeobotanic and osteological analyses place Ervenica well into the general picture of life in the Aeneolithic in SE Europe, where people lived from tilling (growing einkorn wheat and emmer) and herding and hunting, which boosted their living standard. The most significant domestic animals were cattle, followed by pigs and also goats/sheep. Several fish vertebrae and freshwater mussels, which cannot be identified more precisely due to insufficient indicators, suggest that the River Bosut was also used for everyday nutrition, but to a lesser degree.

15 ORGANIC RESIDUES IN POTTERY

ARCHAEOLOGICAL BIOMARKERS

Although the first papers discussing organic residues appeared in scientific journals in the 1960s, and their number grew intensively in the 1980s, only in the past 10 or so years has the analysis of organic residues in pottery become a discipline widely present in archaeology (Barnard & Eerkens 2007). In the meantime, numerous analyses and experiments have been done on pottery, aimed at identifying traces of archaeological biomarkers, or substances occurring in organic residues that provide information relating to past human activities (Evershed 2008: 897).

Organic residues have been found at nearly all archaeological sites: some as visible evidence of human activities (such as bones, charcoal, wood, carbonized seeds, pigments) or as less visible substances such as plant and animal fats and oils, resins and waxes, but majority of them as invisible substances 'hidden' in the form of archaeological biomarkers, such as lipids and proteins (Miloglav & Balen 2013).

All organic residues present at archaeological sites are of biological origin, and they can be analysed through a combination of various methods. One of the most frequently-used methods of analysing the molecular structures of organic residues is gas chromatography-mass spectrometry (GC-MS). The application of this method in the analysis of archaeological pottery has made it possible to decompose, and analyse in detail, molecular components of the biological material. Thus far, analyses have shown that organic matter absorbed in the walls of pottery vessels, as a product of the processing of plant and animal fats, has been preserved in as many as 80% of the vessels that had been used for cooking and food preparation (Evershed 2008: 904). Information obtained through this analysis enables us to provide answers to questions relating to the vessel's function, the local and regional economy, and technological choices and changes.

There are several forms in which organic residues can persist on or in pottery:

1 – as the original content of the vessel found *in situ*. This is the form in which organic residues are most rarely found preserved in archaeological contexts;

2 – as residues visible on the interior and/or exterior of the vessel. Such marks provide direct and visible evidence of the use of cooking vessels. The exterior surface often displays soot marks, while the interior contains carbonized residues; both are consequences of the vessel's exposure to fire. Visible organic residues on pottery can also be used for radiocarbon dating. However, there is an increased chance of contamination of such samples, given that those residues have been exposed directly to external environmental factors and activities in connection with irregular storage after their recovery. Radiocarbon analysis of pottery sherds for the purpose of their dating is possible thanks to lipids preserved in the pottery. Using preparative capillary gas chromatography (PCGC), sherds containing a sufficient quantity of lipids, or fatty acids (animal fats), absorbed in their walls, are singled out. For adequate samples that can be subjected to radiocarbon dating using the accelerator mass spectrometry (AMS) method, a minimum quantity of carbon (200 μg) in the sample is sufficient. This method of radiocarbon analysis offers rather successful dating of pottery, that is, of the time it was last used (Stott et al. 2003);

3 – as invisible organic residue absorbed in pottery walls. This is the most frequent form of 'survival' of organic residues which can be found in pottery, and there are several factors that contribute to this.

The first of these factors is the vessel's use – the method and duration of its use, its physical properties, the environment in which it was deposited and its treatment after it was recovered (Heron & Evershed 1993). Experiments done on pottery have shown that proteins lose their properties and decay as soon as several months after they are deposited in the ground. Lipids are much more resistant to environmental factors: they are hydrophobic and less prone to structural modifications, and thus they can persist in high concentrations in a pottery sherd over several millennia. However, the risk of contamination is higher for lipids than proteins, both during and after an archaeological excavation. Contamination can be caused by irregular storage of pottery in plastic bags, by gluing, washing, and even by frequent inspection of pottery material. For example, traces of cholesterol can originate from animals (animal fats), but they are also present on the surface of human skin.

Squalene, which has been found on several analysed samples, is also present both in the human body and in plants and animals, and it is considered to be the main indicator of contemporary 'human traces'. This polyunsaturated liquid hydrocarbon can be found in small quantities all over the human body, it is released over the skin, and it decomposes very quickly. In the plant kingdom, this lipid is present in very small amounts – for example, in wheat-germ oil. The presence of both these compounds in pottery, in certain proportions, is considered to be indicative of modern-day contamination of pottery material through handling (Evershed 1993).

Plasticizers also cause degradation of lipids, and hence they are a frequent cause of contamination of archaeological material, which is regularly stored in plastic bags. Although pottery washing has no impact on the contamination of lipids, their concentration drops significantly through washing, which brings the results of analysis into question. This is especially true of removing the soil and barely-visible organic residues from the external and internal surfaces of sherds. Therefore, it is advisable not to wash, glue, or label those pottery sherds which will be sent for analysis, and the sample should be sent, if possible, together with the soil in which it was located. Considering everything said above, and with a view to preserving organic residues as much as possible, and eliminating possible contamination, this type of analysis should be planned for in advance and incorporated into the excavation process (Miloglav & Balen 2013).

The most frequent organic residues absorbed in vessel walls are animal fats, characterized by a high proportion of free fatty acids, especially palmitic (C16) and stearic (C18) acid. These fatty acids can easily be isolated and analysed, and they can be found in vessels that had been used for preparation and storage of food. Analyses have shown that they are mostly found in the vessel itself, rather than in the environment, or in the soil in which the vessel was deposited (Craig 2002; Copley et al. 2003). However, contamination with lipids through their migration from the soil in which the vessel was deposited is highly likely (Evershed 1993: 87) (*Fig. 73, p. 136*).

In cases in which samples of soil are not available, it is very important to compare and analyse the external and internal sides of the sherd (Stern et al. 2000). This is what occurs regularly when samples of material, recovered in previous excavations and then kept in museum collections, are sent for analysis. By analysing both the external and internal sides of the sherd, we can exclude contamination caused by its long deposition in the ground, by the vessel's handling during and after archaeological investigation, and its inadequate storage (*Fig. 74 p. 137*). Such contamination is usually present on both sides in the same concentration, while archaeologically-significant organic residues are present on one side only (Steele 2011).

The analysis of organic residues in pottery, those very good indicators of archaeological biomarkers, will be interpreted more accurately if compared with other analyses that provide evidence of human activities in the same locality. Those include analyses of plant and animal species present at the site, analysis of pottery assemblage which will enable us to establish links between vessels' shapes and their utilitarian functions, analysis of abrasive and non-abrasive processes affecting the vessel, and the context of its deposition (Miloglav & Balen 2013).

All such traces are present on pottery vessels, and they can be identified and analysed easily, as discussed in chapter 8. Therefore, information obtained through a GC-MS analysis should not be interpreted in isolation.

As for any other analysis, the applied method of sampling plays an important role in the interpretation of the results obtained. If samples consist of sherds that cannot be identified from either a functional or a stratigraphic point of view (originating from settlements or from grave units, for example), the results of analysis will be unusable. In order to avoid such occurrences, sampling should be prudent and planned, and suitable for the research question that has been posed.

The concentration of lipids in various parts of the vessel (orifice, body, base) plays a big role in the identification of the vessel's function, since the accumulation of lipids in specific parts of the vessel can suggest its function (e.g. boiling or baking) (Charters & Evershed 1995). A number of experiments have been done to that effect, and they included analyses of original parts of vessels and their replicas (Charters et al. 1997). It has been demonstrated that, in those vessels which were used for heating water and cooking food, the highest concentration of lipids can be found at their orifices. This is a result of the flotation of lipids released from food, which accumulate at the water surface and evaporate towards the orifice. Another reason is temperature, which is lower at the vessel's orifice (around 100 °C), and the degradation of lipids is not as strong as at the bottom (where the temperature can be as high as 800 °C). Furthermore, experiments have shown that lipid residues can be identified after just one cooking. With each new heating, their concentration increases, especially on the vessel's body and orifice. For these reasons, if samples are taken from different parts of the vessels, from vessels of diverse functional shapes, discovered in various depositional contexts, and if they are representative, it will be possible to obtain data which can be interpreted, through comparative and combined analyses, in the context of the analytical question or problem posed.

RESULTS OF POTTERY ANALYSIS USING GAS CHROMATOGRAPHY-MASS SPECTROMETRY (GC-MS)

The GC-MS method was used to analyse a total of 10 pottery samples: 8 from the site of Ervenica and 2 from the site at Damića Gradina *(Fig. 75).* The analyses were done at the Division of Archaeological, Geographical and Environmental Sciences of the University of Bradford. The samples were taken from various parts of vessels (base, body, orifice), from vessels of various functional shapes (pot, bowl, cup, strainer), and from sherds of diverse surface treatment (polished and burnished sherds, and those treated with barbotine).

The questions raised included the technological aspect of the vessels' production, or possible differences in the technology of production of vessels intended to be used for cooking over a fire,

Fig. 75 – Types of vessels the analysed samples belong to. Labels refer to the designation of the sample, not the type of the vessel

and those which would not be used for thermal processing of food, and the type of food that had been prepared/cooked/stored in vessels of specific shapes. The data have been interpreted together with the results of the archaeobotanic and osteological analyses, typology of pottery shapes, the vessels' depositional contexts, and the analysis of the clay and tempers (XRD and mineralogical-petrographic analysis). In order to exclude any contamination caused by the environment in which the vessels were deposed, and by their post-recovery handling, both surfaces of the sherds were analysed (Steele 2011; Miloglav & Balen 2013: 13, Fig. 1).

All the samples analysed were contaminated by plasticizers to a certain extent, as a result of their storage in plastic bags. The majority of sherds analysed also contained cholesterol and squalene – consequences of their handling. The lipid concentration was insufficient for additional analysis of stable isotopes using gas chromatography-combustion-isotope ratio mass spectrom-

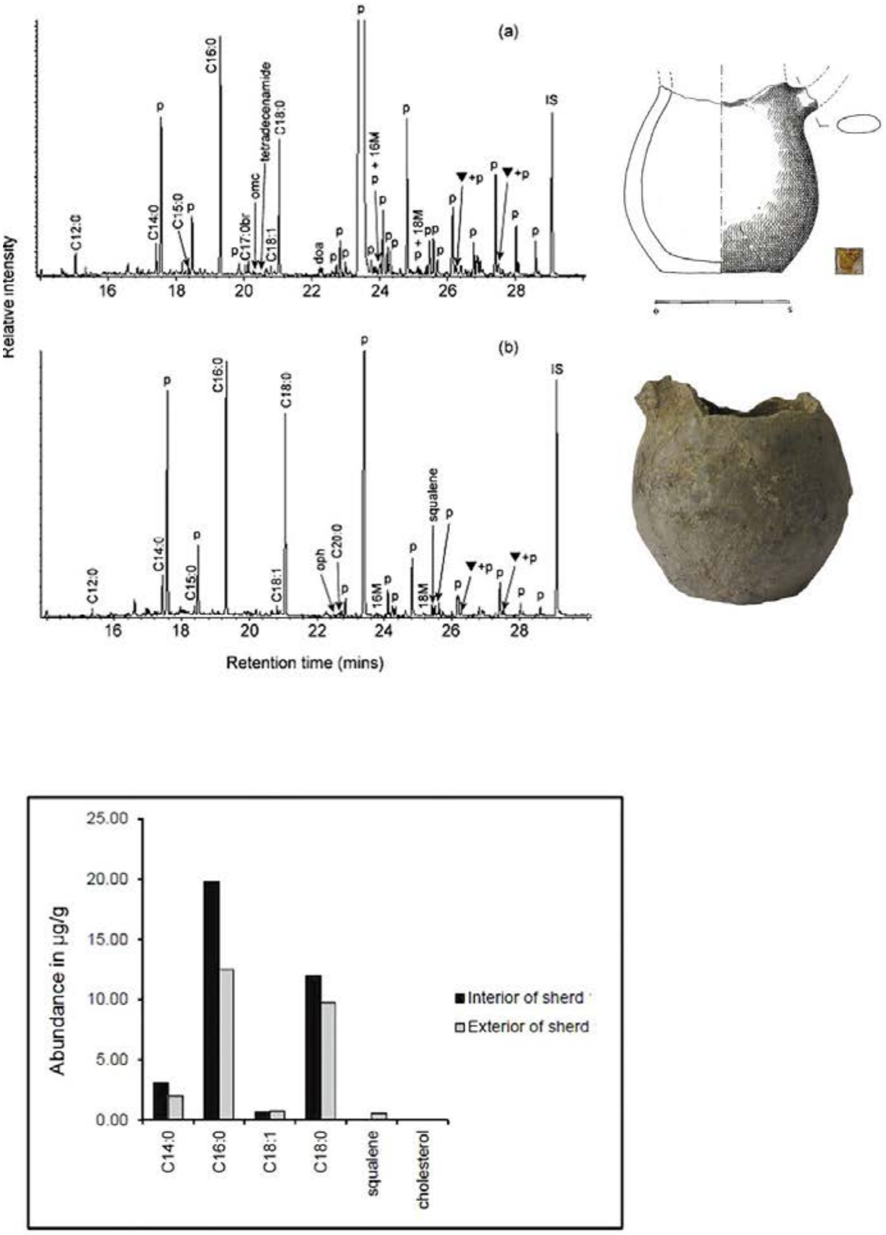
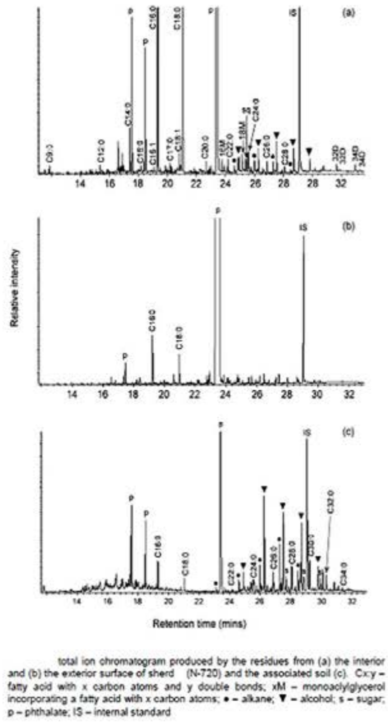
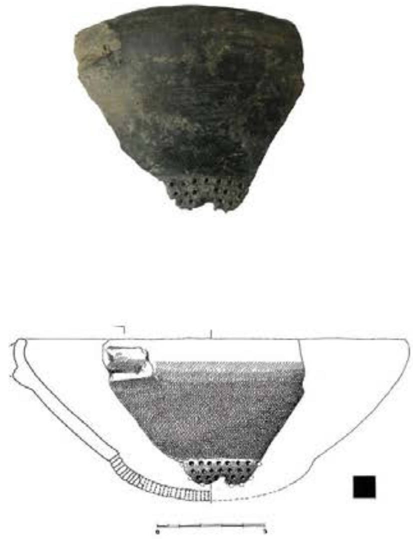


Fig. 76 – Chromatogram showing substances extracted from pottery sherd ER 1 and the chart showing the abundances of the main fatty acids, squalene and cholesterol

etry (GC-C-IRMS), which could have provided more precise information on the origin of animal or plant species (Steele 2011). This analysis allows more precise identification and distinction between ruminant (cattle, goat, sheep) and non-ruminant fats, and especially dairy products, which are otherwise difficult to distinguish from animal fats due to the lack of unique biomarkers for milk (Dudd et al. 1999; Craig 2002; Evershed 2008).

All the samples contained high amounts of C16:0 and C18:0 fatty acids, resulting from the degradation of animal fats (Steele 2011). More precise distinction of animal fats could be achieved for two functional types, the shallow bowl (ER 3) and strainer (DG 1), while possible traces of dairy fats have also been recorded on the sample that belongs to the functional shape of the cup. Degraded fats were present on both surfaces of the sherd which belonged to a cup (ER 1), although they were less present on the external surface than on the internal. According to the data interpretation (Steele 2011), the original residues of animal fats were located in the vessel's





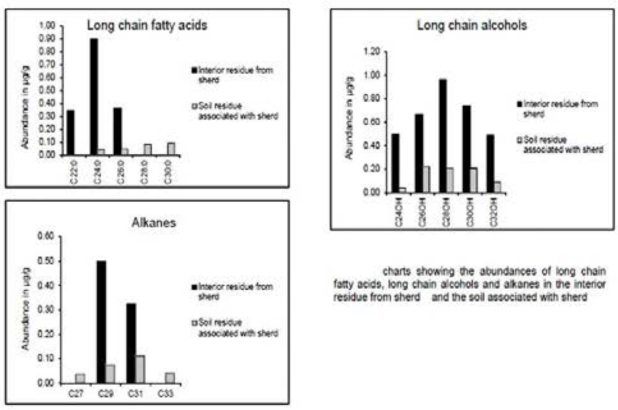


Fig. 77 – Chromatogram and charts showing substances extracted from pottery sherd DG 1 and the associated soil sample

interior, while the traces discovered on the external side were probably the consequence of spillage of the vessel's contents. In addition, these residues could be residues of ruminant fats or dairy fats (*Fig. 76*).

Although interpreting residues of dairy fats without additional analysis of stable isotopes is an ungratifying task, other analyses performed suggest that this functional shape can easily be described as a vessel used for drinking milk. Based on the parameters analysed, this type of vessel (cup – type C 1a) was not used for preparing food over a fire, since no traces that would indicate this have been found on any of the sherds analysed. Furthermore, according to the analysed animal remains, the economy of the Vučedol settlement at Ervenica was based on animal herding, primarily on raising cattle (65.24%), pigs (25.00%) and goats/sheep (4.88%), which is characteristic of the Aeneolithic period in general. Thanks precisely to GC-MS analysis, nowadays we know that dairy products were already in use in the Early Neolithic (Craig 2002; Copley et al. 2003; Craig et al. 2005; Evershed et al. 2008; Dunne et al. 2012; Isaksson & Halgren 2012; Salque et al. 2013), so it is probable that dairy products made up part of the dietary habits of the Vučedol population, too.

Ruminant fats have also been found in the interior of the strainer of type E 1a (DG 1 – *Fig. 77*), as the original content of the vessel (Steele 2011). A strainer that belongs to a different typological shape (DG 2 – type E 2a) also contained traces of lipids in its interior; these were decayed residues of fats or oils which could not be identified more precisely due to too low a concentration of lipids. Prehistoric strainers are usually interpreted as vessels used in the preparation of cheese, while some interpretations also associate them with the production of honey (Regert et al. 2001: 567; Elster & Renfrew 2003). Given that neither of the two analysed sherds revealed any traces of wax, but only traces of ruminant fats, or more generally animal fats, and bearing in mind the economy of the Vučedol population, it is likely that both strainers were used in the production of cheese. Recent analyses of some sherds from Poland have demonstrated that similar strainers were used in the production of cheese 7000 years ago, and that they played a major role in the production of dairy products with reduced lactose content (Salque et al. 2013).

A sample taken from a low vessel with thick walls (type A 1a) contained by far the greatest quantity of fatty acids (most probably ruminant fats) in its interior, while no traces of lipids have been recorded on its exterior (ER 3 – *Fig. 75*). Given its very thick walls (up to as much as 19 mm), lack of height (up to a maximum of 6.50 cm), very large orifice radius (up to 11.50 cm) and traces of soot and oxidation stains on its surface, this bowl was used for the thermal processing of food.

A technological aspect has been identified on analysed sherds originating from three vessels, which contained traces of beeswax on both internal and external sides of the samples (ER 4 – type A 4c; ER 5 – type A 2a; ER 8 – type C 1a). On one sample, traces of degraded wax were present only on its internal surface (ER 2 – type D 1a). Recording wax on pottery sherds is not new, although it may be rare, but the presence of wax has been confirmed on pottery sherds from a period as early as the Neolithic (Heron et al. 1994; Regert et al. 2001; Copley et al. 2005; Mayyas et al. 2010). It is known that honey was collected by some of the earliest prehistoric communities, and used in medicine, the arts, rituals and cosmetics, as a food supplement and for the preparation of drinks (Needham & Evans 1987; Garnier et al. 2002). The results of a recent study of a 6500-year-old human mandible from Slovenia have shown that it is the earliest known evidence of a therapeutic-palliative dental filling made of beeswax (Bernardini et al. 2012).

On pottery, beeswax is found either on its own or in combination with other natural materials, or animal and plant oils. It was used primarily to fill pores in the pottery and make it impermeable (Schiffer et al. 1994; Charters et al. 1997; Regert et al. 2001; Ogrinc et al. 2014). In chapters 5 and 6, various options of post-firing surface treatment are discussed whose goal was to decrease the vessel's permeability and improve its strength. Wax is a hard substance, insoluble in water. In can be found in both plants and animals; and, as an element of protective coverage, it can be found in plant leaves, animal furs and feathers. Natural waxes are softer, and they melt at lower temperatures (above 45°C), unlike fats and oils. The best known animal wax is beeswax, which melts at a temperature of around 65°C. In the case of the Ervenica samples, this was probably some kind of waterproofing agent, added to the pottery to fill its pores, since traces of wax have been found on both the internal and external sides of the vessel (Stern 2011). Some analyses indicate that the wax was probably applied to pottery vessels after firing, while the ceramics were still hot. Thus the wax would melt and enter the walls of the porous pottery, blocking small holes in the structure of the clay paste. Such creation of an impermeable layer would prevent liquids from escaping the vessel.

In an attempt to uncover the role of wax in pottery, an experiment was performed in which wax was heated over a vessel. The wax melted at a temperature of 60-65°C, the vessel was then taken off the fire, until the wax consolidated as a thin coat/filter over the vessel. Then the vessel was placed over a fire, so that the wax came in direct contact with the fire. The wax lost its colour and become a brown-black tar-like mass which adhered to the vessel. The procedure resulted in a black shine and softness of the vessel, similar to the polishing effect (Heron et al. 1994). Analyses and experiments have shown that, when fats and wax were found together, as a rule the wax had been applied to the vessel before the animal fats (Charters & Evershed 1995).

Although the number of samples analysed is low, certain pottery shapes can be linked to specific functions of vessels. Traces of wax recorded on analysed sherds can be interpreted within the framework of their techno-functional characteristics, given that wax has been found on vessels of different shapes: two different types of bowls, a cup and a jug. Wax is associated not with a specific type of vessel, but rather with a specific use of the vessel (Miloglav & Balen 2016). None of the vessel types analysed displayed any traces of having been placed over a fire, so they were used for consumption and/or serving food which was dry, liquid or semi-liquid, and was not thermally processed. Based on the context in which they have been found and the archaeobotanic analysis of bowls of type A 4 (ER 4 – *Fig. 75*), this shape was the most numerous in a pit in which the largest quantity of cereals has been found; this could suggest that such vessels could have been used for waste disposal, where they were deposited together with used foodstuffs.

The shallow bowl (ER 3) was used for thermal processing of food, as was one sample of pot of type B 1a which contained traces of fatty acids only in its interior (ER 7 – *Fig. 75*). According to all the indicators, the strainer was used for the preparation of cheese, while a sherd from a bowl on a cross-shaped foot (ER 6) was unfortunately contaminated with plasticizers to such a high degree that it has not provided any relevant lipid residues that would be archaeologically relevant.

16 THE CLAY PASTE FOR VUČEDOL CERAMIC VESSELS

MINERALOGICAL-PETROGRAPHIC ANALYSIS AND X-RAY POWDER DIFFRACTION

In the first part of the book, we were already acquainted with the development, subject matter and main goals of archaeometry, and its importance for the analysis and interpretation of archaeological artefacts. As far as pottery goes, the aim of archaeometric analysis is to identify production technologies (paste recipe, method of preparation of raw material and its shaping, firing and decoration), the raw material's origin and the function of the pottery products. The analysis of sherds from both investigated sites has attempted to provide answers to some of these questions. Although the number of sherds that have been analysed and are presented here is relatively small, the results obtained provided some guidelines for further analyses to be performed on a much bigger number of samples, and in view of a more extensive array of questions which have been raised as a consequence of the results obtained (Mileusnić & Miloglav 2015).

The sampling of pottery sherds from both sites has been done in line with research questions which sought information on: a) differences in tempers added to various functional shapes; b) firing method and temperature; c) composition of and recipe for clay pastes. Thus, the sherd samples have been classified into three categories: a) sherds of various functional shapes (bowl, pot, cup etc.); b) various colours of cross-section; c) various surface treatments (polishing, burnishing and barbotine treatment).

After the research questions were posed, 17 pottery sherds were sent for analysis – 7 from the site at Ervenica, and 10 from the site at Damića Gradina.

The mineral composition of the raw materials, the texture of the paste and the type and quantity of temper in it, were established by mineralogical-petrographic analysis under an optical microscope (OM), and X-ray powder diffraction (XRD). The analyses were done at the Department of Mineralogy, Petrology and Mineral Resources of the Faculty of Mining, Geology and Petroleum Engineering of the University of Zagreb. In addition, 8 sherds from various Vučedol sites (Ervenica, Tržnica Tell, Borinci, Vučedol) were subjected to Fourier-Transform Infrared Spectrometry (FT-IR), with a view to identifying the composition of the incrustation. Those analyses were performed at the University of Natural Resources and Life Sciences in Vienna. At this moment, only preliminary results are available, and those indicate that the incrustation paste was made only of freshwater shells.

X-ray powder diffraction is the main method of analysing the mineral composition of pottery and clay samples. This analysis has the advantage of identifying clearly and directly specific clay minerals, which cannot be identified using other physical methods, especially in the case of polyphase pastes.

The optical microscopy and X-ray analysis have established the following mineral composition of the pottery: quartz, a mineral from the mica group (muscovite/sericite), K-feldspar, plagioclase, fine crystalline aggregate grains and possibly clinopyroxene. Particles of rock (quartzite/chert) have also been found sporadically. In addition, medium- to large-grained grog and some rounded organic grains have also been observed in the sherds.

The sherds' core ranges from dark brown and grey to black, with some samples displaying light-brown to orange-red external and/or internal walls. Such structures can be a result of reduction firing with the final cooling phase in an oxidizing atmosphere.

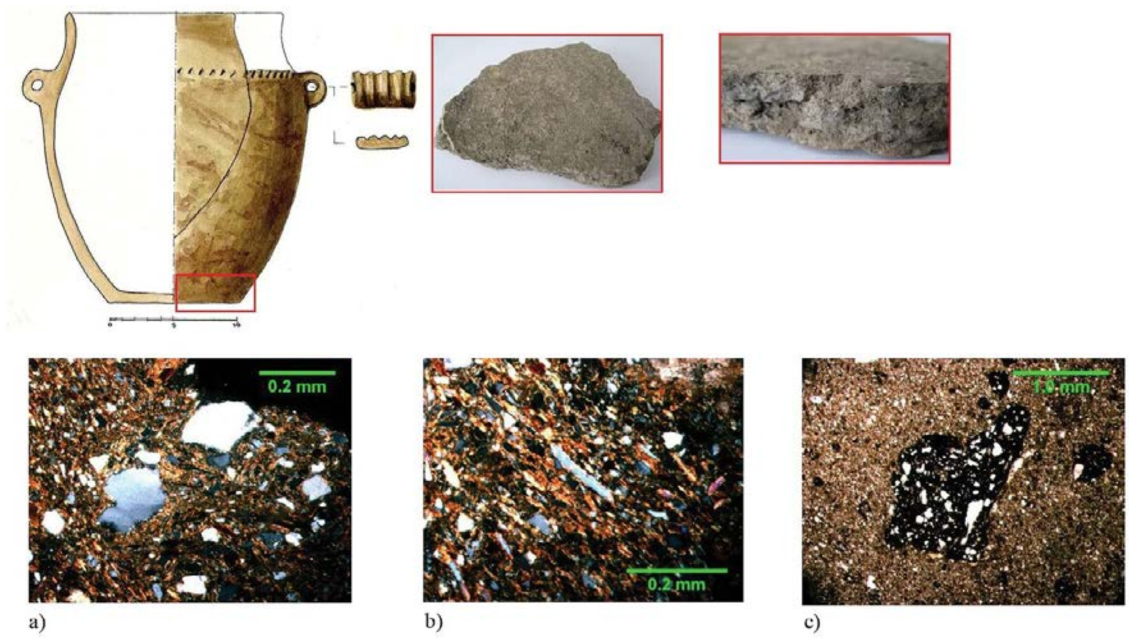


Fig. 78 – Pot of type B 1a: a (crossed nicols) – the microphotograph shows two relatively large grains of quartz with typical undulose extinction; b (crossed nicols) – elongated muscovite with high interference colours; c (parallel nicols) – grog with embedded quartz.

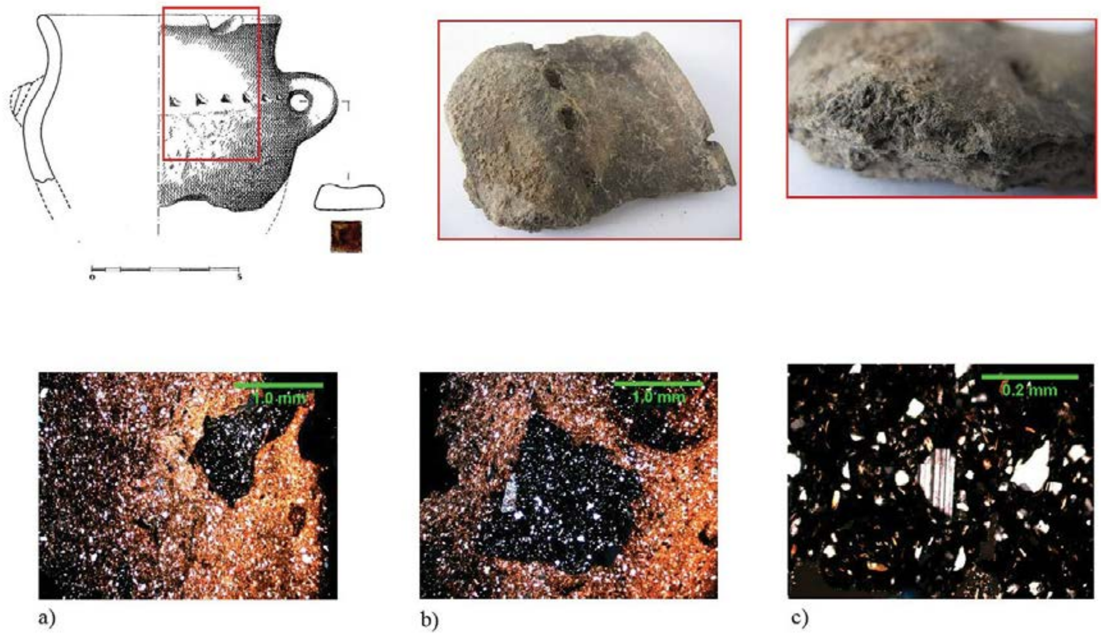


Fig. 79 – Pot of type B 1b: a (crossed nicols) – external oxidized wall of a sample with embedded angular, black fragment of grog, located in the upper right corner; b (crossed nicols) – a large grain of grog, with embedded elongated fragment of chert at the left edge of the grog; c (crossed nicols) – plagioclase with polysynthetic twinning.

The petrographic analysis of pottery samples from the sites of Ervenica and Damića Gradina has not resulted in a separation of samples into groups based on different textural, structural and mineral properties, because samples originating from the two sites do not display any significant differences. The matrix contains abundant homogeneously-distributed fine-grained subangular to angular quartz and a flaky mineral from the mica group. The unimodal distribution of quartz and mica particles, silt to sand in size, present in the matrix, suggest that the minerals are natural ingredients of the raw material (Velde & Druc 1999).

The only difference observed among the pottery sherds analysed regards different quantities of grog tempering. It has been established that shapes which belong to the functional group of pots (vessels for thermal processing of food) contain higher quantities of large-grained grog in their clay paste.

Although grog is present in large amounts in all the sherds processed, the size of the grog particles present in pots ranges between coarse (1–3 mm, 85.71%) and very coarse (> 3 mm, 14.29%), while the grog temper in bowls is medium-grained (0.2–1 mm, 100%). There is no correlation between the observed differences in tempers and vessel dimensions, given that pots can be smaller and larger (as are, in this case, types B 1a and B 1b, fig. *78* and *79*), and thus, in this case, the hypothesis that size of particles varies with size of vessel and thickness of walls has not been confirmed (Rye 1981).

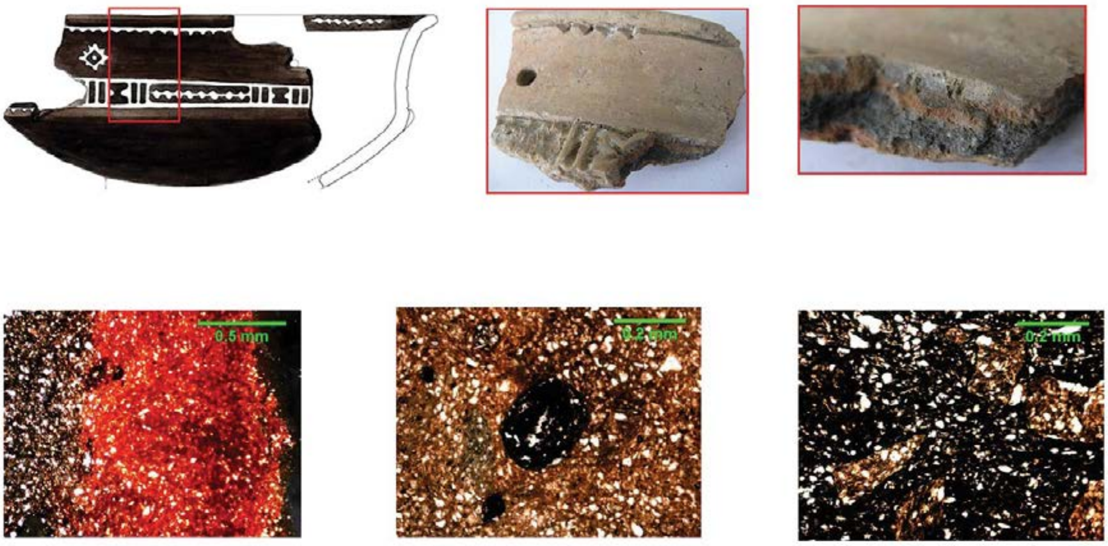
The importance of adding temper to the clay paste, especially for vessels intended for thermal processing of food, has been discussed in the first part of the book. The properties of grog have also been described in chapter 4, with an overview of its positive and negative features relevant to the thermal and physical properties of the vessel. Therefore, we should not disregard the differences observed in adding substantial quantities of coarse-grained grog to the clay paste for the production of pots, irrespective of the small number of analysed samples. Tempering clay paste with grog is one of the oldest technological choices. Broken and crushed pottery sherds were always available in settlements, so its preparation did not require any additional engagement, on behalf of the potter, relating to the search for and procurement of temper. In addition to reducing the thermal stress in cooking pots, tempering with grog also provides the clay with plasticity necessary for its shaping. The majority of grog present in the pottery samples analysed consists of angular grains, whose size varies between 0.25 and 6.56 mm. Pieces of recycled grog can also frequently be observed in the sherds, consisting of smaller grains of older grog embedded in a larger grain of newer grog (*Fig. 80*).

Fig. 80 – Pot of type B 3a: a (crossed nicols) – rounded organic grain; b (parallel nicols) – grog which contains, in the lower right section of its large grain, two smaller angular grains of grog which are older than that in which they are embedded.

The analyses performed allow the conclusion that the clay pastes used to produce these vessels do not display any significant differences in their structure. The pottery's mineral composition corresponds to the mineral composition of loess – the natural geological base of the location of the two sites investigated. Given that the main ingredients of loess are quartz, feldspar and minerals of the mica group, as discussed in detail in chapter 10, the presence of these minerals in the clay paste of the analysed pottery was expected. Therefore, we can assume that local raw material was used for the pottery's production. With a view to establishing the location of potential raw material in the vicinity of both sites, clay samples have been collected, and they are currently being analysed.

The potters used fine-textured clay and tempered it with grog for the production of all types of vessels (bowl, pot, cup, jug). In an attempt to improve the physical properties of cooking vessels, they added increased quantities of coarse grog grains to their clay paste. In the first part of the book, we have already learned that various kinds of temper were used for diverse types of vessels, so tempering cooking pots with larger quantities of grog can be associated with the vessels' function, in that they had to sustain the thermal stress to which they were exposed on a daily basis. The choice of temper added by the potter to his clay paste is also linked to the vessel's resilience to such stress.

Although the sample was relatively small, the differences observed in tempering pots with higher quantities of grog have prompted additional sampling and analyses, currently under way, whose aim is to confirm the relevance of the data on a bigger sample from both sites.



a) b) c)

Fig. 81 – Bowl of type A 4c: a (crossed nicols) – interference colours of the external edge of the wall are covered by its own bright orange-red colour; b (parallel nicols) – well-rounded black organic grain; c (parallel nicols) – grains of grog that can be identified in the black matrix by their light colour and angular edges.

17. PRODUCT STANDARDIZATION, CRAFT SPECIALIZATION AND ORGANIZATION OF POTTERY PRODUCTION

Specialization is as much a social relation as it is an economic one, because it diminishes autonomy and creates new kinds of interdependencies that underwrite complex forms of social integration (Costin 2005: 1062)

The application of an interdisciplinary approach to the processing of pottery assemblages from both sites has yielded the basis for reconstruction and identification of the context in which the pottery was produced, distributed and used. Each of these three categories comprises several aspects which have been analysed, and for which an attempt has been made to interpret them on the basis of data obtained. Special emphasis has been placed on production organization, craft specialization and pottery standardization. The results and interpretation of the analyses done within each of these aspects have facilitated better understanding and identification of social processes within Vučedol society. There are many variables that can be defined within the overall production process (Schortman & Urban 2004), and here only those have been selected that could be interpreted on the basis of the obtained and available data.

Although results pertaining to standardization and craft specialization in the Vučedol Culture arising from the processed material from Damića Gradina and Ervenica have already been published in several places (Miloglav 2012b; 2013), they are presented here again to facilitate a comprehensive and thorough interpretation of the pottery production and its role in Vučedol society.

PRODUCTION ORGANIZATION

Identification of the production process, craft specialization and pottery standardization began to develop more intensively in the 1980s (For an overview, see Tite 1999). Many papers have been written about this, and there is an increasing quantity of research focusing on production, standardization and craft-specialization models (Rice 1977; 1981; 1989; 1996a; Arnold 1985; 2000; Hagstrum 1985; Sinopoli 1988; Costin 1991; 2000; 2005; Costin & Hagstrum 1995; Roux 2003a). The majority of authors agree about one thing, and that is that production organization can be identified and defined in several ways. However, it is worth emphasizing that the proposed production-organization models have to present some flexibility, since they cannot be applied linearly to all the societies (Vuković & Miloglav 2016).

The majority of authors stress that, in order to identify and define organized production and craft specialization, first we need to develop a framework which was necessary for their creation. This framework includes socio-economic, political and environmental factors which affect the development and functioning of a community; answering questions concerning these factors is of key importance for identifying traces of organized specialization.

The economic strategy of the Vučedol population included herding and tilling, hunting and metallurgy, and it led to social stratification, in that a richer class stood over all the others. Hoarding animals and metallurgical products made it possible to create large reserves, and the population growth was probably a result of improved living conditions. Traces of social stratification are most evident in burial customs and certain indicators pertaining to housing and settlement organization.

Evidence of social hierarchy can easily be observed at the eponymous site of Vučedol, whose size and spatial organization sets it apart from other settlements of the period. The production of copper objects played a special place in the society and economy, as testified to by remains of metallurgical furnaces, moulds and tools discovered at many Vučedol sites. All this gives sufficient ground to claim with certainty that metallurgy was a highly specialized activity, and traces of organized production can be observed at nearly all large sites of the Vučedol Culture. In economic terms, craft specialization emerged in those societies which featured a certain level of complexity (Forenbaher 1999), and this can undoubtedly be confirmed by the well-developed Vučedol society. Although specialized metallurgical production is not the topic of this chapter, it is important to emphasize that it existed and that it was important within the overall framework of the Vučedol Culture.

CRAFT SPECIALIZATION

There are many different definitions and interpretations of specialization, with reference to an archaeological context and organization of production. One of the clearest is perhaps that by P. M. Rice (1981: 220), who defines specialization as regulated behavioural and material variety in productive activities. For C. L. Costin (1991), specialization is a relative state, not an absolute one, and she distinguishes between various degrees and types of specialization. Specialization can be organized in many ways, ranging from that at the level of an individual to community specialization, from household specialization to that in larger organized workshops. According to Costin, production is “the transformation of raw materials and/or components into usable objects”, and specialization is “a way to organize this production.”

One of the models most often cited is that proposed by Earle (see Costin 1991), involving attached and independent specialization. He made a distinction between the production of special, high-value goods consumed and controlled by the elite, and the production of utilitarian goods for broad distribution, which was not systematically controlled. The definition was soon accepted by many authors (e.g. Hagstrum 1985; Sinopoli 1988; Costin 1991). When she discusses specialization, Rice (1989: 110) differentiates between individual specialization and community specialization, and between specialization of a single form, or a single function, of a vessel.

As emphasized above, there are many types of specialization and many definitions, because specialization is not a uniform phenomenon and it depends on a number of factors, primarily on social, economic, political and environmental conditions. In terms of the economy, it is important to stress that any economic system comprises three components: production, distribution and consumption. Distribution and consumption jointly provide information on the economic, social and political contexts of production (Costin 1991). Distribution is linked to the model of exchange, and, to a certain degree, the organization of the production depends on it. The last link in this chain is consumption, or demand for the final product. In this respect, Costin (1991) distinguishes between: a) the nature of the demand, defined by the function of the products within the socioeconomic roles of the people using them; b) the level of the demand, which describes the number of products in circulation and the number required to satisfy the demand; c) the logistics of distribution, which include identifying the ways in which the producer acquires raw materials and delivers finished products to his end consumers; and d) the rationale of the supplier/producer, which identifies the main stimulating force behind production and distribution. In an archaeological context, the consumption component is the most difficult to identify, and, in terms of its interpretation, it is the weakest link in the descriptions of the economic systems of the earliest communities.

Supply and demand are very important aspects of any study of organized production. In typical economic systems, those are the fundamental economic principles and the main fabrics of the market economy. However, in archaeological contexts, we come across economies which were neither market economies nor capitalist economies, and the above terms are used to describe social and political factors affecting the need to have a product. The demand or consumption conditions cannot always clearly be identified in an archaeological context, and they include the following questions: 'Who were the goods produced for?', 'For what purpose?' and 'In what context?' One of the aspects of the demand is the product's function, which relates to the use of a product and its function in everyday life, in rituals, or in social life (Costin 2005: 1047). Characterization of demand involves three sets of analytical techniques: a) identification of the context in which the products were found; b) morphological analysis of the pottery, to establish its function (which includes analyses of organic residues, of raw material, and use-wear and use-alteration analysis of the vessel); c) quantitative and qualitative methods (Costin 2005: 1048). All these attributes can be identified as characteristics of a production system. As for the pottery production, it is important to emphasize that it can be organized in many ways (Rice 1981; Sinopoli 1988; Costin 1991; 2000; Costin & Hagstrum 1995).

Here, we will present a model developed by van der Leeuw which outlines various levels in the organization of pottery production as known from ethnographic and archaeological investigation (see Sinopoli 1991: 98–117). According to him, organization of pottery production can be divided into four levels.

At the lowest level, we have household production. At this level, pottery is produced periodically, in the open, with meagre and limited investment in tools and raw materials (clay and temper). The pottery produced usually consists of a household's yearly needs.

The second level of production also refers to production within a household, but this time much of the production is oriented towards needs other than those of the household, i.e. towards trade or exchange within the settlement. The potters are still not specialized with 'full-time jobs'; they produce pottery as a part-time activity, and their production fulfils the needs of an increased economic demand. At this level, the production volume is higher, and it takes place more frequently, than at the previous level.

Only with the third level of pottery production does there emerge a workshop industry, in which a specialist labour force is needed, which produces pottery as a full-time job. This level includes some major technological changes. However, some authors include, in the notion of technological innovations, the organization of production, that is, a division of the population which makes the core of the labour force, their social status or the location in which the work is done (Miller 2007: 185-186). As pottery-making becomes a regular activity, the number of vessels increases proportionally, leading to the first signs of standardization, as the potters attempt to reduce the time and energy needed to produce a single vessel. In this period, vessels are also produced for a wider distribution.

The last level of pottery production involves the notion of higher-scale production, which means mass production and the employment of a large number of highly specialized potters. This level implies the existence of workshops and work organized at a 'factory level'. The pottery is extremely standardized, and technology is highly specialized.

Another interesting model which is also useful for identifying the production organization at the Vučedol sites studied has been proposed by Costin (1991). She distinguishes among eight degrees of production organization, based on four parameters: context of production, concentration of production facilities, scale and intensity of production.

HOW CAN WE RECOGNIZE ORGANIZED POTTERY PRODUCTION?

Archaeologists generally agree that there are two types of evidence which make it possible to reconstruct organized production: direct and indirect. Direct evidence comprises pottery-production sites, pottery kilns, tools, waste material, pigments, moulds etc. However, a production locus differs from a production unit. *Production loci* are sites in which pottery vessels are manufactured, and they can refer either to the production site as such, or to the community in which the production took place, without specifying the number of producers or workshops. The *production unit* implies not only the production site, but also elements of discrete organization (Costin 1991: 29-30).

Within the Vučedol Culture sites, no pottery kiln has been found, making it evident that pottery was fired in open fireplaces or in pits. Vučedol settlements consisted of very densely-set houses separated by passageways which were less than 1 m wide (Forenbaher 1994). Thus it is likely that refuse and waste materials were often cleared from the houses' surroundings, to keep them passable. As a result, it is very difficult to discover and identify direct evidence of production sites and waste-disposal sites by archaeological excavation.

The only indirect evidence of a possible production site is perhaps three large piles of hematite, which was used for vessel decoration (incrustation); they were discovered in the immediate vicinity of a house at the site of Vučedol ('Streim Vineyard' position). Although they suggest that production took place at the site of Vučedol, and not at the sites discussed in this book, the importance of this evidence should be emphasized, as an indication of a production site which does not include pits, fireplaces or kilns, tools, or unworked clay (Miloglav 2013: 207, Fig. 4).

Indirect evidence is present when, in an archaeological context, the production sites cannot be located, but the pottery product in itself testifies to specialized production. However, indirect products rarely allow us to identify the context, degree and intensity of production. There are several factors which are taken into consideration when dealing with indirect evidence. They include primarily the recognition of large numbers of more or less standardized products, and the skill and efficiency of their manufacture. Indirect evidence of skill is usually measured by technical attributes of finished products. Several ways of measuring skill have been proposed, and they include gestures used to decorate vessels (Hagstrum 1985) and movement control (Costin & Hagstrum 1995). Some ethnoarchaeological research suggests that the potter's skill and repertoire vary with years of experience, and that the skill in manufacturing large vessels progresses linearly as the years go by (Kramer 1985; Roux 2003a).

It is very difficult to define skill in an archaeological context. It is a combination of social and individual learning, transferred in practice and accumulated over years. The degree of the potter's skill can be identified by the so-called technological signature, which can be identified on finished vessels. Just as each potter possesses skill at a certain level, a different skill level is required by each vessel, depending on its purpose and complexity of shape. For example, small vessels of simple shapes, such as cups and small bowls, require a lower skill level than large vessels of more complex forms, such as pots for food storage or urns. Furthermore, vessels of simple shapes require fewer steps in the chain of operations which constitutes the production process.

S. Budden (2008) has proposed a method to measure skill degree using 12 technological variables that can be defined and measured for various morphological forms, i.e. for various degrees of technological complexity of pottery making. This approach to measuring and defining the skill allows relatively simple measuring during the processing of archaeological material. Since, within the sites of Ervenica and Damića Gradina, no areas have been identified which would suggest that some organized production had taken place there, the pottery material has been used as indirect evidence of craft specialization and production organization.

PRODUCT STANDARDIZATION

Standardization of excavated pottery is normally applied in the analysis of production organization (Rice 1989; Stark 1991; Blackman et al. 1993; Kvamme et al. 1996; Arnold P. J. 2000). The best definition of standardization might be that offered by Rice (1987; 1996a: 178-179), who defined it as a reduction in variability of shapes, dimensions and decoration of ceramic vessels. This also implies a reduction in the chain of operations in the production process, and, consequently, a simplification of manufacturing methods (Rice 1981: 220). Furthermore, Rice believes that we should differentiate between standardization within the technology of production, and a reduction of variability resulting from specialization and an increase in the number of people making the pottery. She also emphasizes the need to make a distinction between increased production (intensification) and specialization, since the two are not necessarily linked. The former includes an economic process, or the need for massive production, which implies an increase in labour and funding, while specialization involves special skills necessary to produce a certain product.

Standardization actually measures the number of production groups, and it is usually assumed to be an integral part of specialization for two reasons. The first is that specialized systems consist of fewer producers, which means less individual variability, and the second reason is that specialists practice their craft more often, through both training and practice, and their actions become routinized (Costin 1991: 33–35; Costin 2005: 1067). However, some authors believe that what reduces variability in pottery is not necessarily specialization, but routine. The constant repetition of the same actions, or routinized actions, is mostly discussed separately from specialization, which implies product standardization (Arnold 1991).

Generally, the degree of specialization is affected by the degree of production, and, in identifying the degree of specialization, an important role is played by the ratio of the number of potters/specialists to the number of final users/consumers. As we saw previously, the production can be organized in several ways, from small pottery units at the level of a household, to large workshop centres. The production consists of several components which together form a production system. A production-system model proposed by Costin (2005) includes:

a) artisans (people who manufacture products);
b) means of production (raw materials, tools, skills, knowledge);
c) organization and social relations of production (relationship between producer and consumer);
d) objects;

e) relations of distribution (mechanisms whereby products are transferred to consumers);

f) consumers.

The first component of this production system is potters, that is, specialists producing standardized pottery vessels, as a result of their knowledge, skill and experience. It is usually emphasized that a distinction should be drawn between intentional and mechanical attributes. The former affect the vessel's functionality, and include technological, morphological and stylistic attributes; they cannot reveal much about the way the production was organized. Such actions reflect social and economic norms and the community's demand for a certain functional product. Mechanical attributes are actions that the potter does unintentionally as he manufactures a vessel. Given that they are unintentional, they can tell us more about the production organization. These actions include the selection of clay, and variability in measures such as small deviations in the vessel's morphology (symmetry of the rim, base, handle, wall thickness, etc.). Mechanical attributes are affected by skill, knowledge, experience and working habits (Costin & Hagstrum 1995; Costin 2005).

The standardization hypothesis (Blackman et al. 1993) suggests that the reason for higher uniformity in pottery products lies in a higher degree of production, and that it is linked to economic specialization (Rice 1981; Costin & Hagstrum 1995; Costin 2000; 2005). Specialist pottery production has to be defined in an archaeological context through standardization of raw materials and techniques (Rice 1981), shapes and dimensions (Sinopoli 1988), and decoration (Hagstrum 1985). Although decoration is considered to be an intentional attribute, deliberately placed on the vessel by the potter (Hagstrum 1985; Costin & Hagstrum 1995), measurings of pottery standardization mostly avoid this variable.

The majority of authors agree that the best way to measure standardization is by comparing two different pottery assemblages, since this method provides the best chance of observing the degree of standardization (Rice 1981; Blackman et al. 1993; Costin & Hagstrum 1995; Roux 2003a). Standardization tests are usually based on metric values, manufacturing technology and chemical composition of the clay. However, some authors believe that the composition of the paste cannot tell us anything about the organization of pottery production, while it can reveal a lot about the organization of pottery distribution in the landscape. Moreover, it has been emphasized that uniformity of clay paste cannot be taken as evidence of product standardization and an elevated degree of specialization, and that some other factors should be considered, such as availability and procurement of raw material, and its employment in the preparation of paste. In this respect, it should be borne in mind that technological and environmental factors do not affect the organization of pottery distribution in the same way in which they affect the organization of production, which is largely conditioned by socio-political and socio-economic factors (Arnold 2000).

It is important to emphasize that several things should be borne in mind when establishing standardization, which will be useful for interpretation of specialization and production organization:

1. the attributes analysed reflect production organization, and not unconscious actions which are conditioned by social, economic or political factors (Costin 1991)
2. it is necessary to compare two or more analytical units (sites, assemblages, regions, phases or types)

3. when interpreting data, due attention should be paid to subjectivity, which is an integral part of typological classification; thus, it is advisable to use various statistical tests and methods
4. the sample size is very important, since it should ensure that the data are representative
5. it is very important that, for the purpose of measuring and comparing, data be taken from the same typological group, to avoid deviations in metric values
6. utilitarian objects should be separated from high-value and luxurious objects, whose size and decoration set them apart from the usual repertoire, and their purpose and meaning for the community are different
7. cumulative blurring should be taken into account when interpreting the scale of production.

It has already been mentioned that standardization tests are most often conducted within the scope of ethnoarchaeological studies (Arnold 1985; 2000; Kramer 1985; Stark 1991; Kvamme et al. 1996; Arnold P. J. 2000; Roux 2003a), which help us interpret archaeological theses, while the information used in them cannot be obtained (or is very difficult to establish) in an archaeological context. This includes the majority of metric measurements (e.g. the height of the entire vessel, or the vessel's maximum diameter), information concerning distribution, consumption and production, and on pottery originating from a single potter or from a single production series.

Ethnoarchaeological studies are particularly precious for determining the demand and supply – important aspects of any research into organized production. Some works warn, though, that ethnoarchaeological studies cannot be fully projected onto archaeological research (Costin 2000; Harry 2005). On the other hand, ethnoarchaeological studies do provide some new information and expose archaeologists to different ways of thinking about the material world, and they provide an opportunity to examine the value of the information we possess (Tite 1999). Still, information obtained by ethnoarchaeological studies is very difficult to obtain in an archaeological context, and the values of the coefficients of variation will be much higher. One of the reasons for such results is so-called cumulative blurring, which occurs when measuring all the pottery products from one settlement, which means vessels produced by several potters and originating from several production series (Blackman et al. 1993). This is a fairly common problem in archaeology, since the majority of archaeological material does not come from clearly closed units, as is the case with the investigated site of Damića Gradina. Ethnoarchaeological studies have shown that the coefficient of variation is much smaller when the vessels analysed were produced by a single potter (Roux 2003a: 775; Underhill 2003: 250).

RESULTS OF THE STANDARDIZATION TEST CARRIED OUT ON POTTERY MATERIAL FROM THE SITES OF ERVENICA AND DAMIĆA GRADINA

Looking at the processed pottery material, it could be noticed even at the lowest level of visual perception that pottery assemblages from two sites, observed within individual typological shapes (bowl. pot, cup, jug), were similar. The simplest comparison of variables measured within each typological group has shown that metric data are either matching, or that they depart by very small metric values. For this reason, a test was made to measure the degree of standardization, and to either confirm or deny its presence.

Generally, standardization can be measured in several ways, one of which uses coefficient of variation (CV) to measure the dispersion within a cluster of data. When coefficient of variation is calculated, the standard deviation (SD) of a group of data has to be divided by its mean (M), and the calculation is expressed as a percentage (Shennan 2001). The mean is the arithmetic mean of a group of data, which represents its centre of distribution. It includes all the values/measurements within a group of data. Thus, if the data are widely dispersed, i.e. if some of the results are extremely low or extremely high, it causes problems. In such a case, the mean will no longer reflect a typical value for the group of data. In order to correct such deviations, standard deviation can be used, which features in many statistical tests as the most important measure of data dispersion around the mean.

Nowadays, standard deviation is usually calculated using various statistical programs. We used the SPSS (Statistical Package for the Social Sciences) program. It has already been explained that, in archaeology, the coefficient of variation is used to calculate the degree of standardization of certain products. Generally, the higher the mean, the higher the standard deviation, which could be interpreted as a lesser degree of production standardization. This problem can be overcome using the coefficient of variation, calculated using this formula: $CV = \frac{\sigma}{x} 100\%$ (Shennan 2001).

When measuring the coefficient of variation, extreme values (the highest and the lowest) were excluded, to a maximum number of three measurings per type. Such an approach is not unusual, and it is generally applied, and for two reasons. The first reason is the necessity to differentiate between utilitarian objects and exclusive ones, made for special purposes, which deviate both in terms of their shape and decoration from other pottery. The second reason is to reduce the subjectivity and possible mistakes made during typological classification, especially when the size of the vessel is at issue (Blackman et al. 1993). In view of the above, measurements resulting in extreme values which are not excluded from statistical analysis yield false and unreliable data. Furthermore, it is important that data from the same typological group be taken for the purpose of measurement and comparison, precisely because of deviations in metric values.

For the purpose of standardization testing of pottery material from both sites, measures of vessel rim radius and wall thickness were taken. Ethnoarchaeological studies have shown that the vessel's height and the diameters of its rim and shoulders are those parameters that have the greatest impact on the potter's motor habits (Roux 2003a), and, in today's traditional communities, particularly important is the standardization of the vessel's orifice (Underhill 2003). It is not necessary to reiterate how important the vessel's orifice is for its appearance and function, but the wall thickness – although an important variable from the point of view of the vessel's function – is much less suitable for comparing different types, since measures are taken from different parts of the vessel. Thus, when wall thickness was measured, attention was paid always to measure the same parts of the vessels, usually bodies. For certain types, heights and radiuses of bases were measured, and for those types for which the relevant parameters were few or none, comparisons and measurements were not made.

Already during the processing of pottery finds, a great similarity among bowls of type A 4 was noticed. The type was divided into five variants, with variants A 4a, A 4b and A 4c exhibiting minimal morphological deviations. The coefficient of variation for these bowls is exceptionally low and displays the highest degree of standardization. For rim radiuses from both sites, the coefficient of variation varies 11.61–12.75%, and for wall thickness it is 10.84–13.79% (*Table 25*).

Ervenica - Vinkovci					Damića Gradina - Stari Mikanovci				
Type	**n**	**Mean**	**SD**	**CV**	**Type**	**n**	**Mean**	**SD**	**CV**
A 1a - WT	5	12.10	1.91	15.79%	**A 1a - WT**	9	13.11	2.75	20.97%
A 1d - RR	4	11.87	1.43	12.05%	**A 1d - RR**	7	13.72	2.71	19.75%
A 1d - WT	8	8.13	1.38	16.97%	**A 1d - WT**	18	8.08	1.18	14.60%
A 2 - RR	6	8.57	2.16	25.20%	**A 2 - RR**	30	9.10	1.95	21.42%
A 2 - WT	27	6.85	1.18	17.23%	**A 2 - WT**	88	6.42	1.07	16.66%
A 3a - RR	10	12.60	2.22	17.62%	**A 3a - RR**	33	13.62	1.98	14.53%
A 3a - WT	25	7.32	0.98	13.39%	**A 3a - WT**	78	7.92	0.99	12.50%
A 4a - RR	14	12.02	1.52	12.65%	**A 4a - RR**	14	11.34	1.35	11.90%
A 4a - WT	36	7.00	0.91	13.00%	**A 4a - WT**	28	6.82	0.92	13.48%
A 4b - RR	3	15.50	1.80	11.61%	**A 4b - RR**	3	13.46	1.70	12.63%
A 4b - WT	7	6.80	0.75	11.03%	**A 4b - WT**	9	7.25	1.00	13.79%
A 4c - RR	6	14.26	1.66	11.64%	**A 4c - RR**	28	13.09	1.67	12.75%
A 4c - WT	22	7.19	0.78	10.85%	**A 4c - WT**	90	7.06	0.86	12.18%
A 5 - RR	8	5.57	0.79	14.18%	**A 5 - RR**	24	6.14	1.40	22.80%
A 5 - WT	22	6.34	0.89	14.04%	**A 5 - WT**	75	6.40	1.06	16.56%
B 1a - RR	13	9.31	2.27	24.38%	**B 1a - RR**	49	10.74	2.88	26.80%
B 1a - WT	23	7.33	1.03	14.05%	**B 1a - WT**	87	8.86	1.35	15.23%
B 1b - RR	4	5.75	0.64	11.13%	**B 1b - RR**	32	7.23	1.25	17.28%
B 1b - WT	8	6.54	0.87	13.30%	**B 1b - WT**	56	6.85	1.23	17.95%
B 3b - RR	7	7.28	1.28	17.58%	**B 3b - RR**	11	6.51	1.41	21.65%
B 3b - WT	7	9.32	2.53	27.15%	**B 3b - WT**	15	8.37	1.40	16.72%
C - RR	4	4.10	0.33	8.05%	**C - RR**	3	3.83	0.47	12.27%

n - number of sherds; SD - standard deviation; CV - coefficient of variation; RR - rim radius (cm); WT - wall thickness (mm).

Table 25 – Comparative table with coefficients of variation (CV) for values measured on types from both sites

In contrast with type A 4, type A 2 does not display a high degree of standardization (21.42% and 25.20% for the rim radius), the reason lying in the fact that this type varies considerably in terms of its height and rim radius. Although they appear to be similar, these two types are actually rather different in their morphologies, as regards both their shapes and dimensions. Type A 2 is smaller, has an *omphalos* base and an S-profiled contour. Type A4 is larger, with a flat base and biconical contour.

Small variations in the morphology of bowls of type A 4 reveal that this type of vessel was primarily used for utilitarian purposes, while type 2 was evidently also made for some special purposes, and its morphology varies considerably.

It has already been emphasized that it is very important to use data from the same typological group for the purpose of establishing the coefficient of variation, due to deviations in metric values and in order to reduce subjectivity and potential mistakes in the development of typology. An example of this problem can be observed on bowls of type A 1. The CV of the rim radius for all bowls of type A 1 from Ervenica is 35.89%, and for those from Damića Gradina as much as 43.75%. The same is true of values calculated for all bowls of type A 4 and all pots of type B 1 (Miloglav 2012: 42, Table 3). If we were to consider these results in isolation, we could conclude that this type of bowl shows no standardization. Type A 1 is divided into several variants, based on the height, wall thickness and rim radius; therefore, it would be unrealistic to expect a degree of standardization, when measurements are made on all variants of this type of bowl. However, if metric values focus on the same shape within a typological group, the CV is significantly reduced, and a certain degree of standardization is identified (*Table 25*).

The high degree of standardization observed on bowls, especially those of type A 4, does not come as a surprise, especially in view of the fact that bowls are the most numerous shape at both sites. As discussed in previous chapters, type A 4 is the bowl type with the highest presence at both sites, making up 40.32% of all bowls at Ervenica, and 28.81% at Damića Gradina. It was said previously that one of the analytical techniques used for the purpose of interpretation of the demand is the vessel's function. The function of bowls of type A 4 was serving and consumption of food that had not been thermally treated. Several important factors point to this. In addition to the bowl's morphology, there are no traces of oxidation on its exterior, nor traces that would speak of thermal shocks such as suffered by vessels constantly exposed to heating and cooling. Moreover, the GC-MS analysis (chapter 15) has revealed remains of wax, which was applied as a waterproof filter/coat on both the interior and exterior surface of the vessel, to prevent its liquid contents from escaping. Therefore, the reason for a higher degree of standardization of bowls of this type probably lies in their intensive use in everyday life, which implied an increased rate of wear, deformation and breakage, and thus also more frequent production and more experience in their manufacturing (*Fig. 82, p. 156*).

Repair marks present on pottery vessels, including perforations on both sides of the fracture, are present most frequently on bowls of type A 4, and those of type A 3a, which is an additional confirmation of the intensive use and wear of certain types of bowls and of their recycling and secondary use (*Fig. 28; Table 28*).

It has been established that the CV of pots is considerably high, especially of types B 1a and B 3b, while the variability of smaller pots of type B 1b is somewhat lower. A reason for the higher CV of pots is probably the size of such vessels, in that the manufacturing error increases linearly with the size of intended end products (Roux 2003a: 778). Confirmation of this could be found in pots of types B 1a and B 1b, since those are pots of the same functional shape, which are separated into different subgroups solely on the basis of their heights (type B 1a is m uch larger). The very low CV of the cups from Ervenica – 8.04% for rim radius and 4.57% for height – can be explained as a reflection of a small number of samples, although cups exhibit a relatively high degree of standardization, irrespective of their small share in the whole assemblage.

The chart showing the CVs for both sites, for all the types of pottery processed, is very interesting: the same CV curve can be observed in it (*Fig. 83*). The values that match the most pertain to bowls of type A 4, discussed above. Other values can be traced linearly for both pottery assemblages, which undoubtedly confirms that a certain degree of standardization of pottery vessels was present. The linear curve of the CV, with values for both sites dropping or rising equally, definitely confirms the presence of standardization which depended on the intensity of production of specific pottery shapes, which were present at both Ervenica and Damića Gradina, almost to the same degree. The metric data reveal that the size of vessels from both sites is relatively equable; thus, further analysis in a broader cultural-geographic area could provide indications of the possible economic function of a certain type of vessel.

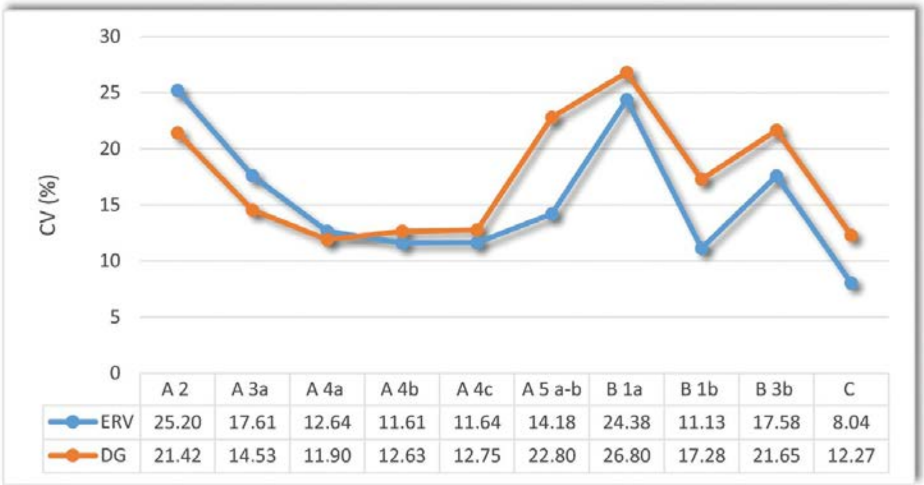


Fig. 83– Coefficient of variation for rim radius of the measured types from the sites of Ervenica and Damića Gradina

MODEL OF ORGANIZED POTTERY PRODUCTION IN VUČEDOL SOCIETY

The values obtained by the CV measuring for both sites discussed here undoubtedly point to a certain degree of standardization of pottery material. These percentages cannot be compared to those obtained by ethnoarchaeological studies, where the values do not go beyond 5%. Some researchers believe that the coefficient of variation should be a standard statistical technique, and they have endeavoured to provide basic values for a minimum and a maximum coefficient of variation used to establish the presence of pottery standardization. Thus a value of 1.7% is the minimum amount of variability, or the highest degree of standardization, attainable through manual production of pottery artefacts. It is also the limit of human ability to perceive a difference in size. A coefficient of variation of 57.7% would indicate that the pottery material is completely non-standardized. This value can also represent an error on behalf of a person creating typological groups, who has put different types into the same typological class (Eerkens & Bettinger 2001).

On the basis of the research carried out to date, it can be concluded that standardization reflects intensified production and manufacturing organization, that it arises from the economic and social framework of a community, and that it affects the homogeneity of the product (Miloglav 2012). The values obtained by measuring the CV point to standardization of certain types of bowls. The reason lies in the fact that bowls make up the largest pottery category, and in time their production reached a certain skill level, related to experience. The intensified production of bowls resulted in increased experience in their making, enhanced motor skills and a higher degree of product standardization, as indicated by results of ethnoarchaeological studies (Eerkens & Bettinger 2001). It is also very probable that bowls and pots were produced by different potters, because, generally speaking, higher standardization means a smaller number of potters/specialists.

In Vučedol society, an organized pottery production must have been present – it still took place within the household, but it was more intensive and oriented to trade and exchange both within and outside the household. We still cannot speak of workshop centres, but there is no doubt that a certain number of people stood out with their skills and took part in pottery manufacturing. The level of such specialization was not yet professional, in that pottery-making was not a full-time job. The measuring results lead to the conclusion that there were several potters who manufactured ceramic vessels within a settlement. This can be read from the CV percentages, which vary considerably, making it likely that each of the potters introduced their mechanical attributes into the pottery making. Even when samples were taken from a single closed unit (pit SU 47/48) and measured, the CV percentages did not display any significant differences (*Table 26*). As a rule, a higher percentage of the coefficient of variation indicates a higher number of potters/specialists who produced the pottery, while a lower CV points to a single potter. Given that the pottery material from pit SU 47/48, the most prolific pit at the site of Ervenica in terms of pottery material, is not susceptible to 'cumulative blurring' and that the degree of standardization measured in it is no higher than the results of other measurements made on the material from both sites, we believe that this also corroborates the thesis that there were several potters and several pottery units within the settlement.

Ervenica - pit SU 47/48				
Type	**n**	**Mean**	**SD**	**CV**
A 4a - RR	4	13.27	2.20	16.58%
A 4a - WT	12	6.81	0.89	13.07%
A 4 - RR	6	13.85	1.92	13.86%
A 4 - WT	17	6.84	0.80	11.70%

n - broj ulomaka; SD - standardna devijacija; KV - koeficijent varijacije; PR - polumjer ruba (cm); DS - debljina stjenki (mm).

Table 26 – Results for the coefficient of variation of type A 4 from pit SU 47/48

The results obtained can be interpreted through the prism of the abovementioned four parameters that define the organization of production, described by Costin (1991: 8):

a) ***context of production*** – This defines the nature of control over production and distribution. In Vučedol society, control over the production of copper objects, that is, over metallurgical production, was probably in the hands of the elite. It is an important fact that this raw material was not easily accessible, and it could be found neither within the settlement nor in its vicinity; thus, the possibility of a certain social control over the raw material cannot be ruled out, since the finished products brought wealth, prestige and power. On the other hand, the elite would not have been particularly interested in controlling items of everyday use, for which raw materials were easily accessible. In the case of the sites of Ervenica and Damića Gradina, such raw materials could be found in the immediate vicinity of the settlements (Chapter 16). Although some signs of social inequality can be observed in Vučedol society, that inequality was still in the making, and it is unlikely that all segments of economic and political life were controlled. As for pottery production, it is more likely that it relied on independent specialists, who produced utilitarian objects for all the households and distributed them within and outside the settlement, without any control over the products and raw materials. Here, the possibility should remain open that certain special-purpose objects were ordered by better-off families or individuals, which has been confirmed by archaeological finds. The appearance of special-purpose objects, or vessels which stand apart from the standard pottery repertoire by their shape, size and decoration, has been ascertained in nearly all the sites of the Vučedol Culture, including those of Ervenica and Damića Gradina (Pls 31, 32). Such vessels were manufactured by exceptionally skilful potters/specialists, and it cannot be excluded that there was a special category of specialists who produced particular types of vessels to which the community attached great social or religious meaning. The difference can be observed most easily at the site of Vučedol, which displays some visible marks of differentiation and the emergence of a large number of high-value objects. However, further analysis, study and testing should be made on the pottery material, to obtain data relevant for scientific interpretation.

b) ***relative regional concentration of production*** – This relates to the geographic organization of production, the way in which specialists are organized across the landscape, their mutual relationship and their ties with the consumers for whom they produce. This aspect of the production system could be the most difficult to define at the sites under examination. Although the two settlements were very large, and in terms of their organization they belong to large Vučedol sites, for the time being we can only speculate about the distribution of specialists across the landscape and about their mutual relationships. As far as distribution goes, it could have included supplying smaller settlements in the surrounding areas whose level of organization was not as high as in the settlements discussed here.

c) ***scale of production units*** – This includes the number of individuals working in a single production unit, and the division of labour. The pottery production was organized at a household level, and it could encompass several production units. Each consisted of individuals with certain knowledge, skills and experience, or even members of the same family. Since there is no direct evidence of labour division in an archaeological context, we cannot comment on it with certainty, but there is no doubt that tasks were divided on the basis of sex and kinship, since knowledge was passed down from generation to generation, usually within the same family.

d) ***intensity of production*** – This reflects the amount of time the potter spends and the way in which the production is organized, as either a part-time or a full-time occupation. Generally, it is very difficult to establish how much time was invested in production in an archaeological context. Taking into consideration a broader background of the socio-economic demands of the Vučedol community, the post of potter did not require full-time engagement which would imply that pottery manufacturing was the only daily activity. This task could have been performed alongside other duties in the community. For example, pottery could be fired in one part of the day, while the rest of the time could have been dedicated to other chores (tilling or animal herding). Furthermore, ceramic vessels were certainly not produced every day; rather, their manufacturing depended on the weather and economic activities. This means that pottery was not produced during rainy periods, and that manufacturing must have intensified during harvests and other agricultural activities. Bowls, the most numerous functional category, were most widely used in everyday life, and, consequently, they were worn, broken, repaired and manufactured the most frequently. A high degree of standardization of some types of bowls points to their regular production, a certain level of skill acquired through experience and less time spent on their making. It is also very likely that those bowls and pots that do not exhibit a high degree of standardization were produced by different potters. Generally, production at a household level can vary between less intensive and very intensive (Costin 2005:

1040), and many ethnoarchaeological studies have shown that the production which takes place in small communities, at a household level, can be very intensive even without full-time engagement (Henrickson & McDonald 1983; Hagstrum 1989). This parameter can be estimated on the basis of the total quantity of ceramic vessels produced by a single household/house during its lifespan (Naroll 1962; Brown 1987; Costin 1991; Loeffler 2003) – but, at both sites under examination, the formation processes have not provided sufficient data for such calculations.

The organization of production in Vučedol society can be best defined using the model proposed by van der Leeuw: it still took place within the household, but the production was mostly oriented towards the demand that existed outside it, that is, to trade and exchange beyond the household's consumption (Miloglav 2012: 51, Fig. 3). If we were to elaborate this further, the production was caused by a model of supply and demand whereby intensified pottery production was caused by enhanced economic activity, a growing population, and a social organization which showed signs of social stratification and the development of hierarchical relations.

Thus, the increased pottery production was a reflection of new socio-economic changes, and it included a division of labour within the scope of everyday activities. This can be explained simply with the system of supply and demand. The production had to be organized in such a way as to satisfy the population's daily requirements and to ensure that some products could be traded and exchanged. In addition, the demands of all layers of the society had to be met, from more affluent individuals/families to smaller and poorer households, whose demand did not go beyond satisfying their annual and seasonal need for pottery inventory.

In general, identifying and defining specialization and its importance in a society in archaeological terms is both challenging and ungratifying, because the relationship between specialization and the socio-political situation is very complex. However, it is worth reiterating that some parameters can already be identified during archaeological excavation (direct evidence) and during the processing of pottery material (indirect evidence). Finally, it is up to us to recognize those patterns and endeavour to interpret them as credibly as possible within the data available.

18 USE-RELATED PROPERTIES AND THE SOCIAL CONTEXT OF VUČEDOL POTTERY

Ceramic vessels are tools – objects used in specific activities to serve specific ends.
(Braun 1983: 107)

In the introductory chapter it was emphasized that pottery vessels were produced and used in a social context, that they were part of socio-cultural interactions, and that they can and must be seen, analysed and interpreted only as such. The production of pottery depended on the needs of the community, and potters adjusted to its demands, while respecting their traditional legacy. In this regard, the production of a certain type of vessel could be more or less intensive. In view of the fact that percentages of various types of vessels are nearly identical in both sites (*Figs 50-53*), it can be assumed that the two contemporary Vučedol settlements shared the same socio-economic needs. The comparative analysis of archaeological material and 14C dates have shown that the settlements at Ervenica and Damića Gradina existed at the same time (Miloglav 2012). During the same period, the Vučedol population also lived in the settlements of Sarvaš, Vučedol and Gomolava, although the majority of these places were already inhabited in the earlier phase (B-1) (Durman 1988; Forenbaher 1994; Balen 2005a; 2010; Petrović & Jovanović 2002; Rajković & Balen 2016).

The greater diversity of types present at Damića Gradina than at Ervenica can be attributed to the surface area excavated, and to a larger sample of pottery material. Actually, other sites of the Vučedol Culture in Vinkovci (at Ervenica and the Tržnica Tell) exhibit similar percentages of types to that at Damića Gradina (Dimitrijević 1979; Krznarić Škrivanko 1999; Durman 2000; Gale 2002; Miloglav 2007).

In view of their function, vessels could generally be used for cooking, serving and consumption of food, as well as storage and transportation. Depending on the future purpose of the vessel, potters made various technological choices, in order to obtain a paste whose quality would satisfy the vessel's presumed function. The paste recipe – which regulates the production process – is a result of the potter's knowledge and experience, a range of social norms, and technological and traditional practices. In the chain of operations, the paste recipe, surface treatment and shape all play key roles in defining the vessel's utilitarian aspect. In archaeological methodology, another one is the context of the find, which is relevant for identifying the location of final disposal.

Rice (1987: 224–226) writes about four interrelated morphological features that affect the vessel's use-related properties. These are:

a) *capacity,* which depends on the vessel's shape and size, and can be measured using the formula for volume (Rice 1987: 220–222). It should be borne in mind that vessels can have a maximum capacity and a real capacity. For example, cooking pots can never be filled to the brim, but only up to a half or three-quarters of their total capacity. Thus, the difference between their maximum and real capacities should be analysed using other indicators, such as use-wear analysis (e.g. carbonization of the internal wall).

b) *stability* is a property relating to shape, proportions and centre of gravity; it makes it possible for the vessel to stand upright. For example, vessels with flat bases or feet are very stable, while those with rounded bases have limited stability. This means that such vessels need additional 'aids' to stand upright on a flat surface. Thus, some ethnoarchaeological studies provide examples of cooking vessels (with rounded bases and limited stability), once removed from the fire, being placed on some kind of tripod, on pot rests and on concavities in the hearth or floor (Skibo 2013: 32).

c) *accessibility* refers to the ability to access the vessel's contents, which depends on the shape of the vessel's orifice and neck. For example, vessels for storing liquids or seeds have restricted orifices, resulting in limited accessibility of the vessel's contents (using a hand or an object). Such vessels are intended for contents that can be poured directly from the vessel. On the other hand, cooking pots have relatively wide orifices, and the contents are completely accessible, allowing easier extraction or mixing of food.

d) *transportability* is the vessel's property relating to the ease of its movement from one place to another. The majority of vessels have low transportability, since their primary function is not transport. Some are rarely moved (for example, vessels for storing), and cooking pots feature a limited transportability, which is sufficient to allow them to be placed on and off the fire (Skibo 2013: 33). The vessel's shape and size, thinning of the walls, surface treatment (with barbotine, for example) which prevents the vessel from slipping from one's hands) and adding handles – these are some of the features the potter should consider when producing vessels intended for transport.

The identification of use-related properties of vessels has been discussed in chapter 8, and it has been emphasized that certain types of vessels can be associated with their primary functions through comparison of all the available data and results of analysis: the vessel's morphological and technological properties, results of archaeometric analyses and data on the archaeological context. Using the data available and the analysis presented in the second part of this book, in this chapter we will present indicators suggesting certain use-related properties of specific types of Vučedol pottery.

COOKING POTS

Cooking pots were discussed most extensively in the first part of the book. Bearing in mind their function, such vessels presented the greatest technological challenge for potters, since they had to ensure their strength, impermeability and resistance to thermal stress. In view of this, defining the function of a vessel that was used for cooking is a very complex task which depends on a number of parameters that can be identified during the processing of the pottery material.

Based on the data analysed, the assumption can be made that all vessels of types B 1 and B 3f were used for cooking foodstuffs of plant and/or animal origin (*Table 27*). The morphological and technological analyses have pointed to certain 'patterns' present in those vessels. Their slightly S-shaped contour allows even heat transfer and reduces breakage of vessels exposed to thermal stress. All vessels of these types feature flat bases, handles and/or grips for their easier lifting or appendage above a fire, and orifices that are wide enough to allow input and extraction of food. The rims are everted, the neck segments are polished or burnished, and the bodies are coated with barbotine (*Table 13, 16*).

The vessels' resistance to thermal stress was achieved through clay tempering with larger quantities of coarser grog, and more textured treatment (barbotine) of the vessels' exteriors, while the interiors were burnished. Barbotine increased the vessel's resistance to thermal stress, cracking and breakage, and with its 'relief' surface, it also facilitated the vessel's transport, since fingers adhered better to the ridges left by the application of soft clay after the vessel's firing. This treatment of the vessel's exterior and interior granted it the necessary impermeability and strength, i.e. resistance to mechanical damage that could be caused by frequent stirring, extraction of food and cleaning.

Traces of soot and oxidation stains have been present on the majority of vessels of this type, and pottery hooks (*Fig. 26*) could indicate that some pots were suspended above a fire. Interestingly, ceramic hooks were present in large numbers at nearly all Vučedol sites (Durman 1988: 71; Balen 2005a: Pls 55, 56, 57: 215–217; Rajković & Balen 2016: Pl. 43: 270–278), while they are hardly known in the preceding cultures.

Residues of lipids discovered on a sherd of a pot of type B 1a (*Fig. 25*) have demonstrated that residues of ruminant fats were only present in the vessel's interior, which suggests that those are remains of its original contents.

Vessels with textured exterior wall (for example, coated with barbotine) are stronger and more resistant to thermal stress – these are the main features of cooking pots, especially if their secondary use was storage (Young & Stone 1990). Furthermore, it has been demonstrated that vessels with textured exterior surface have longer use-life (Pierce 2005; Skibo 2013).

Heat transfer, a very important factor in the cooking process, was neglected in the majority of cases to the benefit of the vessel's resistance to thermal stress (Hein et al. 2015: 49). The terms used in archaeological literature discussing the study of heat transfer are heating effectiveness (Skibo et al. 1989; Schiffer 1990), heating rate (Young & Stone 1990), and cooking effectiveness (Pierce 2005). Heating effectiveness is a complex parameter that depends on thermal conductivity, heat capacity, permeability and the vessel's shape, as well as on some external limitations (Hein et al. 2015: 50). As for vessels used for cooking over a fire, this indicator is very relevant to the final interpretation of use-related properties. Here, experimental archaeology plays a great role, using diverse testing methods on vessels of various shapes (for example, with rounded and flat bases), containing various tempers and with differently treated surfaces (for example, polished or treated with barbotine) to determine their heating and cooling effectiveness (Skibo et al. 1989; Schiffer 1990; Young & Stone 1990; Pierce 2005; Hein et al. 2008; Hein et al. 2015).

The demand for cooking pots was nearly identical in both Vučedol settlements (*Fig. 52*), but their standardization has not been observed (*Table 25*). This could be a result of the vessels' dimensions, where the probability of manufacturing error increases linearly with the size of the vessel (Roux 2003a). Once they were damaged or broken, some of the vessels continued their use-life in their secondary function, as evidenced by repair marks noticed on some sherds (*Table 28*). Various ethnoarchaeological studies have stated that the average use-life of cooking vessels ranged between several months and 1.3 years, where high temperatures used for cooking and frequent movement of vessels from one place to another were the main reasons for their breakage (Longacre 1985; Tani & Longacre 1999; Arthur 2002). Since such vessels could no longer be used for cooking, they could function, for example, as storage containers for dry foodstuffs, such as grains. Repairing broken vessels which could not be used in their primary function any longer was evidently one of the usual methods of re-use of vessels in the Vučedol Culture. Repair marks have been observed on vessels from both sites discussed here, almost to the same degree. At Damića Gradina, such sherds make up 2.71%, and at Ervenica 2.80%.

Although their percentage is much lower, according to the parameters analysed, bowls of type A 6 could also be used for cooking (*Tables 9, 27*). They were produced using the same technology as pots of type B 1, and the only difference is the vessels' morphology. The bowls have very large rim radiuses (min. 14.50 cm; max. 20.50 cm), and handles at their widest part; in addition, they were only made in large sizes. All sherds of this type of bowl contained oxidation stains. In contrast to pots which could be suspended above a fire, these vessels were placed directly in the fire, as indicated by their shape and size, and the positions of the oxidation stains.

Although their morphology is very simple, bowls of type A 1a are rather specific, and they had been produced since the Early Neolithic. These very shallow bowls with thick walls (12.51 mm on average) feature a rim diameter that is equal to the maximum diameter of the vessel (*Tables 4, 27*). Grips, as secondary elements, are integral parts of the morphology of these vessels, and they facilitate their holding and lifting. Traces of oxidation discoloration and soot were present on the exterior of all samples of this type, suggesting that they were placed in direct contact with the fire, while chemical analyses have shown that high concentrations of ruminant fats were present only in the vessels' interiors. This is an indication that the vessel had not absorbed organic residue from the environment, but that lipids are original residues of its contents. From the point of view of technology, thick walls were not an ideal choice for cooking vessels, because heat transfer through such walls is slower; however, they make it possible to maintain a constant temperature of the vessel's contents and contribute to a higher resistance to mechanical damage, that is, increase the vessel's strength. Still, some ethnoarchaeological studies have demonstrated that thick walls were an ordinary technological choice for cooking vessels (Henrickson & McDonald 1983).

The vessel's function cannot always be easily established on the basis of only one parameter, so it is necessary to consider all of its properties. A major role is played by the vessel's morphology, which in this case is very simple, without any sharp inflections of the vessel's contour, and with straight or partially conical walls, which additionally increases the vessel's resistance to thermal stress. Based on an analysed specimen from the site of Vinča, larger vessels of this type, with average rim diameter of around 30 cm, known in older literature as "Güveç vessels", have been described as vessels used for bread-baking (Vuković 2013). This interpretation has been confirmed by some ethnoarchaeological examples, too (Henrickson & McDonald 1983). The Vučedol vessels have much smaller rim diameter, and no large vessels have been recovered to date, making it likely that these vessels were used for thermal processing of foodstuffs of animal origin.

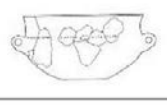
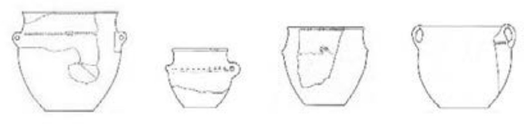
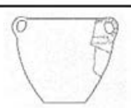
Presumed function	Type	Shape	Secondary use
cooking	A 1a		consumption
	A 6a		short-term storage of dry foodstuffs
	B 1a, 1b, 1c, 1d		storage of foodstuffs, transport
	B 3f		storage of dry foodstuffs, transport

Table 27 – Cooking vessels – presumed function on the basis of morphological and technological features

VESSELS FOR FOOD CONSUMPTION AND SERVING

This category includes vessels used for everyday consumption and serving of food, and for preparation of foodstuffs that did not require any thermal processing (e.g. oatmeal or mash) (*Table 29*). Such vessels could be used by individuals or groups of people, depending on their size.

Vessels of type A 2 are among those that belong to this category (*Table 5, 29*). The *omphalos* base, characteristic of this type, probably facilitated holding of the vessel in one hand, given the impression in the base. The type's morphology allowed liquid or semi-liquid food to be taken out of a relatively large vessel and consumed. It is known that the Vučedol population, and members of cultures preceding the Vučedol, used ceramic spoons for stirring food (*Fig. 84, p. 165*). Spoons and other utensils used for stirring food during cooking were also made of wood, but such objects are rarely found in archaeological contexts, because of the materials they were made of.

Residues of beeswax present on both interior and exterior sides of vessels of this type indicate that the surface was deliberately treated with wax to ensure its impermeability. In the first part of the book, it was noted that reducing the vessel's porosity through surface treatment with resin, wax or fruit juices was a frequent phenomenon (Rice 1987: 231; Schiffer et al. 1994). Furthermore, all vessels of this type display finely polished walls, both internal and external, which also contributed to their impermeability and strength, or resistance to various kinds of mechanical damage. Foodstuffs of plant or animal origin cooked in these vessels also affected their permeability, since fats present in them closed small pores in the pottery structure. In vessels not used for thermal processing of foodstuffs of plant or animal origin, their impermeability is ensured through special surface treatments (such as polishing).

No traces of soot or oxidation stains have been recorded on sherds of bowls of type A 2, corroborating the notion that such vessels were not used for thermal processing of food. Smaller vessels of this type could also be used as lids for storage vessels.

It has already been said in chapter 17 that bowls of this type do not exhibit signs of production standardization, and the coefficients of variation for their height and rim radius vary considerably. Some bowls of this type were probably used by the community for some special purposes (rituals, special events and celebrations, orders by some eminent persons, etc.).

Bowls of type A 4a-c (*Tables 7, 29*) were discussed more extensively in chapter 17. Here, the degree of intensive and standardized production suggests that this type was demanded by the community and that potters had greater experience in its making. The frequent and intensive use of such bowls also meant that they were worn faster, often deformed or broken, so some of them continued to be used in their secondary function. Repair marks present on pottery vessels, including perforations on both sides of the fracture, are present most frequently on bowls of type A 4, and those of type A 3a (*Table 28*). Bowls of type A 3a (*Tables 6, 29*) also display some degree of standardization and increased demand, and all of their features indicate that they can also be classified in this category.

Beeswax residues in the interior and exterior of vessels of type A 4a-c, lack of soot traces and oxidation stains, and the exceptionally sharp biconical profile, unsuitable for cooking above a fire since it causes unequal heat transfer, as well as the finely polished external and internal surfaces – these features indicate that this type of vessel was not used for thermal processing of food.

Ethnoarchaeological studies have shown that the majority of bowls used for food consumption and serving are decorated, and this corresponds to the results of the analysis of the Vučedol material. At Damića Gradina, bowls of type A 2 are decorated in 58.70% of cases, and at Ervenica in 42.86%. The decorated bowls of type A 4 make up 70.32% of such bowls at Damića Gradina, while at Ervenica this percentage is somewhat lower and stands at 37.50%.

Type	no. of sherds	%
A 1d	1	4.76%
A 2a	1	4.76%
A 2b	1	4.76%
A 3a	6	28.57%
A 4a	3	14.29%
A 4b	1	4.76%
A 4c	4	19.05%
A 6a	1	4.76%
B 1a	2	9.52%
B 1b	1	4.76%
Σ	21	100.00%

Table 28 – Repair marks on pottery vessels from the site of Damića Gradina

Coating of the vessel's interior and exterior with beeswax has also been observed in cups of type C 1a (*Tables 17, 29*). Lipid residues on both the interior and exterior have been interpreted as residues of ruminant fats or dairy fats. While traces present in the vessel's interior indicate what the original vessel's contents were, it is possible that those on the exterior are results of spillage of those contents. Since we know that the Vučedol economy was based on animal herding, primarily on raising cattle (65.24%), pigs (25.00%) and sheep/goats (4.88%), and that dairy products had been used in human diet ever since the Early Neolithic (for an overview, see Salque 2012), we can assume that dairy was an element of the dietary habits of the Vučedol population, too. All vessels of type C display finely polished or burnished exteriors and interiors, with no traces that would suggest that they were exposed to fire. In view of the techno-functional characteristics of this type and its morphology, which corresponds to the consumption of liquid foodstuffs, we can say that vessels of this type were used for drinking. The lipid residues present on one specimen suggest that they were used for milk consumption.

As noted in chapter 15, ruminant fats discovered by chemical analyses on the interior of a strainer of type E 1a (*Tables 20, 29*) suggest that cheese was produced. Both specimens of this type feature polished internal and external walls, and drilled holes, suggesting that these vessels were used as strainers. Various types of strainers have been recorded even among the earliest cultures, so their presence within the inventory of a Vučedol household is not unusual.

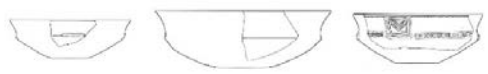
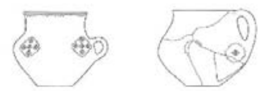
Presumed function	Type	Shape	Secondary use
consumption, serving – food preparation without heat treatment	A 2a, 2b		lids, short-term storage of dry foodstuffs
	A 3a, 3c		short-term storage of dry foodstuffs
	A 4a, 4b, 4c		short-term storage of dry foodstuffs
	A 5a, 5b		short-term storage of liquid foodstuffs
	C 1a, 1b, 2a, 3a		
	E 1a, 2a		

Table 29 – Vessels for food consumption – presumed function on the basis of morphological and technological features

VESSELS FOR FOOD STORAGE AND PRESERVATION

There are two types of storage vessels, used for storing dry and liquid foodstuffs (*Table 30*). The surface treatment depended on the purpose of the vessels, given that those intended for storage of liquid foodstuffs had to have impermeable walls, in contrast to those used, for example, for keeping grains. Vessels in which oil was stored were an exception, since their contents also closed the pores. Furthermore, foodstuffs could be stored for a long or short period of time, and the shape and size of the vessels could reveal their function. Vessels for long-term storage were mostly static and large, while those intended for short-term storage were manipulated and moved more frequently (Henrickson & McDonald 1983).

In view of their morphology and technological features, vessels of types B 3b and B 3c (*Tables 15, 30*) were probably used for storing dry foodstuffs. These were large vessels with restricted orifices, displaying no traces of being exposed to fire. The restricted orifice prevented spillage of the contents, and, given that the interior wall was not treated in any special way to reduce its permeability, it is likely that such vessels were used for storing dry foodstuffs. The vessels were probably used with some kind of lid, which protected the contents from spillage, rodents and insects. Wear marks along the vessel's rim, which could have been caused by the rim's contact with the lid, have been recorded on several sherds of type B 3b. Besides, all vessels of this type had a flat rim, which would allow the vessel to be closed more easily, whether with hide, or some kind of cloth, a ceramic or wooden lid, or another vessel. Although the Vučedol ceramography includes lids (Durman 1988: 130; Balen 2005a: Pl. 58: 225; Rajković & Balen 2016: Pl. 43: 279), they have been found very rarely within the regular pottery inventory (Pl. 33). It is likely that small bowls with rounded bases, such as type A 2, could have served this purpose. Such practice has also been confirmed by ethnoarchaeological studies (Hendricksom & McDonald 1983).

In chapter 14, various socio-economic aspects of the Vučedol society were presented, along with the results of archaeobotanic and osteological analyses pointing to the fact that the population engaged in animal herding, hunting and tilling. The consequent creation of food stocks affected the production of containers for storing foodstuffs, some of which were made of ceramics.

Unlike cups, which, in view of their small size, were used for consumption, jugs (type D) could also be used for short-term storage of liquids (*Tables 19, 30*). Their burnished interiors suggest that attempts were made to make them impermeable. Unfortunately, due to the small sample, non-abrasive traces that would suggest possible fermentation of the contents have not been observed on vessels of this type. It is well known that grains and dairy products ferment, and can thus cause damage to the vessel's exterior wall, and complete erosion of its interior wall (Arthur 2002: 337).

Due to their extremely small dimensions (min. 4.90; max. 8.50 cm), vessels of type A 9 (*Table 12, 30*) are very specific elements of the pottery assemblage and subject to diverse interpretations of their function. They have been described most often as vessels used for cult-related purposes, or as lamps or children's toys (Letica 1967; Balen-Letunić 1982; Balj 2009; 2010). Generally, small vessels mimic some existing larger vessels which belong to the standard inventory, and the technology applied in their production can reveal whether they were made by children or experienced

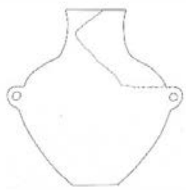
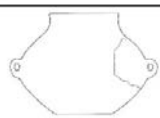
Presumed function	Type	Shape	Secondary use
Storage of dry foodstuffs – long-term	B 3b		transport
	B 3c		transport
Storage of dry foodstuffs – short-term	A 9a, 9b, 9c		consumption
Storage of liquid foodstuffs – short-term	D 1a, 2a		consumption

Table 30 – Vessels for storage – presumed function on the basis of morphological and technological features

potters. Children's handicrafts tend not to be skilfully shaped, their walls are thick and uneven, and they often bear fingerprints (Balj 2009). Such vessels have not been recorded among the material analysed, as all the vessels are shaped very skilfully and precisely, and, in respect of the working technique and surface treatment, they are no different from the larger vessels. The suspension holes recorded on type A 9c suggest that these vessels could have been hung in the kitchen area. Since such miniature vessels had emerged within pottery assemblages since the Neolithic, a symbolic role for them within the social organization should not be ruled out (Tomaž 2005).

TRANSPORT VESSELS

The main feature of transport vessels was thin walls, which made them lighter and easier to transport. Handles facilitated their lifting and manipulation, while their shape depended on the contents and distance (Henrickson & McDonald 1983). Tempering the paste used for such vessels with organic material contributed to their resistance to breakage and mechanical impact and to their transportability (Skibo et al. 1989).

Although the vessel's shape defines its function, it need not necessarily be reserved for only one kind of usage; that is to say, vessels could be multifunctional. For example, cooking vessels could also be used for food consumption, short-term storage of liquid foodstuffs or short-term transport. Similarly, some types of vessels for food consumption and serving could also be used for short-term storage of dry foodstuffs, while certain types of storage vessels could be used for transport. The majority of ethnographic studies have demonstrated that both vessels and storage locations were multifunctional (Hally 1983a: 177).

Besides, a certain type of vessel need not be reserved for the preparation of a single kind of foodstuff. The analysis of organic residues has shown that some of the vessel shapes were used for various cooking techniques. From the morphological perspective, the results indicate that vessels which were exposed to very high temperatures, and in which ingredients had to boil, had large, unrestricted orifices, while the S-profiled vessels were much more suitable for slow simmering and stewing (Eerkens 2005).

When interpreting vessel function, archaeologists are advised to proceed cautiously. Certain shapes of vessels are often interpreted only on the basis of a subjective impression, or on the basis of comparisons with contemporary or ethnographic examples. Unusual specimens, whose shape or decoration stand apart from the usual pottery inventory, have traditionally been described as 'cult vessels', without any additional analysis and interpretation.

An interesting example is that of the so-called milk jugs, whose shape is typical of cultures of the Middle and Late Aeneolithic. Analyses of organic residues have shown that the label applied to them, which suggests the utilitarian function of such vessels and stems from ethnological and historical comparisons, in fact does not correspond to their purpose. Of eight such vessels that have been analysed, dairy protein has been discovered in only one, while traces of dairy fats have been found in some other vessels, such as deep bowls and large storage pots (Craig et al. 2003). Furthermore, the Baden cups have usually been interpreted as cups used for drinking alcoholic beverages, but the analysis of organic residues in four such cups originating from two sites (Vučedol and Tomašanci - Palača) has not confirmed any traces of alcohol (Miloglav & Balen 2016). Clearly, this does not mean that milk jugs were not used for consumption or storage of milk, or that Baden cups were not used for alcohol consumption; but it means that it is incorrect to attribute only one function to any such shape.

Various social and technological practices present in traditional communities should prompt us to approach this subject differently, and not be limited by traditional divisions into very 'rigid' phases and divisions of relative chronology. Social differentiation and its causes are a very complex process which depended on a range of interrelated factors that can be recognized in pottery technology and production. Although differences in style are sensitive to changes brought about by various periods and social influences, ethnographic studies have shown that changes in style can affect production in a very short period of time (Stark et al. 2000).

Interpretation of specific functional shapes also tends to be copied from outdated literature, without any additional analysis. Such an approach is dangerous not only as regards defining the vessel's functional type, but also for all other aspects of archaeological interpretation. Every archaeologist has a responsibility to provide high-quality and objective scientific interpretation, free of preconceived subjective positions and impressions concerning why and when something happened, was created or changed, and why, what and to whom it had some meaning.

In today's world of interdisciplinarity, we should focus on integrating those scientific disciplines that can help us understand and interpret archaeological data, both quantitatively and qualitatively. Given that today's archaeology is a collection of a large quantity of data (resulting from excavations, processing of finds, scholarly literature, comparative studies, various scientific and technical analyses, etc.), our task is to condense the data into an interpretation which is as comprehensive and objective as possible. We also need to be aware that data presented and interpreted are not 'set in stone', that they can be subject to reinterpretation both by their author and by other archaeologists, since new data are constantly emerging in the fields both of archaeological investigations and of processing of material.

In archaeological interpretations, *probability* is a very important term, because our awareness that the analysis has not encompassed all the data about a site (since very few have been investigated in their entirety) or the material processed (which is just part of the material evidence on the life of people in a certain area) enables us to continuously question our research methods and results, and thus enhance our archaeological interpretation.

What archaeologists should keep doing is asking questions: nowadays, we truly are in the position to ask questions, given the accessibility of diverse mechanism that can provide answers. Some answers will come more easily and will be much less painful, while others will cause more headaches, trials and errors.

Based on the large amount of data hidden in pottery material, and using an interdisciplinary approach to its processing, this book offers just some guidelines concerning the ways in which messages contained in a pottery vessel can be read and interpreted. At the end, I will repeat a sentence from chapter 8: *The task of archaeologists is to distinguish between what we know and what we can imagine about a ceramic vessel – which is, of course, also true of all other objects that belong to the past material culture of mankind.*

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O AUTORICI

Ina Miloglav (rođ. Gale) rođena je 1973. godine u Splitu gdje je završila osnovnu školu i opću gimnaziju. Jednopredmetni studij arheologije na Filozofskom fakultetu Sveučilišta u Zagrebu upisala je 1992. godine te diplomirala 1999. s temom *Arheološka topografija otoka Šolte*. Od 2001. do 2004. godine radi kao kustosica Arheološkog odjela Gradskog muzeja Vinkovci. Godine 2005. zapošljava se na Odsjeku za arheologiju Filozofskog fakulteta Sveučilišta u Zagrebu kao znanstvena novakinja na projektu prof. dr. sc. Aleksandra Durmana *Vučedolska kultura na tlu Hrvatske* u okviru kojeg istraživački i znanstveno sudjeluje do njegovog prestanka 2014. godine. Doktorirala je 2012. godine disertacijom *Kasna vučedolska kultura u Bosutskoj nizini na temelju keramičkih nalaza*. Od iste godine u suradničkom je zvanju više asistentice, a od 2016. u znanstveno-nastavnom zvanju docentice na Katedri za arheometriju i metodologiju Odsjeka za arheologiju Filozofskog fakulteta u Zagrebu.

Osim navedenog projekta kao suradnica sudjelovala je na nekoliko znanstvenih projekata i programa: *Rimski vojni logori u Hrvatskoj-Tilurij*, *Eksperimentalnom arheologijom do tehnologije proizvodnje keramičkih posuda u prapovijesti*, *Lončarstvo u prapovijesnim kulturama; s naglaskom na Halštatsku kulturu, na području hrvatskog i austrijskog Podunavlja*, *Između Dunava i Mediterana. Istraživanje uloge rimske vojske u mobilnosti ljudi i dobara u razdoblju Rimskog Carstva (RoMiCRO)* i *Potencijalne sirovine u prapovijesnom lončarstvu, studija slučaja: tel Damića gradina*.

U studijskom programu Odsjeka za arheologiju aktivno sudjeluje od akademske godine 2006./2007. kao izvođač kolegija *Dokumentiranje arheoloških nalazišta*, *Uvod u digitalnu obradu arheološke dokumentacije*, *Metodologija obrade prapovijesne keramičke građe* i *Terenska nastava*. Na doktorskom studiju Mediavistike sudjeluje tijekom dvije akademske godine s kolegijem *Metodologija arheoloških istraživanja*.

Tijekom studija te kasnije kao dipl. arheolog sudjeluje na više od 70 arheoloških istraživanja na području Hrvatske, a od 2010. do 2014. godine voditeljica je arheološkog istraživanja Sv. Kvirin u Sisku.

Autorica je niza radova koji se bave metodologijom arheoloških istraživanja te obradom i analizom keramičke građe. Kao autorica sudjelovala je na više od 20 međunarodnih i domaćih znanstvenih skupova te održala niz predavanja izvan matične institucije. Također, aktivno sudjeluje na domaćim i međunarodnim skupovima kao voditelj sekcija i član organizacijskih odbora. Stručno se usavršavala na nekoliko radionica i tečajeva koji su povezani s digitalnom dokumentacijom. Intenzivno surađuje s kolegama s Rudarsko-geološko-naftnog fakulteta, Veterinarskog i Geodetskog fakulteta u cilju poticanja interdisciplinarnosti.

Članica je uređivačkog odbora časopisa *Opuscula archaeologica* kojeg izdaje Arheološki zavod Filozofskog fakulteta Sveučilišta u Zagrebu te časopisa *Arhaika* Odelenja za arheologiju Univerziteta u Beogradu.

Godine 2013. pokrenula je međunarodni znanstveni skup *Methodology and Archaeometry* na Odsjeku za arheologiju Filozofskog fakulteta Sveučilišta u Zagrebu kojemu je cilj poticanje interdisciplinarnosti, kritičkog promišljanja, novih spoznaja i pristupa te teorijskih okvira u suvremenoj arheološkoj znanosti.

ABOUT THE AUTHOR

Ina Miloglav (née Gale) was born in 1973 in Split, where she attended a local primary and grammar school. She enrolled on a single-honours university course in archaeology at the Faculty of Humanities and Social Sciences of Zagreb University in 1992, and in 1999 she graduated with a thesis entitled *Archaeological topography of the island of Šolta. B*etween 2001 and 2004 she worked as a curator in the Department of Archaeology of the Vinkovci Town Museum. In 2005 she got a post in the Department of Archaeology at the Faculty of Humanities and Social Sciences of Zagreb University, as a research assistant on the project *Vučedol Culture in the Territory of Croatia,* led by Prof. Aleksandar Durman, and she participated in it with her research and scientific work until the project was closed in 2014. In 2012 she earned her doctorate with the thesis *Late Vučedol Culture in the Bosut Valley on the Basis of Pottery Finds*. In the same year, she became a senior assistant, and in 2016 assistant professor, in the Sub-department of Archaeometry and Methodology, Department of Archaeology, at the Faculty of Humanities and Social Sciences of Zagreb University.

Besides the project mentioned above, she has participated in several scientific projects and programmes: *Roman military camps in Croatia – Tilurium; Through experimental archaeology to the technology of pottery production in prehistory; Pottery production in prehistoric cultures, with emphasis on the Hallstatt Culture, in the Croatian and Austrian Danube Region; Between the Danube and the Mediterranean. Exploring the role of the Roman military in the mobility of people and goods in Croatia during the Roman Era (RoMiCRO); and Potential raw materials in prehistoric pottery production, a case study: Damića Gradina Tell.*

Since the academic year 2006/2007, Dr Miloglav has actively participated in the university programme of the Department of Archaeology as a teacher of the following courses: *Documenting archaeological sites*, *Introduction to digital processing of archaeological documentation*, *Processing methodology for prehistoric pottery* and *Field school*. At the doctoral course in Mediaeval Studies, she taught the course *Methodology of archaeological excavations* over two academic years.

During the studies, and since her graduation, she has participated in more than 70 archaeological excavations in Croatia, and between 2010 and 2014 she led the archaeological excavation of St. Quirinus in Sisak.

Dr Miloglav is the author of a number of papers discussing the methodology of archaeological excavation and the processing and analysis of pottery material. As an author, she has participated in Croatian and international conferences as session organizer and member of organizational committees. Her professional development includes participating in several workshops and courses regarding digital documentation. She cooperates intensively with experts from the Faculty of Mining, Geology and Petroleum Engineering, Faculty of Veterinary Medicine and Faculty of Geology, with a view to stimulating interdisciplinary approaches.

She is a member of the editorial board of the journal *Opuscula archaeologica*, published by the Institute of Archaeology of the Faculty of Humanities and Social Sciences of Zagreb University, and of the *Arhaika* journal of the Department of Archaeology of Belgrade University.

In 2013 she initiated the scientific conference *Methodology and Archaeometry* at the Department of Archaeology of the Faculty of Humanities and Social Sciences of Zagreb University, whose goal is to stimulate interdisciplinary approaches, critical thinking, new understanding and approaches, and theoretical frameworks in contemporary archaeological science.

IZVATCI IZ RECENZIJA

Iako naslov knjige govori da će u njoj biti riječi o lončarstvu vučedolske kulture na vinkovačkom području, to je samo djelomice točno. Naime, knjigu čine dva odvojena dijela koji mogu sasvim dobro funkcionirati svaki za sebe, a opet su logično isprepleteni. Prvi dio je zapravo jedan opći, vrlo opsežan i sveobuhvatan, gotovo enciklopedijski priručnik i udžbenik o najčešćim i najbrojnijim nalazima na arheološkim nalazištima iz svih razdoblja, a to su keramičke izrađevine. U njemu se čitatelj upoznaje sa znanstvenim disciplinama koje se bave proučavanjem keramičkih proizvoda i što one iz njih mogu iščitati, s nastankom i razvojem specifične tehnologije, ali i historijatom njezina proučavanja. Moguće je saznati sve o sirovini nužnoj za proizvodnju keramike, o fizičkim obilježjima keramike, o etapama proizvodnog procesa, o parametrima kojima se stručnjaci koriste pri obradi i tipološkoj klasifikaciji keramike. Autorica pomno objašnjava čemu uopće služi tipologija i zašto je takav pristup još uvijek potreban. Posebno se osvrće na problem strukovnog nazivlja koje nedostaje u hrvatskoj arheološkoj praksi i najčešće se iskazuje kao subjektivni i svojevoljni odabir termina. Na kraju predstavlja metodologiju obrade keramičkih nalaza kroz funkcionalni, estetski i taksonomski pristup.

U drugome dijelu knjige teorijski okvir kao i analitičke metode objašnjene u prvome dijelu, praktično su primijenjeni na konkretnim primjerima obrade i analize keramičkih nalaza s dvaju lokaliteta vučedolske kulture na vinkovačkom području. Krenuvši od tipološke obrade keramičkih nalaza temeljene na njihovim morfološkim značajkama, preko deskriptivne statistike, autorica uspijeva definirati model keramičke proizvodnje koji objedinjuje specijalizaciju zanata, standardizaciju proizvoda i organizaciju proizvodnje. Tehnološke analize upotpunjene su petrografsko-mineraloškim te analizama provedenim s pomoću metoda rendgenske difrakcije na prahu i plinskom kromatografijom – masenom spektrometrijom. Gospodarsko značenje proizvodnje keramike u vučedolskoj kulturi dodatnoje potvrđeno rezultatima analiza arheobotaničkih i osteoloških ostataka. Zahvaljujući interdisciplinarnom pristupu proučavanju keramičkih nalaza s odabranih lokaliteta, a koji se nametnuo kao nužan i vrlo učinkovit, autorica je uspjela pokazati kako keramiku ne treba sagledavati samo kao puke predmete načinjene da zadovolje osnovne potrebe pohrane, pripreme i serviranja hrane, nego kao medij kroz koji se zrcali složena mreža društvenih, gospodarskih pa i religijskih odnosa ljudskih zajednica koje su ih osmislile, stvorile, rabile i na kraju odbacile.

prof. dr. sc. Tihomila Težak-Gregl
Odsjek za arheologiju
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Knjiga pod naslovom “Keramika u arheologiji - Lončarstvo vučedolske kulture na vinkovačkom području” Ine Miloglav predstavlja jednu od veoma retkih sveobuhvatnih studija posvećenih keramičkoj građi. Za razliku od tradicionalne arheologije, u kojoj još uvek dominira kulturno-istorijski pristup u proučavanju keramike, gde se ona posmatra isključivo kao hronološki marker, te indikator kulturnih grupa, ova knjiga donosi aktuelni, savremeni pogled na ovu vrstu arheoloških nalaza, pre svega kao dinamične kategorije koja u sebi nosi informacije o ponašanju, svakodnevnom životu i socijalnim odnosima. Knjiga se sastoji iz dve velike celine. U prvoj celini dat je pregled svega onoga što obuhvataju keramičke studije i istaknuta je njihova interdisciplinarnost i neraskidiva veza sa etnoarheologijom i arheometrijom. Veoma je značajno to što se detaljno razmatra i objašnjava pojam tehnologije, kao i sled operacija u proizvodnji keramičkih posuda. S pravom je posvećena velika pažnja problemu tipologije i u teorijskom i u praktičnom smislu; osim kritički predstavljenih različitih pristupa u definisanju svrhe i cilja tipologije, ponuđene su i preporuke kako se one pravilno primenjuju prilikom obrade keramičke građe. Posebna pažnja posvećena je anatomiji posuda i morfološkim parametrima na osnovu kojih se vrši klasifikacija. Izuzetno je važna rasprava o postojanju neadekvatne terminologije i opasnostima koje slede kao posledica njihove nektritičke upotrebe. Takođe, istaknuta je važnost razmatranja funkcije posuđa u cilju razumevanja praksi u ishrani i pripremi hrane, kao važnih aspekata svakodnevnog života.

Drugi deo knjige posvećen je analizi keramike vučedolske kulture sa dva arheološka lokaliteta - Ervenice u Vinkovcima i Damića gradine u Starim Mikanovcima. Metode predstavljene u prvom delu knjige ovde su i praktično primenjene. Posuđe je klasifikovano prema morfološkim parametrima i formalnim atributima u funkcionalne klase za pripremu hrane, konzumiranje i serviranje, i skladištenje, rezultati su obrađeni statističkim metodama, a primenom petrografskih i XRD analiza identifikovan je sastav sirovina te vrste i količine primesa. Sprovedene su i analize lipida, a rezultati su pokazali upotrebu pčelinjeg voska za tretiranje unutrašnjih površina, koje su tako učinjene nepropusnim, ali i za popravke posuda. Najznačajniji domet ove knjige svakako je smeštanje keramičke proizvodnje u socijalni kontekst: rezultati analize standardizacije, odnosno koeficijenata varijacije, upućuju na standardizovanu proizvodnju, što je neminovno dovelo i do definisanja modela njene organizacije, u kome se može pretpostaviti prisustvo specijalizovanih grnčara. S obzirom na to da su ovako sveobuhvatne analize keramičkih asemblaža još uvek veoma retke, ova knjiga će imati velikog značaja, i to ne samo za istraživače eneolitskog perioda. Zahvaljujući sažetom i jasnom pregledu svih važnih aspekata keramičkih studija, kao i promišljenoj i relevantnoj metodologiji primenjenoj na konkretnom arheološkom materijalu, ona će, sasvim sigurno, biti nezaobilazno štivo, kako studentima arheologije, tako i profesionalnim keramolozima.

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EXCERPTS FROM REVIEWS

Although the title of this book indicates that its subject matter is the pottery of the Vučedol Culture in the Vinkovci region, this is only partially true. In reality, the book consists of two separate parts; each of them could function independently, but their logics are also intertwined. The first part is actually a general, very voluminous and comprehensive, almost encyclopaedic manual and textbook on the most frequent and the most numerous of all the finds yielded by archaeological sites of all periods: pottery artefacts. Here, the reader will learn about scientific disciplines involved in studying pottery artefacts and the information they can extract from them, about the emergence and development of specific technologies, and about the history of their research. We can find out all about the raw material needed for pottery production, about the physical properties of pottery, phases of the production process, and about the parameters used by archaeologists in the processing and typological classification of pottery. The author describes in detail the role of typology and the reasons that still make this approach essential. She particularly raises the issue of specific terminology missing from Croatian archaeological practice, which is most often reflected in subjective and capricious choices of terms. Finally, she presents a methodology of pottery processing, using the functional, aesthetic and taxonomic approaches.

In the second part, the theoretical framework and analytical methods described in the first part of the book are applied in practice, to concrete examples of the processing and analysing of pottery finds originating from two sites of the Vučedol Culture in the Vinkovci region. Beginning with a typological analysis of pottery finds, based on their morphological features, through to descriptive statistics, the author succeeds in establishing a pottery-production model which includes craft specialization, product standardization and organization of production. The technological analyses are complemented by petrographic-mineralogical analyses, and X-ray powder diffraction and gas chromatography-mass spectrometry analyses. The economic importance of pottery production within the Vučedol Culture is additionally confirmed by the results of archaeobotanic and osteological analyses. Thanks to an interdisciplinary approach to the study of pottery material from the selected sites – which has proven to be both necessary and very effective – the author has successfully demonstrated that pottery should not be seen merely as simple objects made for satisfying some basic needs such as the consumption, preparation and serving of food, but also as a medium in which a complex web is reflected, made up of social, economic and even religious relations between the human communities that designed them, produced them, used them and eventually discarded them.

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The book "Ceramics in Archaeology - Pottery of the Vučedol Culture in the Vinkovci Region" by Ina Miloglav is one of the very rare comprehensive studies on archaeological pottery. In contrast to traditional archaeology, which is still dominated by the culture-historical approach to the study of pottery, where the pottery is seen exclusively as a chronological marker and indicator of cultural groups, this book brings a current, contemporary outlook to this type of archaeological material. Pottery is seen primarily as a dynamic category which holds in itself information concerning human behaviour, everyday life and social relations.

The book consists of two large parts. The first provides an overview of everything encompassed by pottery studies, with an emphasis on their interdisciplinary nature and their unbreakable tie to ethnoarchaeology and archaeometry. A very important facet is the detailed discussion and explanation of the notion of terminology, and of the production sequence of pottery production. Great attention is rightly paid to the issue of typology, considered from both theoretical and practical points of view; in addition to various approaches to defining the purpose and goal of typology, which are critically presented, suggestions are also offered as to how to apply them correctly during the processing of pottery assemblages. Particular attention is paid to the vessels' anatomy and the morphological parameters used for their classification. The discussion focusing on inadequate terminology and risks involved in its uncritical use is particularly relevant. Furthermore, the book emphasizes the importance of considering the function of the vessels, with a view to gaining an understanding of food habits and food preparation, as important aspects of everyday life.

The second part of the book is dedicated to an analysis of the Vučedol Culture pottery from two archaeological sites: Ervenica in Vinkovci, and Damića Gradina in Stari Mikanovci. Here, the methods presented in the first part of the book are put to practical use. On the basis of its morphological parameters and formal attributes, the pottery is classified into functional classes: food preparation, consumption, serving and storing; these results have been processed using statistical methods, while petrographic and XRD analyses have been used to identify the composition of raw materials, and types and quantities of temper. Lipid analysis has also been done, and its results have demonstrated that beeswax had been used for treatment of interior surfaces in order to make them impermeable, and also for curation of vessels. Undoubtedly, the most important achievement of this book is the placing of pottery production in a social context. The results of the analysis of standardization, or of the coefficient of variation, suggest that the production was standardized, which had to result in a defined model of its organization, and the presence of specialized potters can be assumed. Given that such comprehensive analyses of pottery assemblages are still very rare, this book will have a major impact, and not just on scholars focusing on the Aeneolithic. Thanks to the clear, brief overview of all important aspects of pottery studies, and the notable and relevant methodology applied to the actual archaeological material, this will certainly be an item of indispensable reading, to students of archaeology and professional ceramologists alike.

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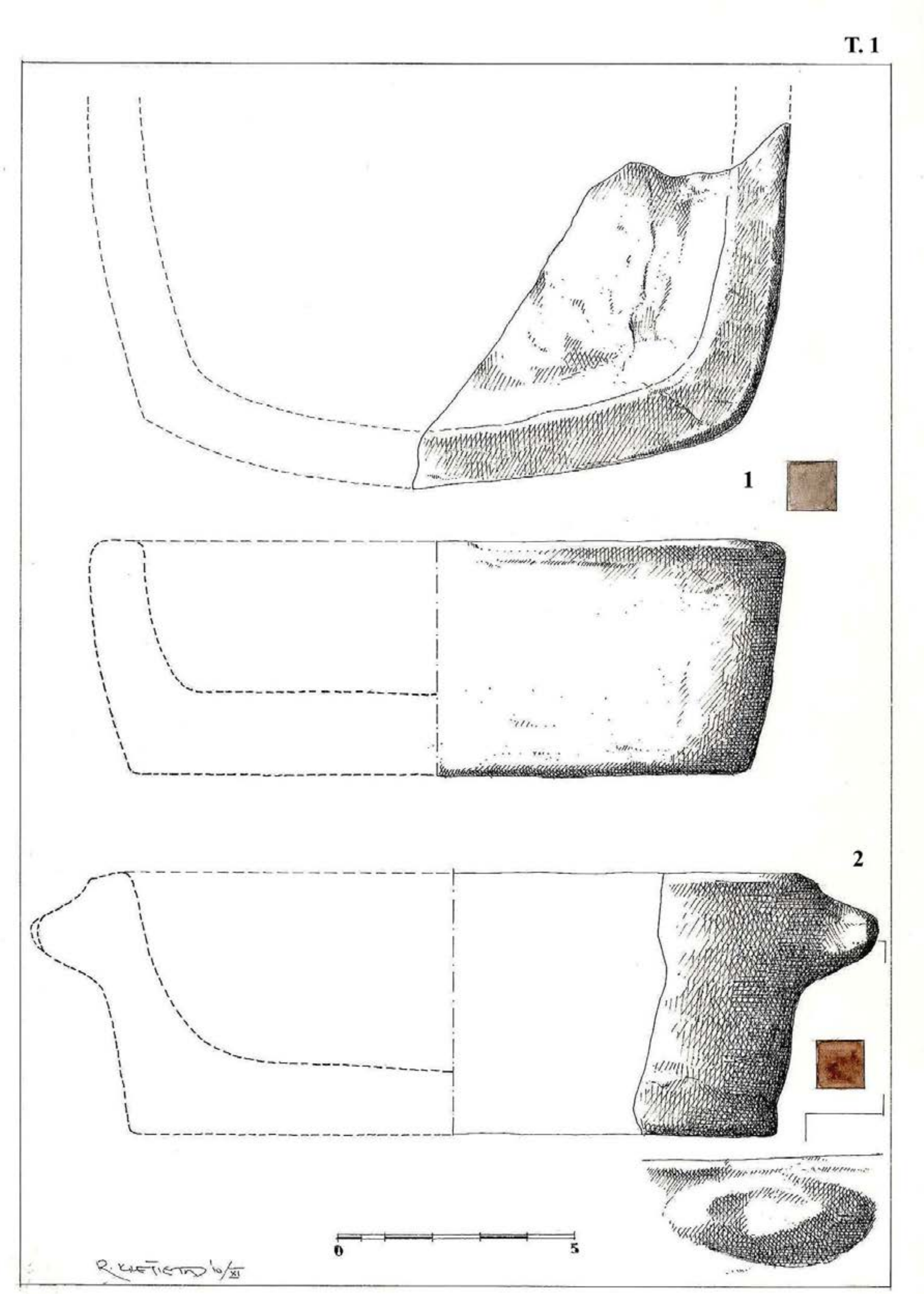
Department of Archaeology
Faculty of Philosophy, University of Belgrade

TABLE S KERAMIČKIM MATERIJALOM/

PLATES OF DRAWINGS OF POTTERY



Plates of drawings of pottery are marked with 'T.' (instead of 'Pl.')

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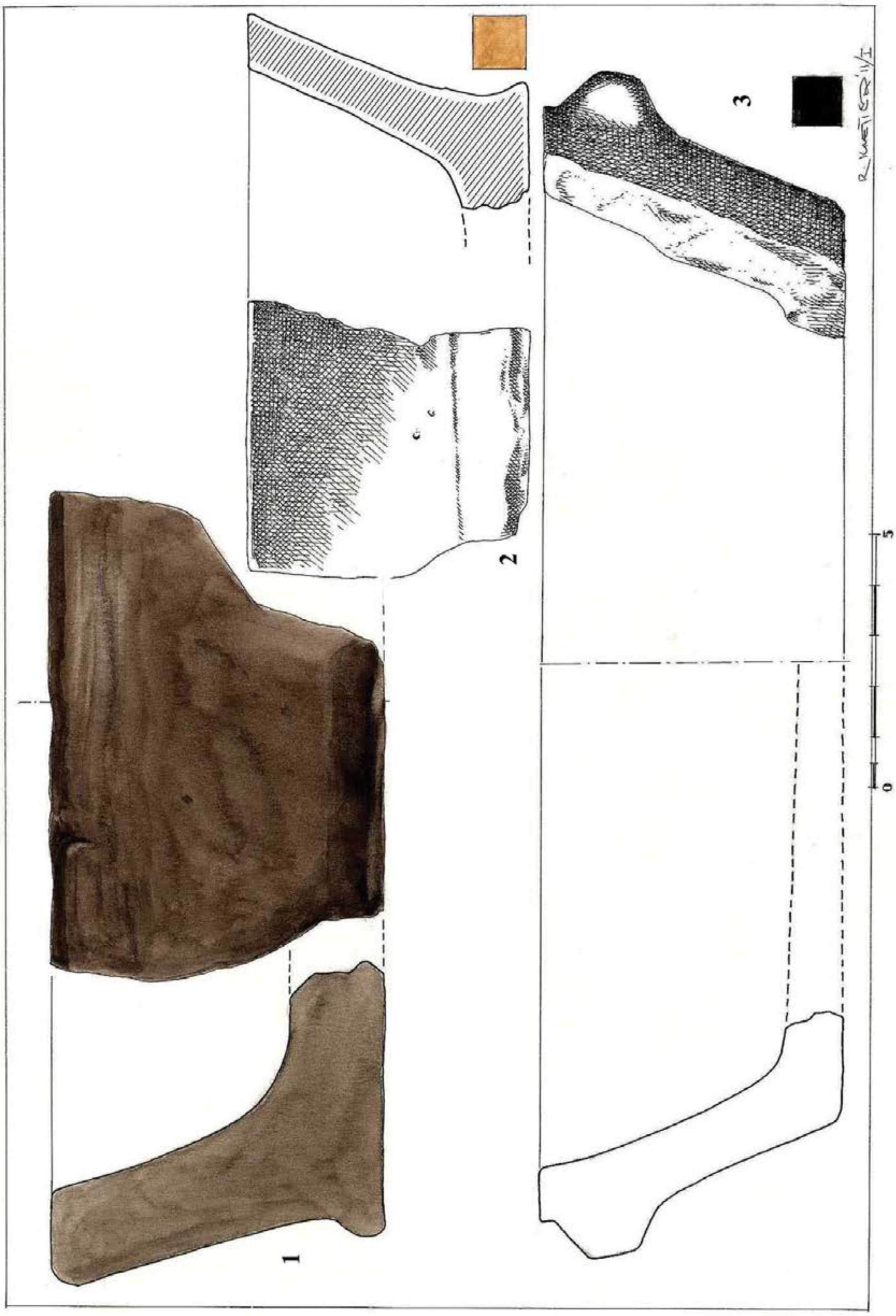

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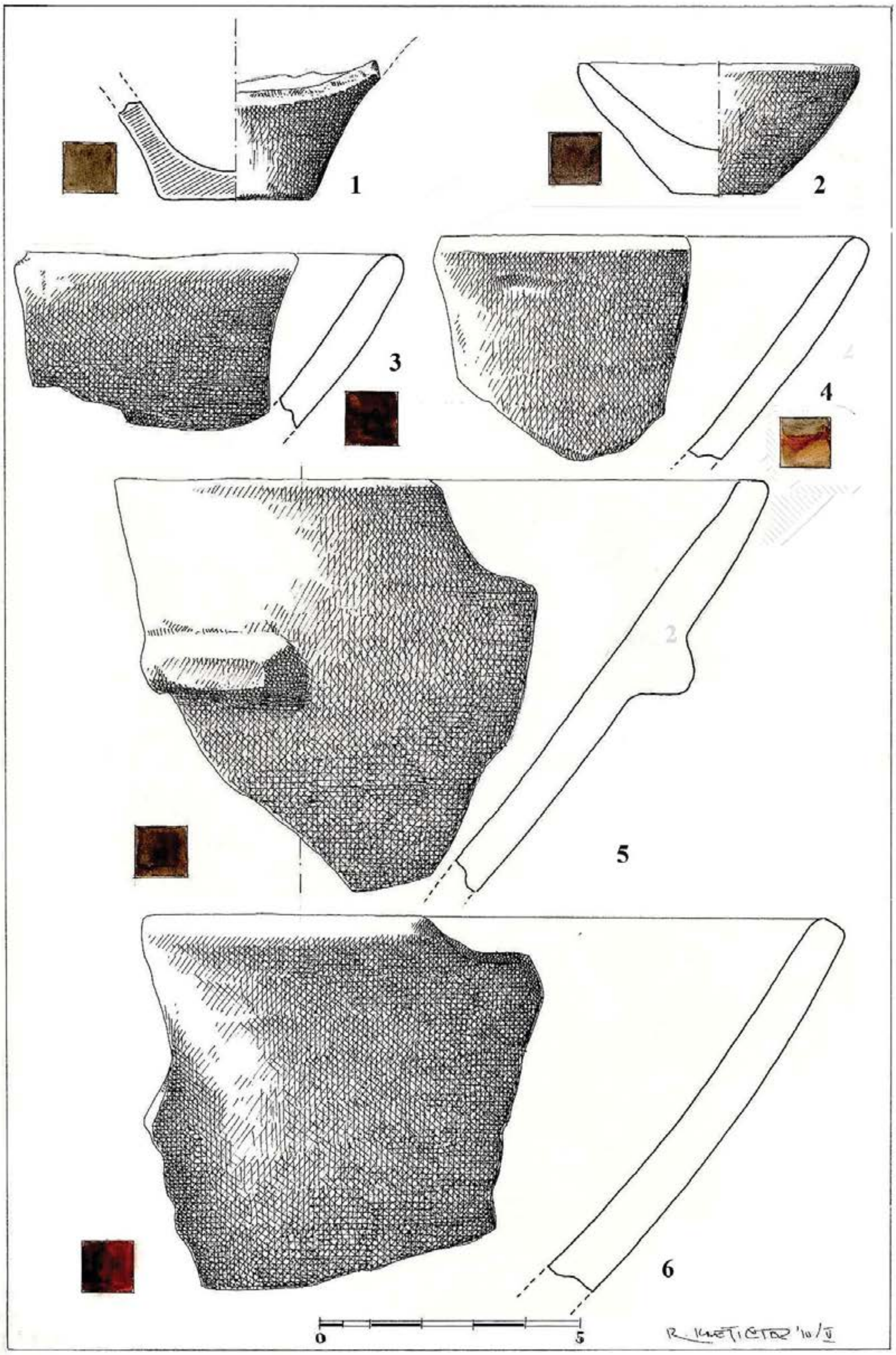

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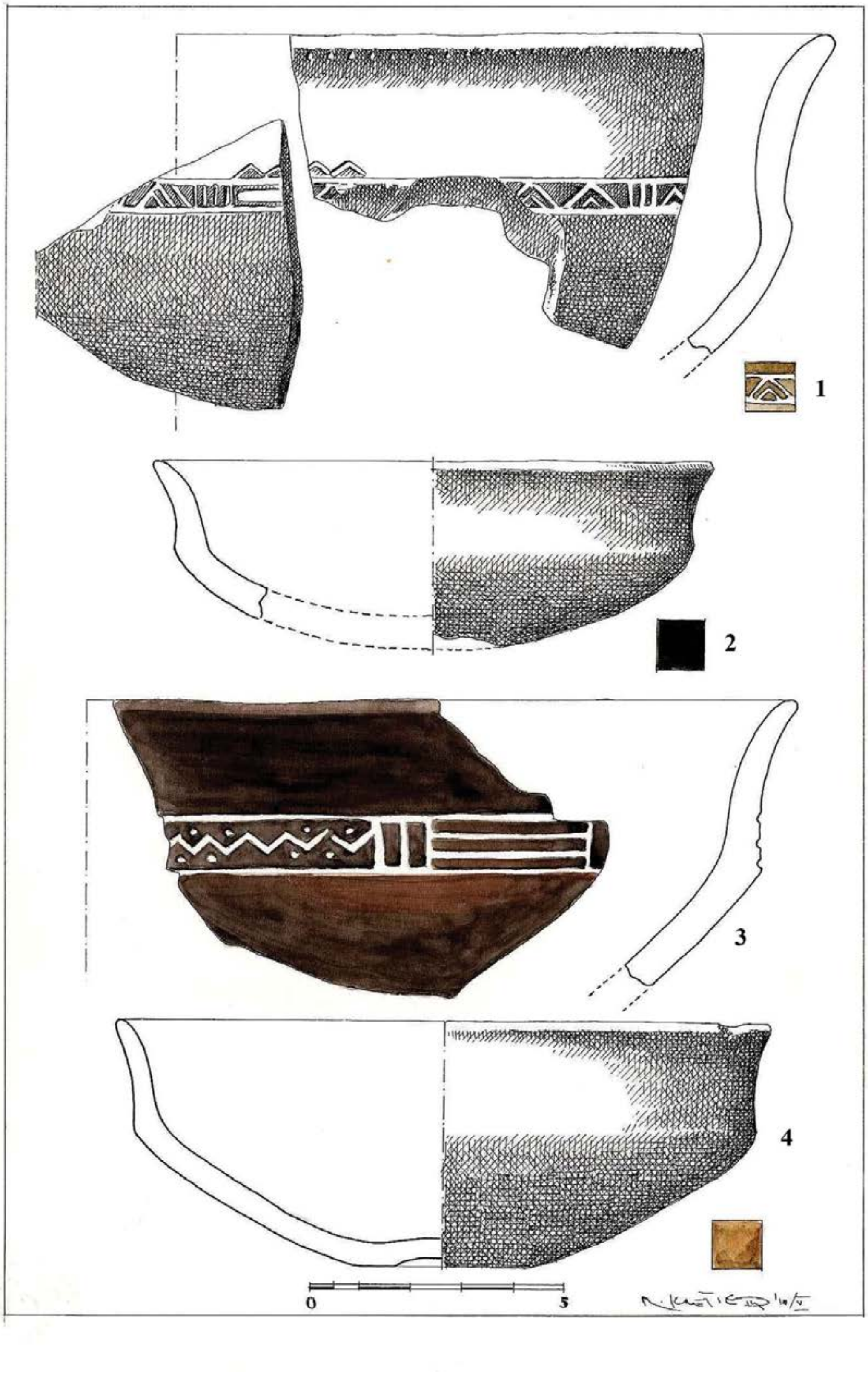

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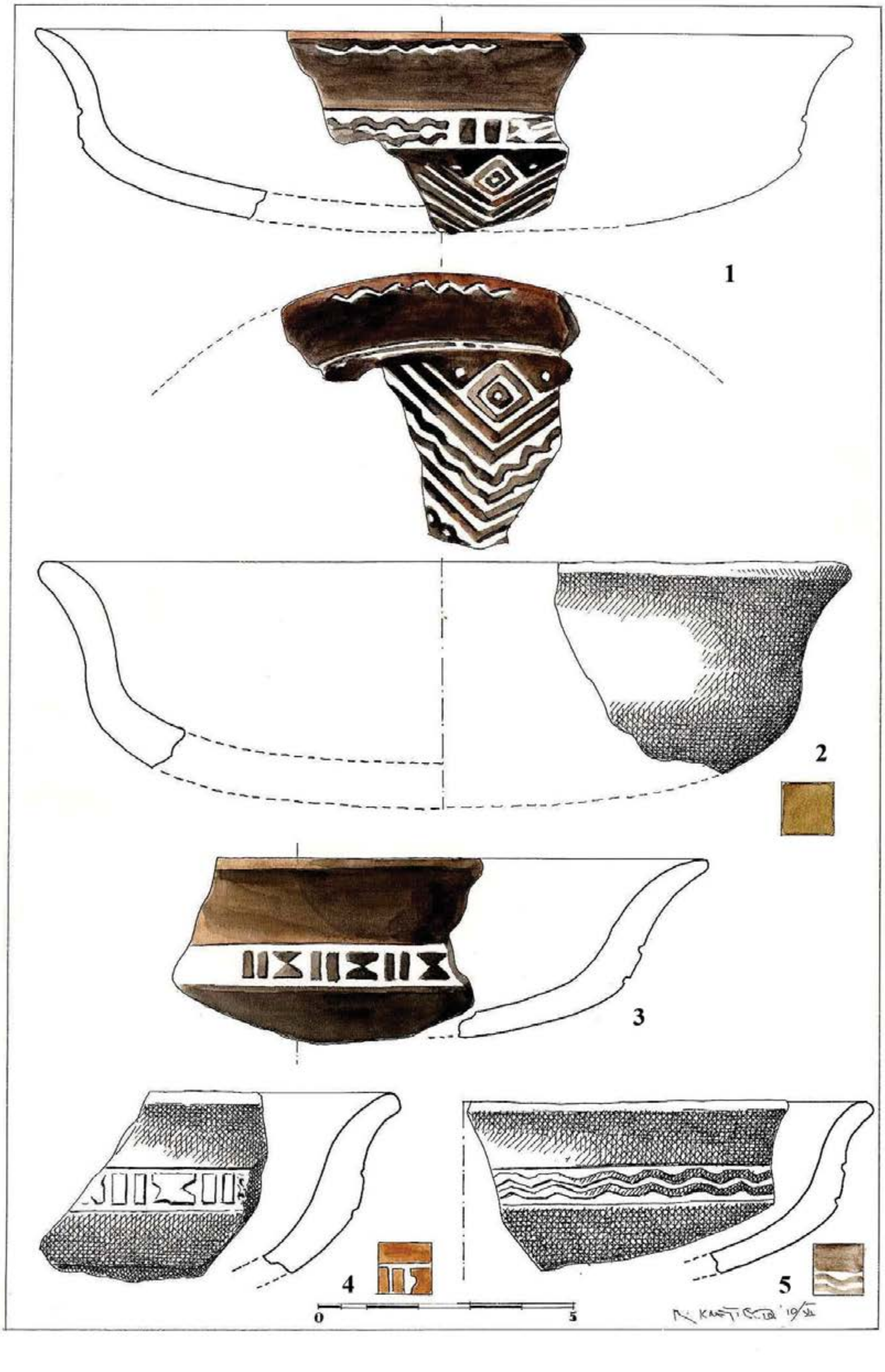

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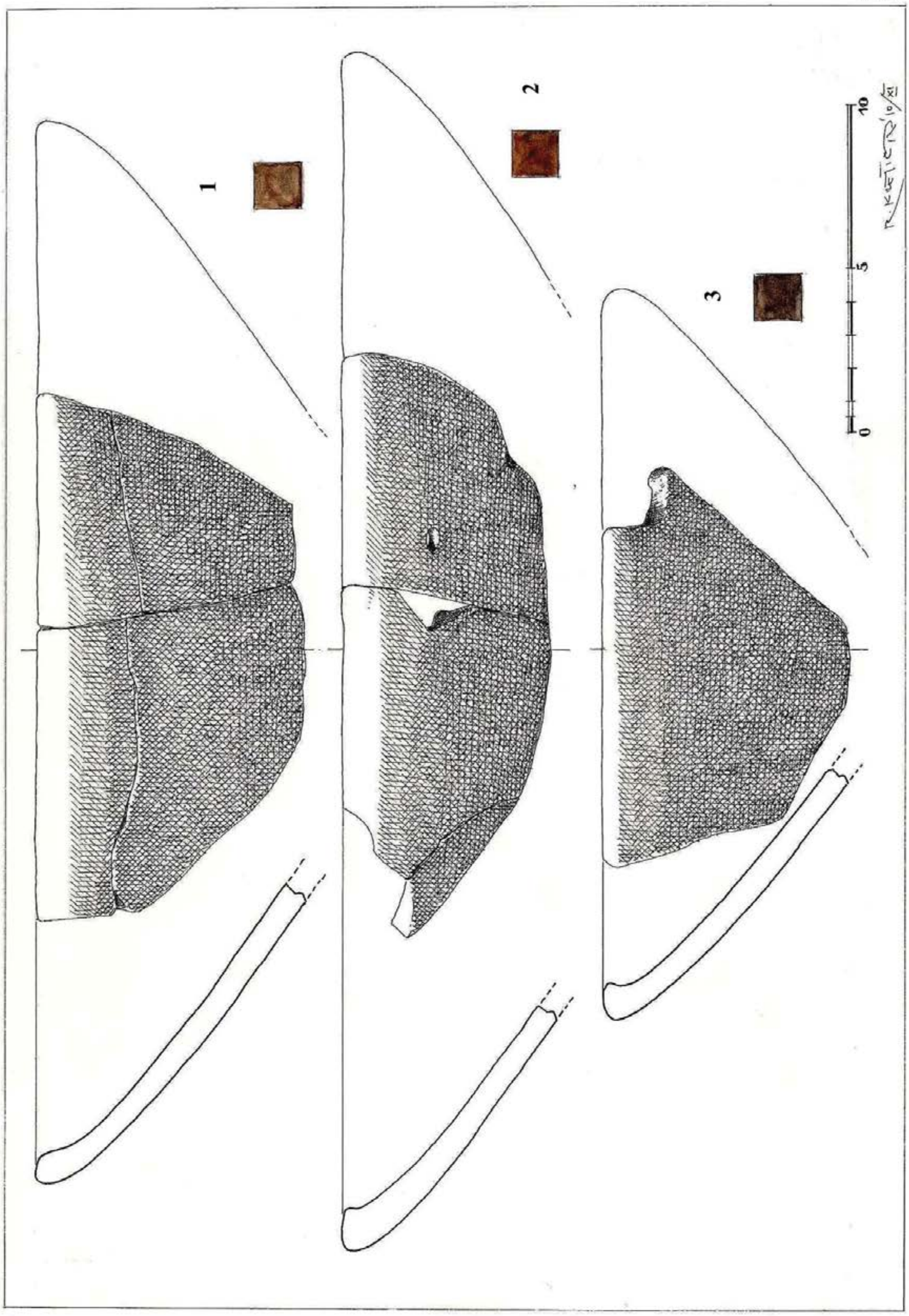

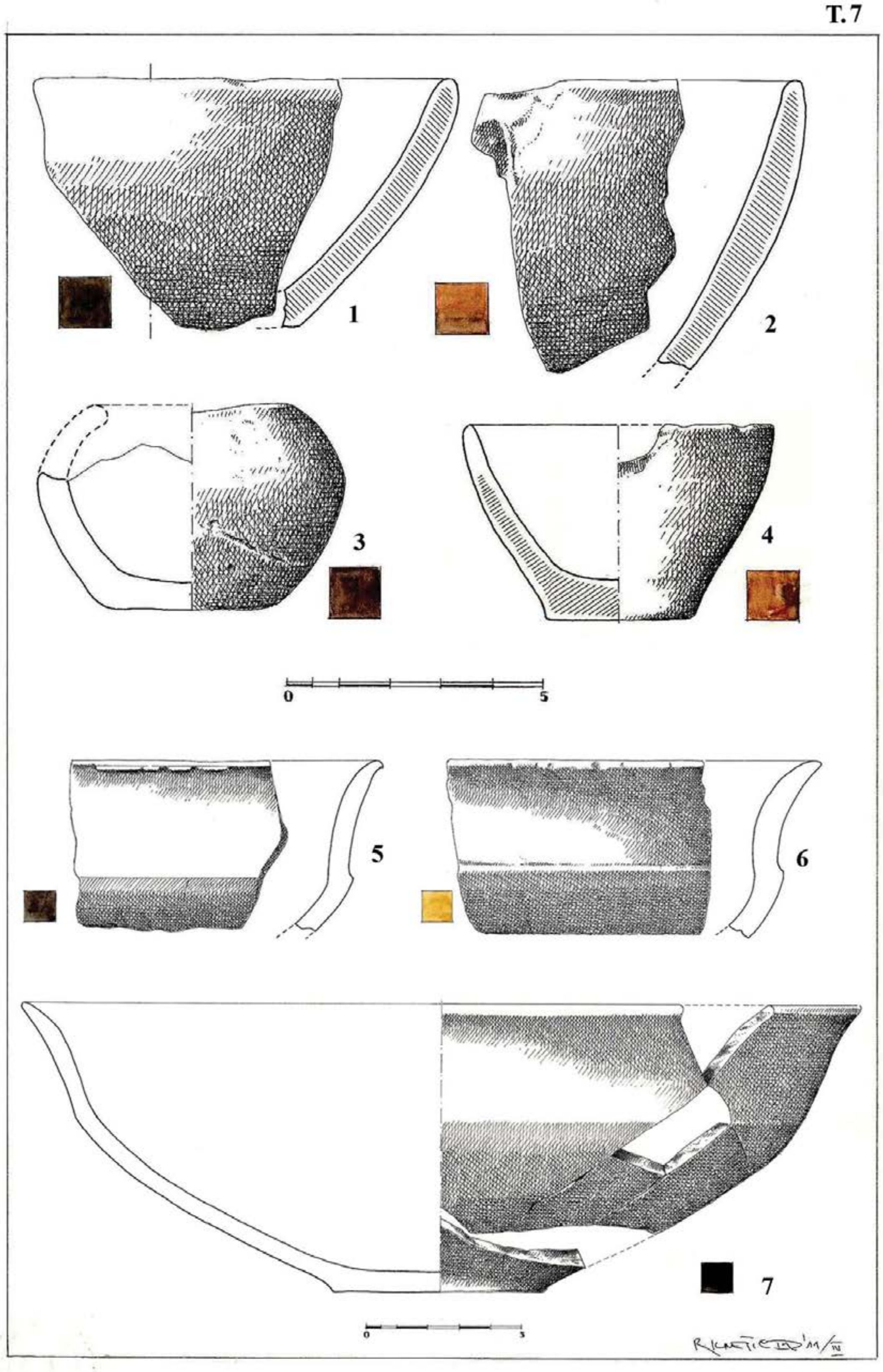
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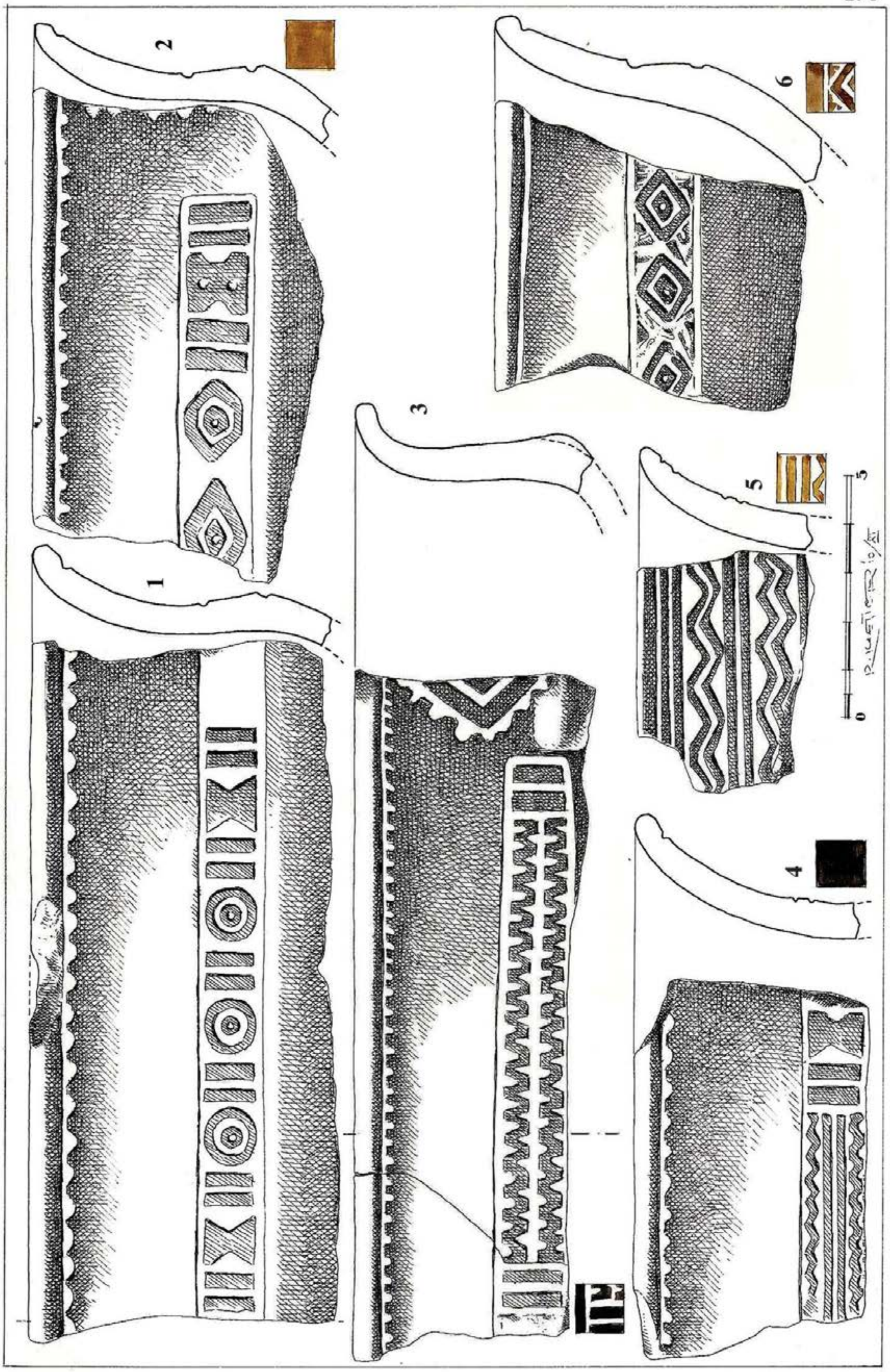

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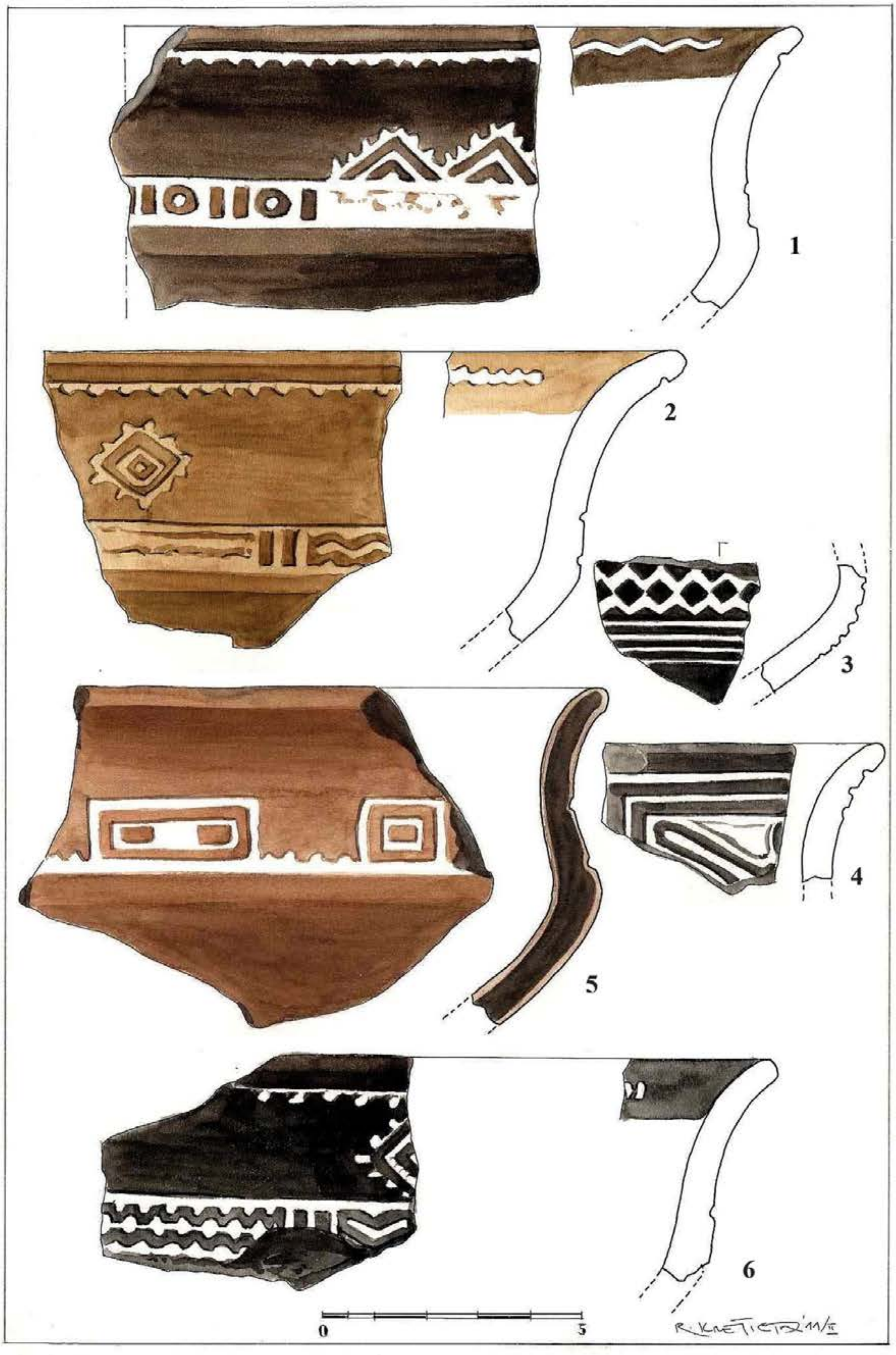

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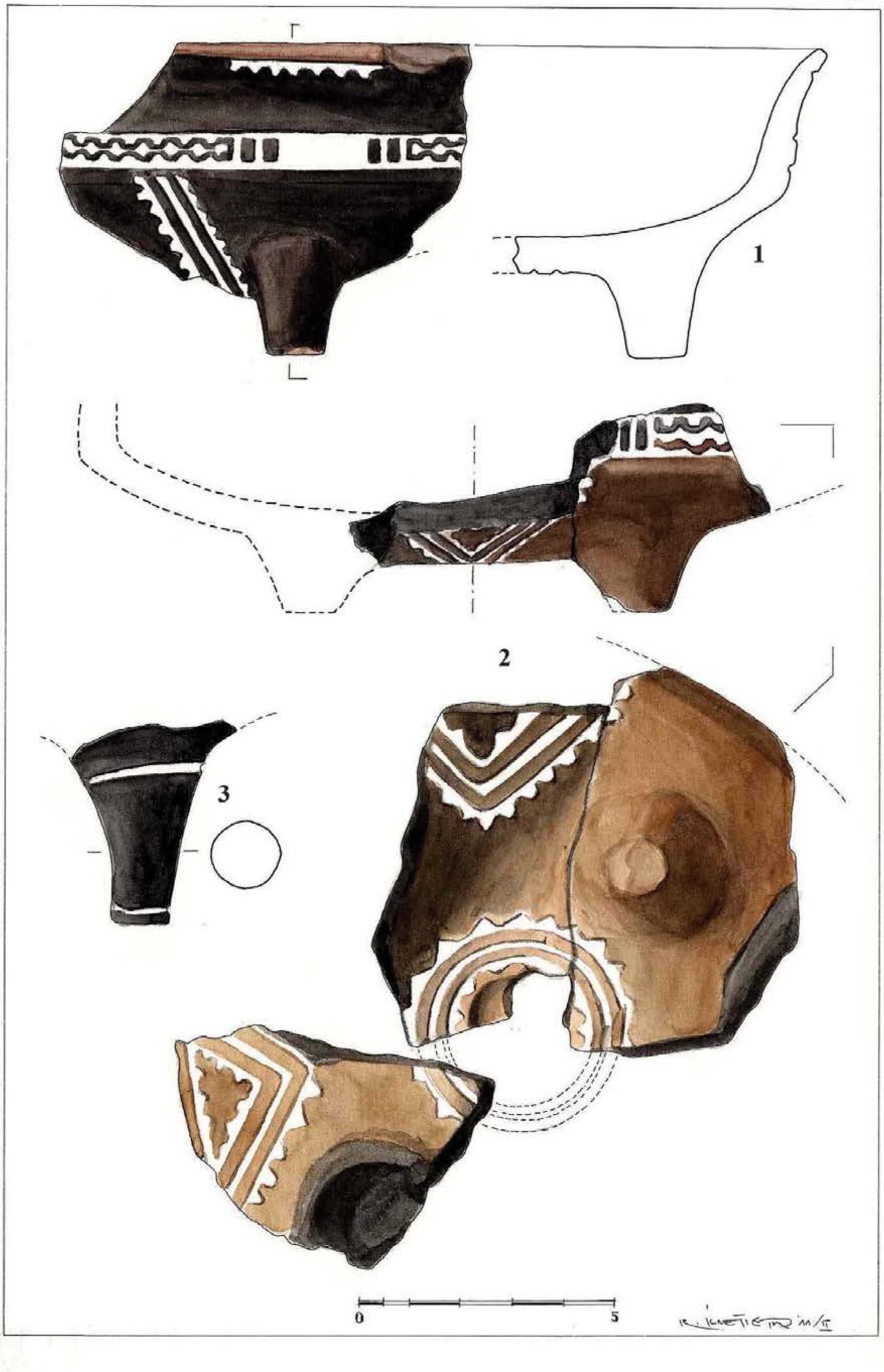

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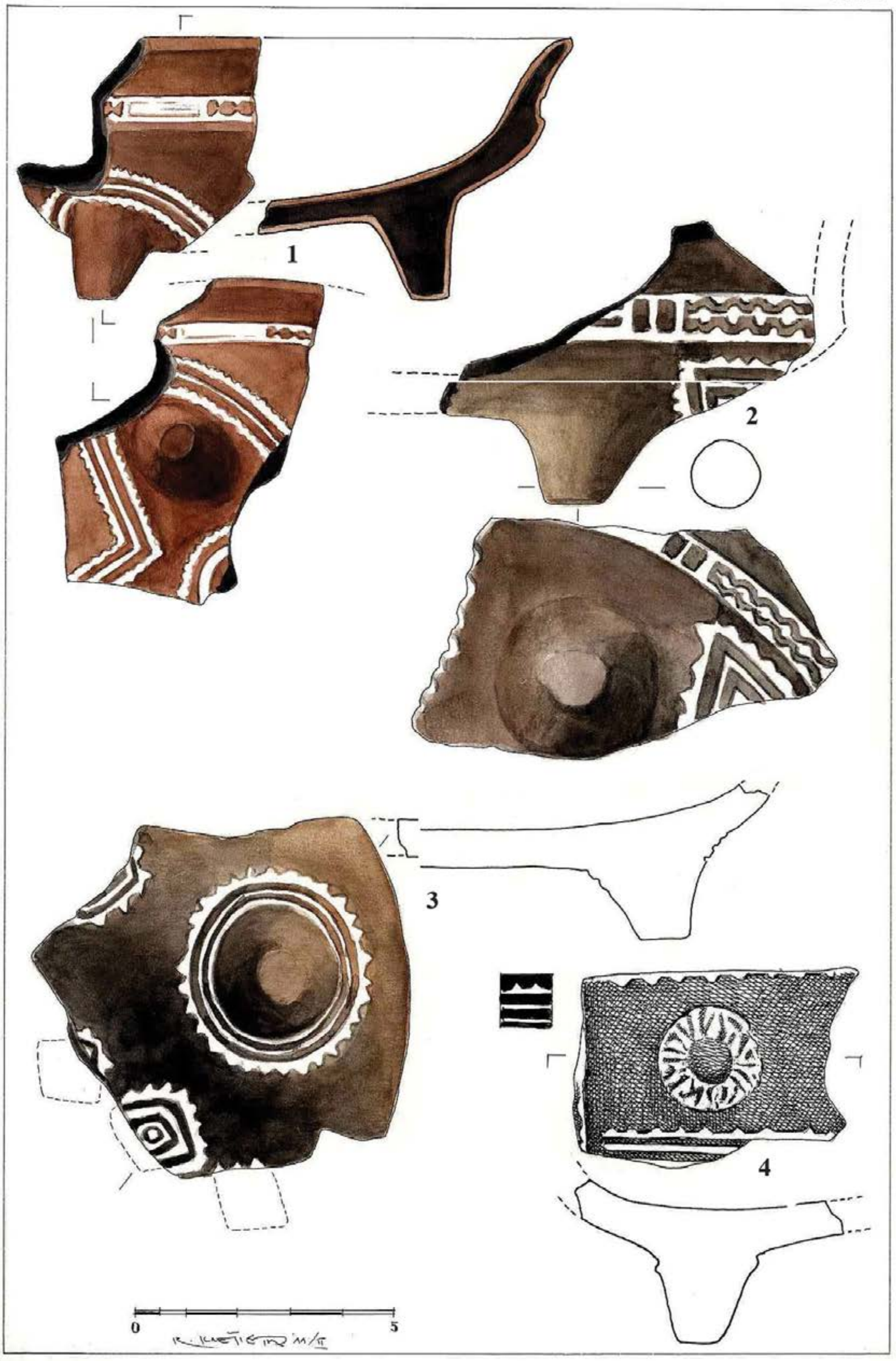

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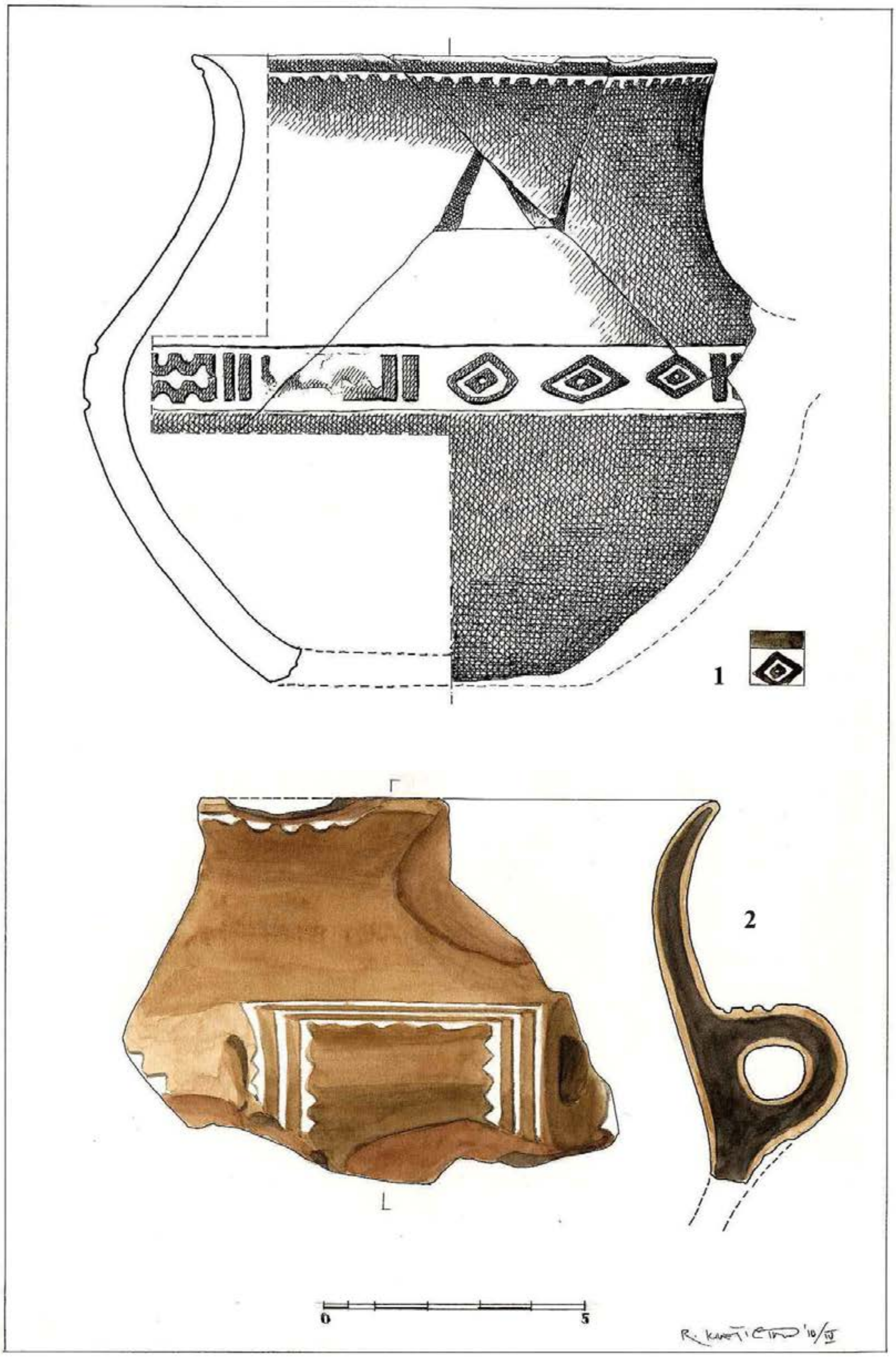

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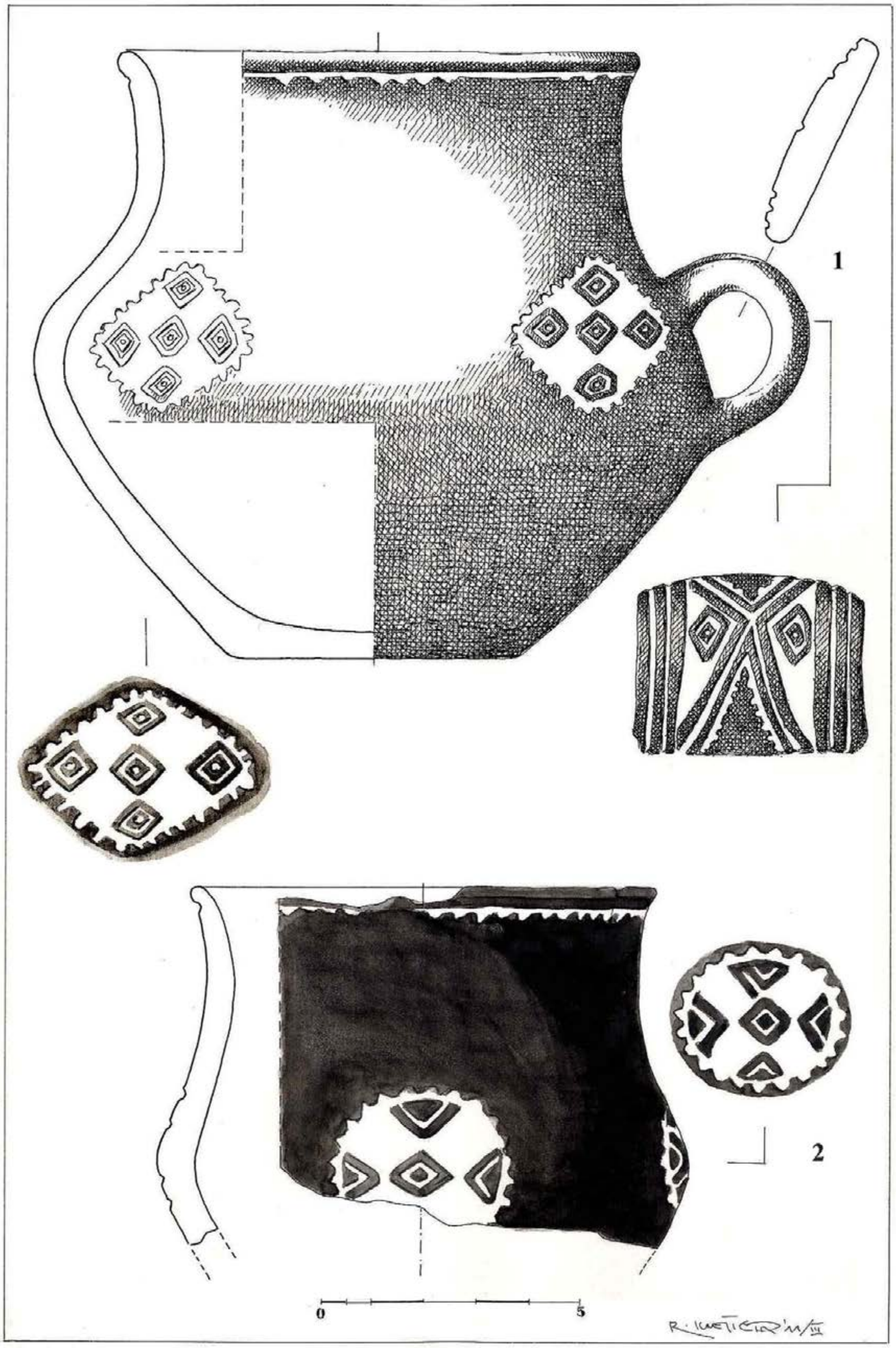

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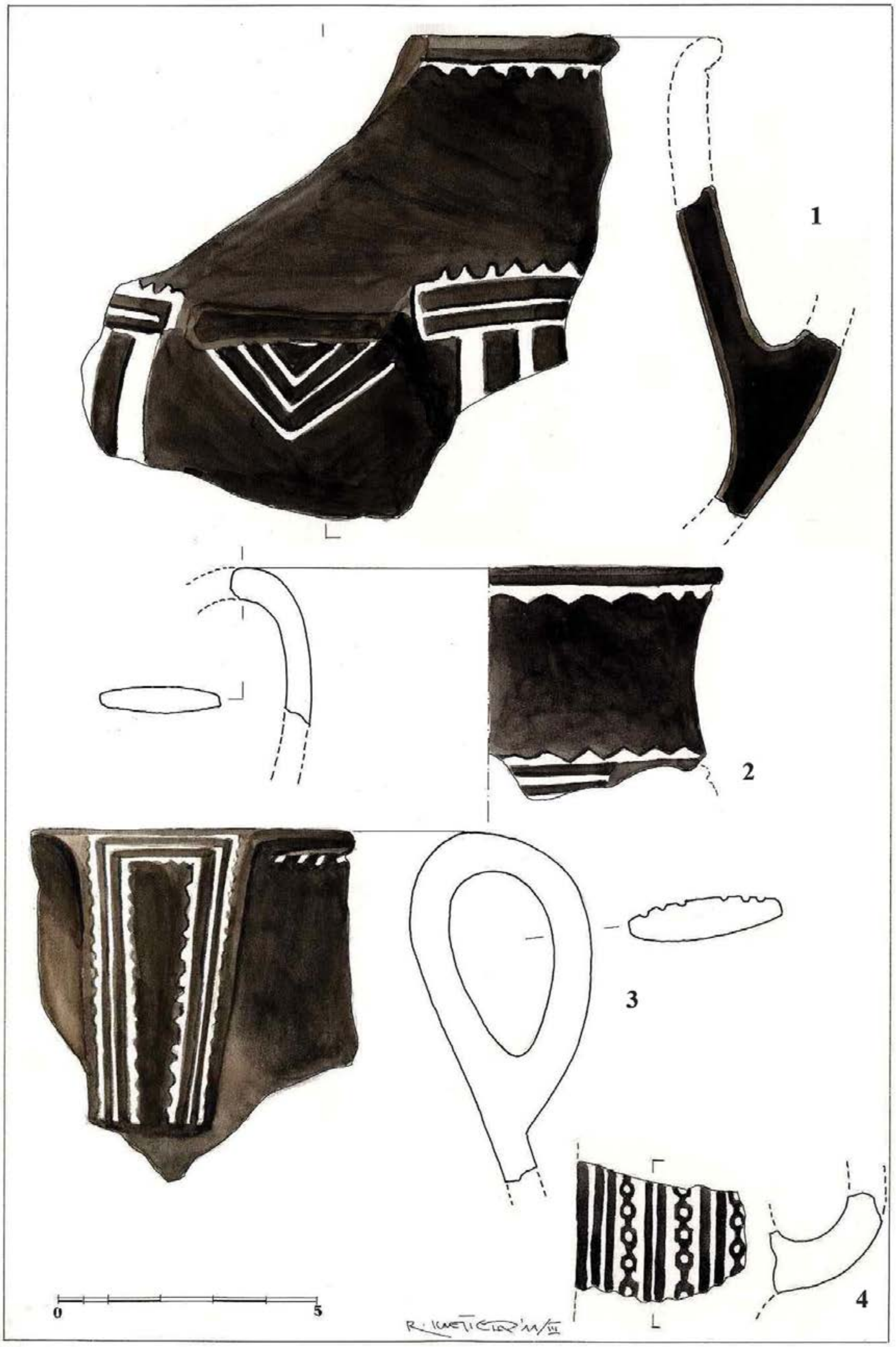

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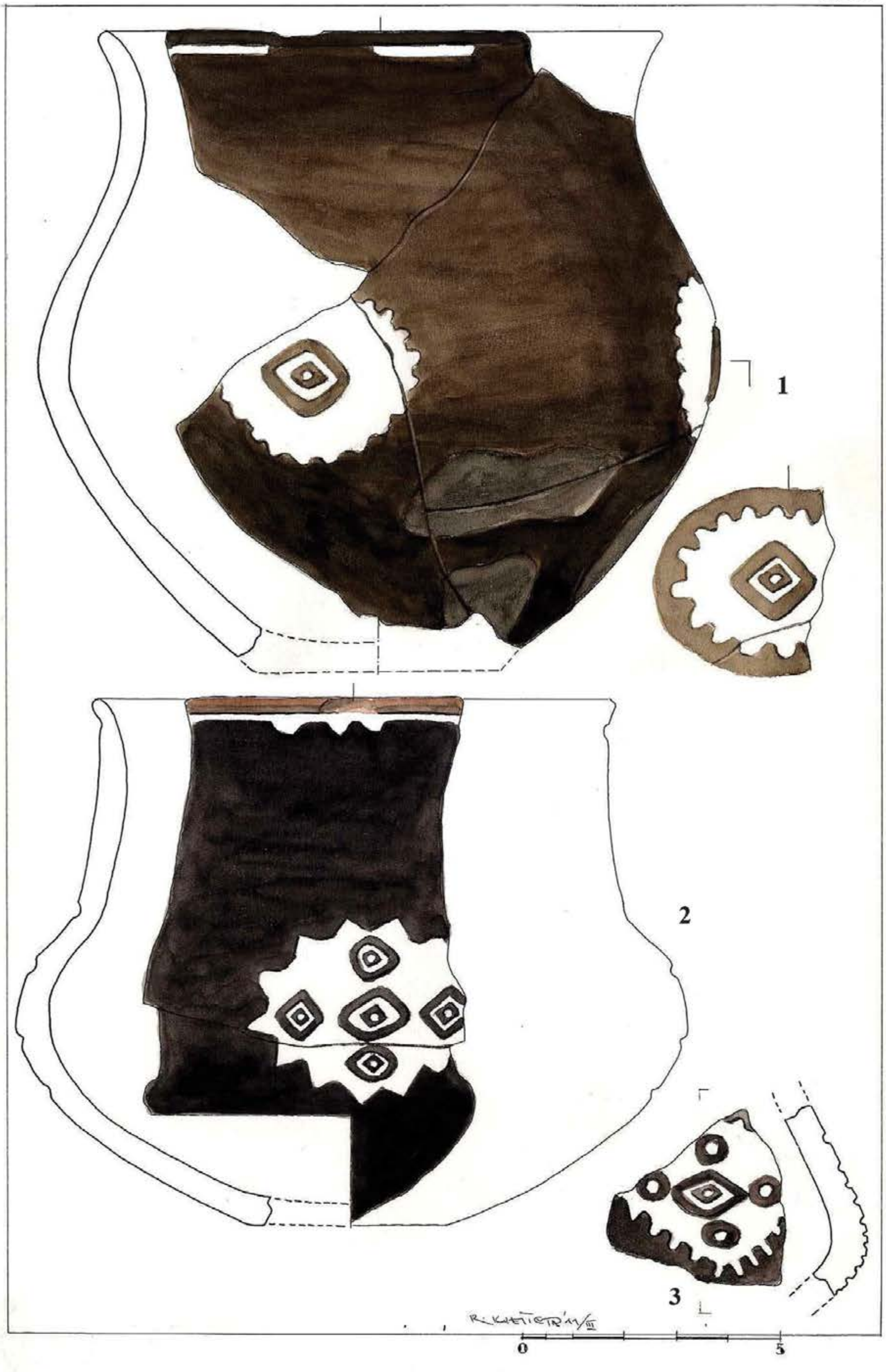

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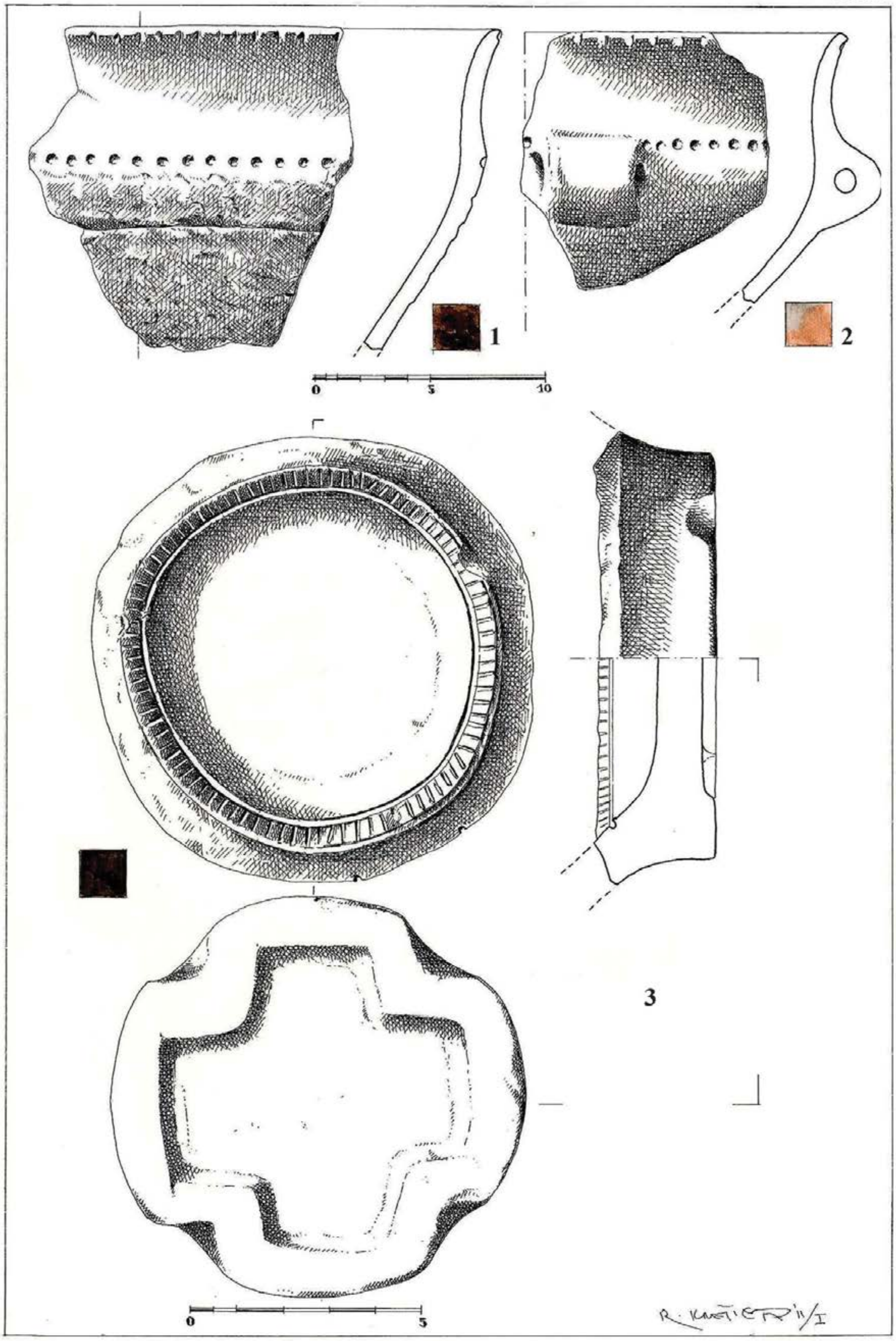

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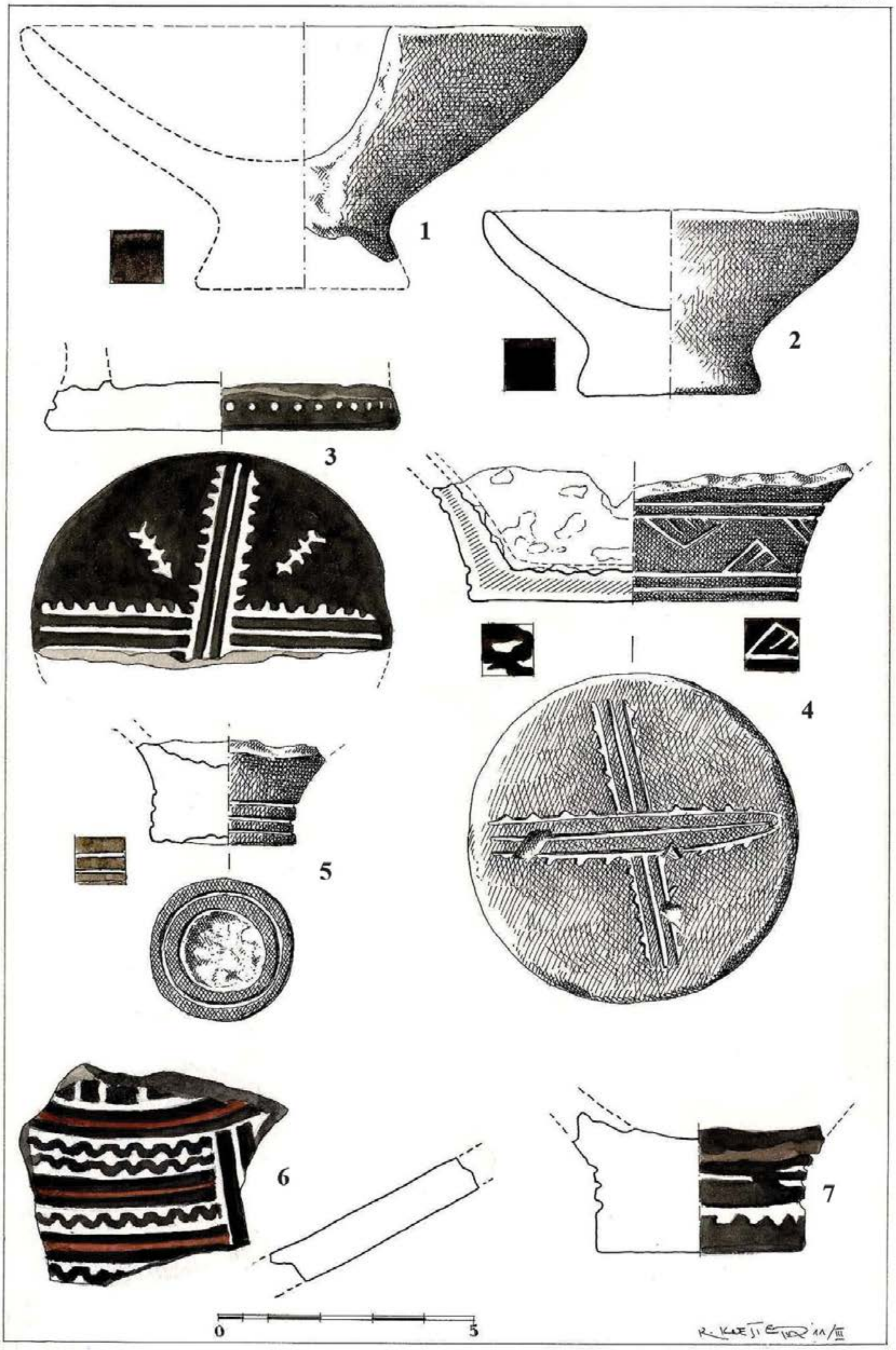

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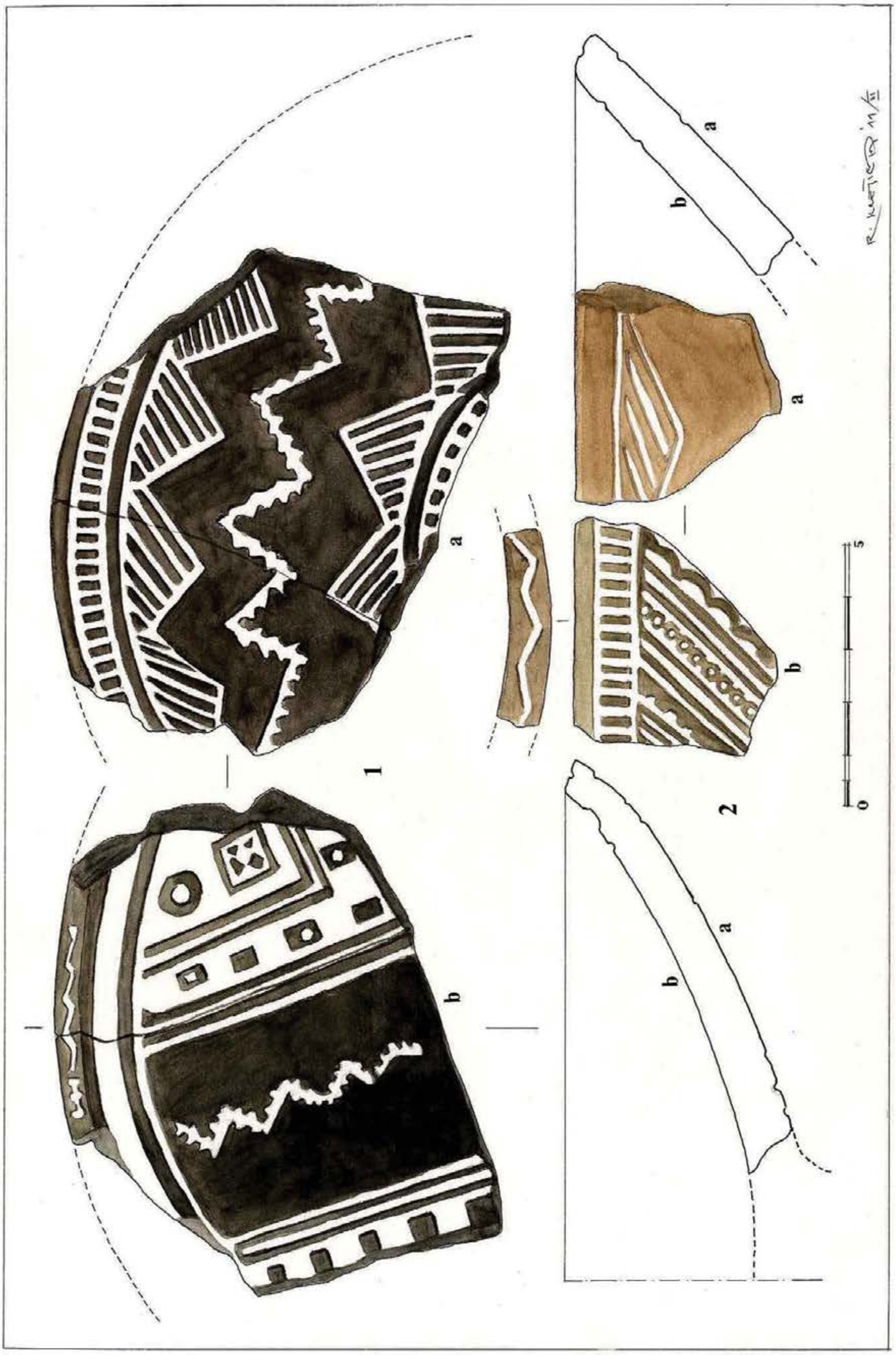

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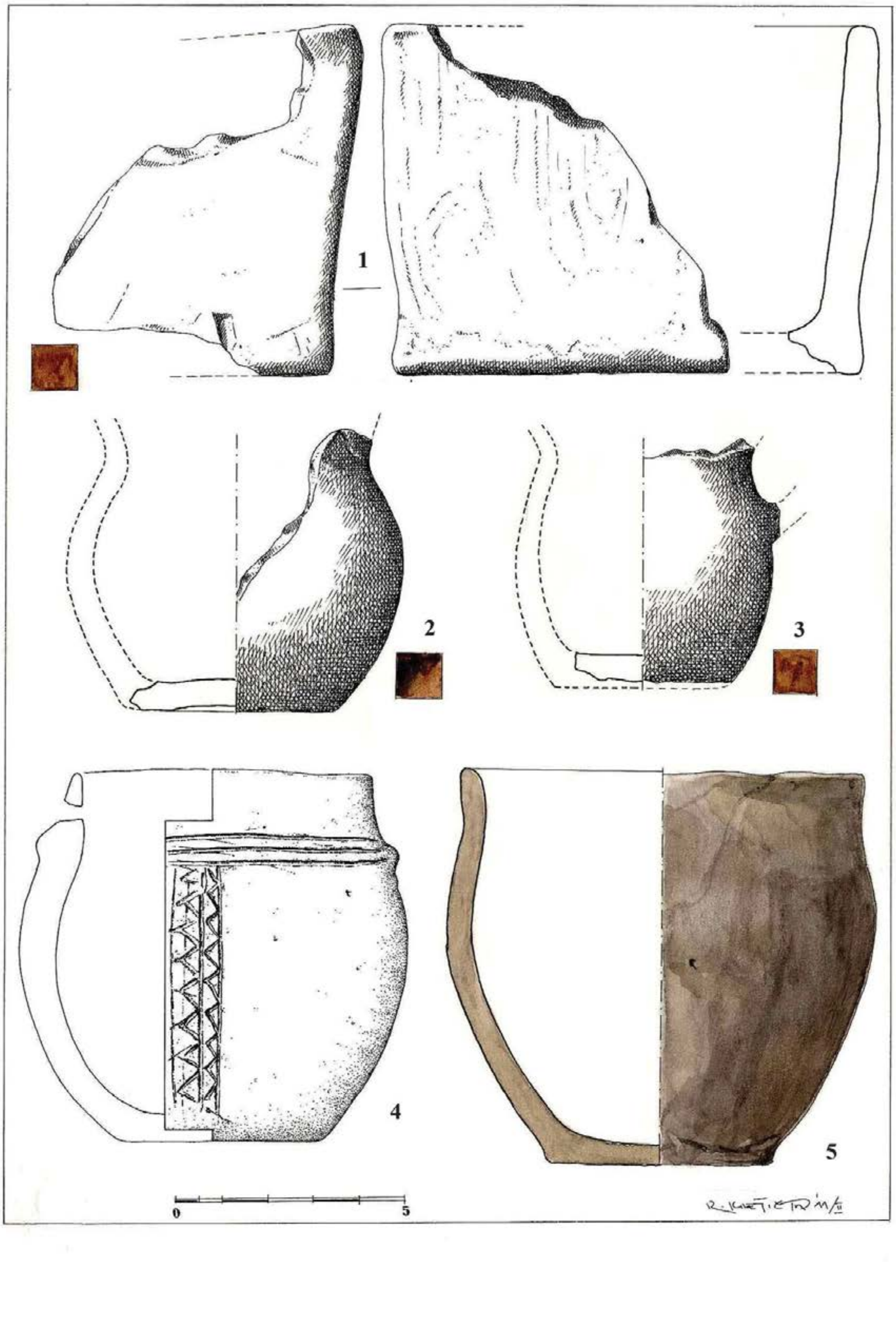

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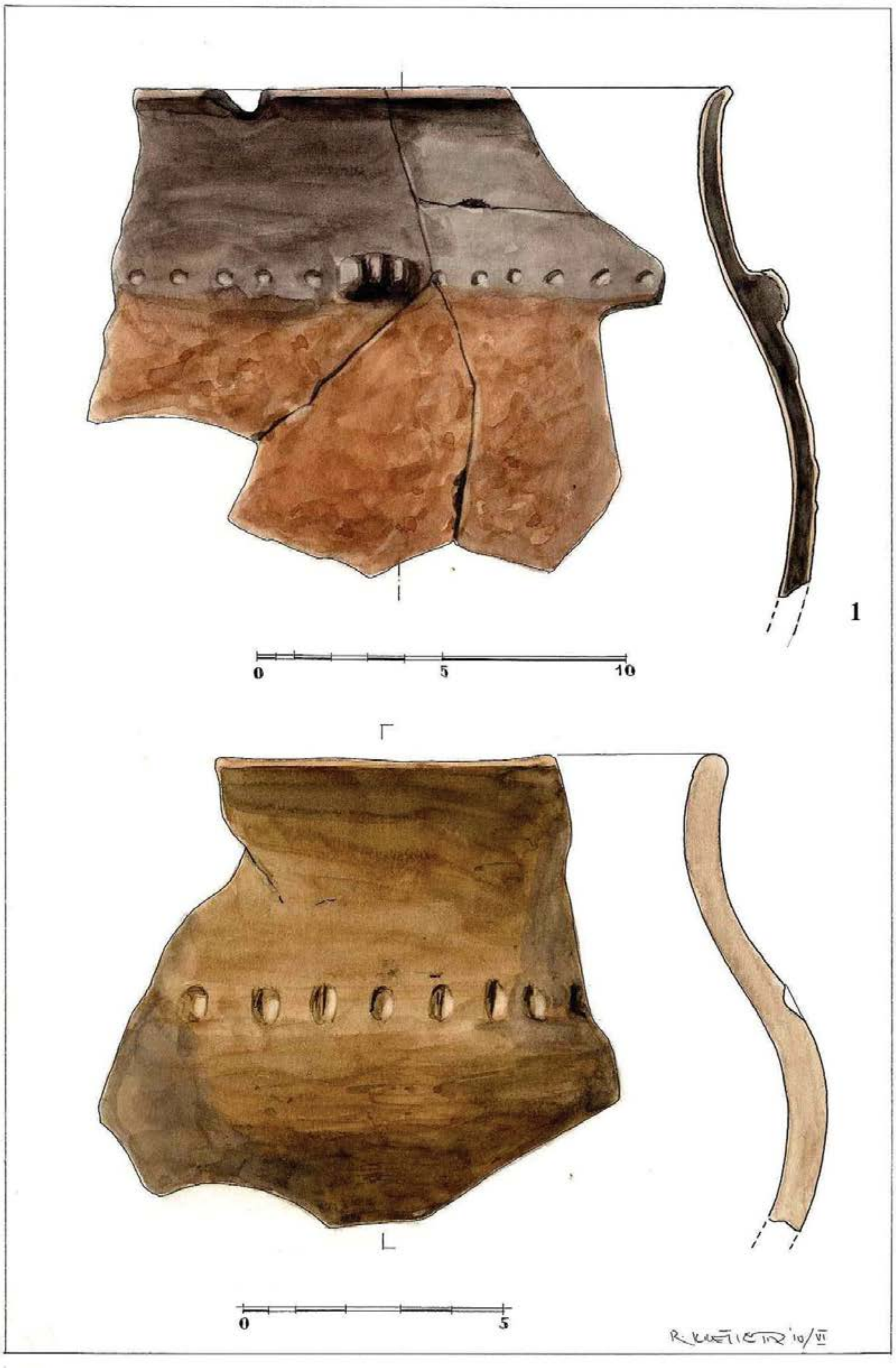

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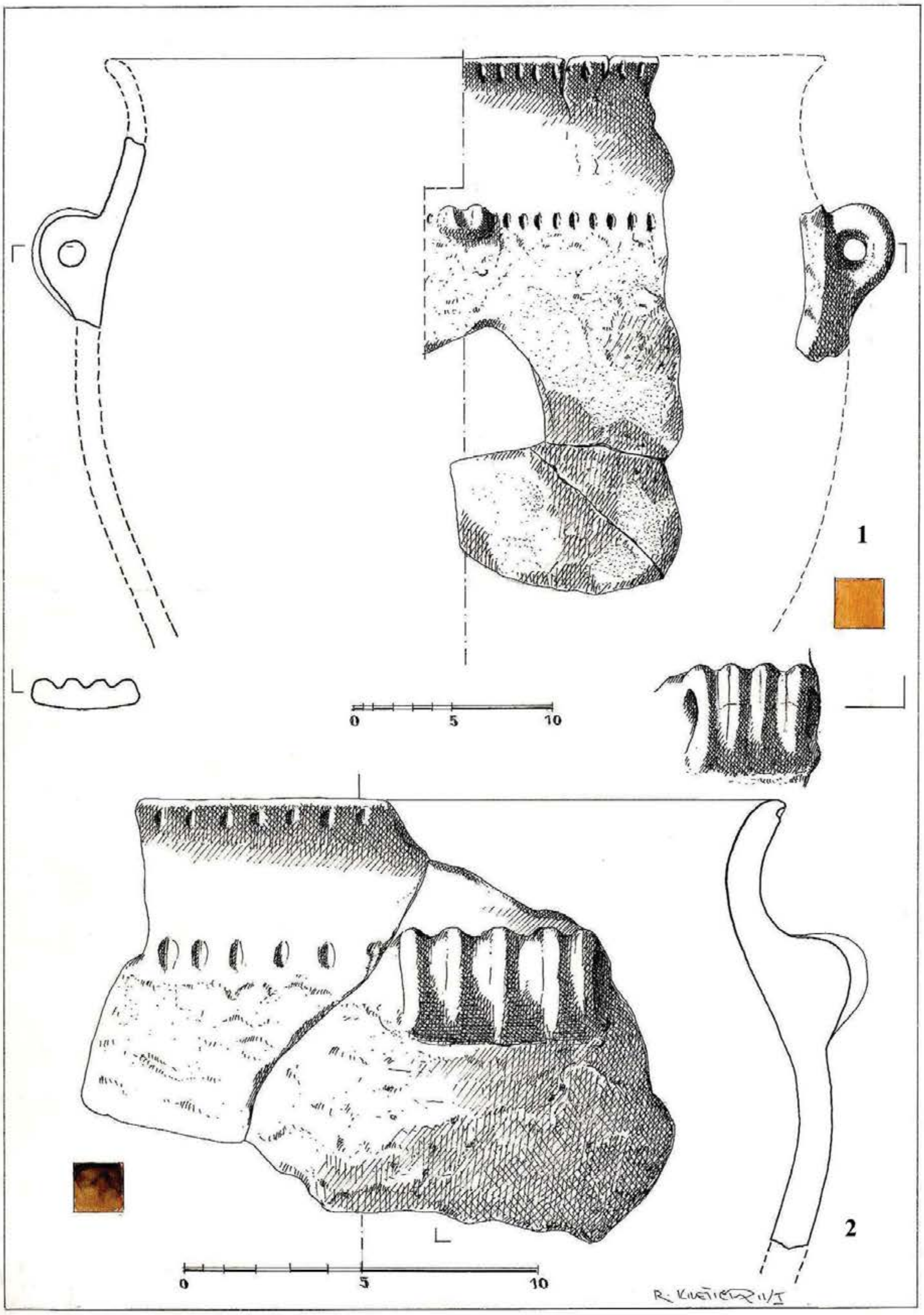

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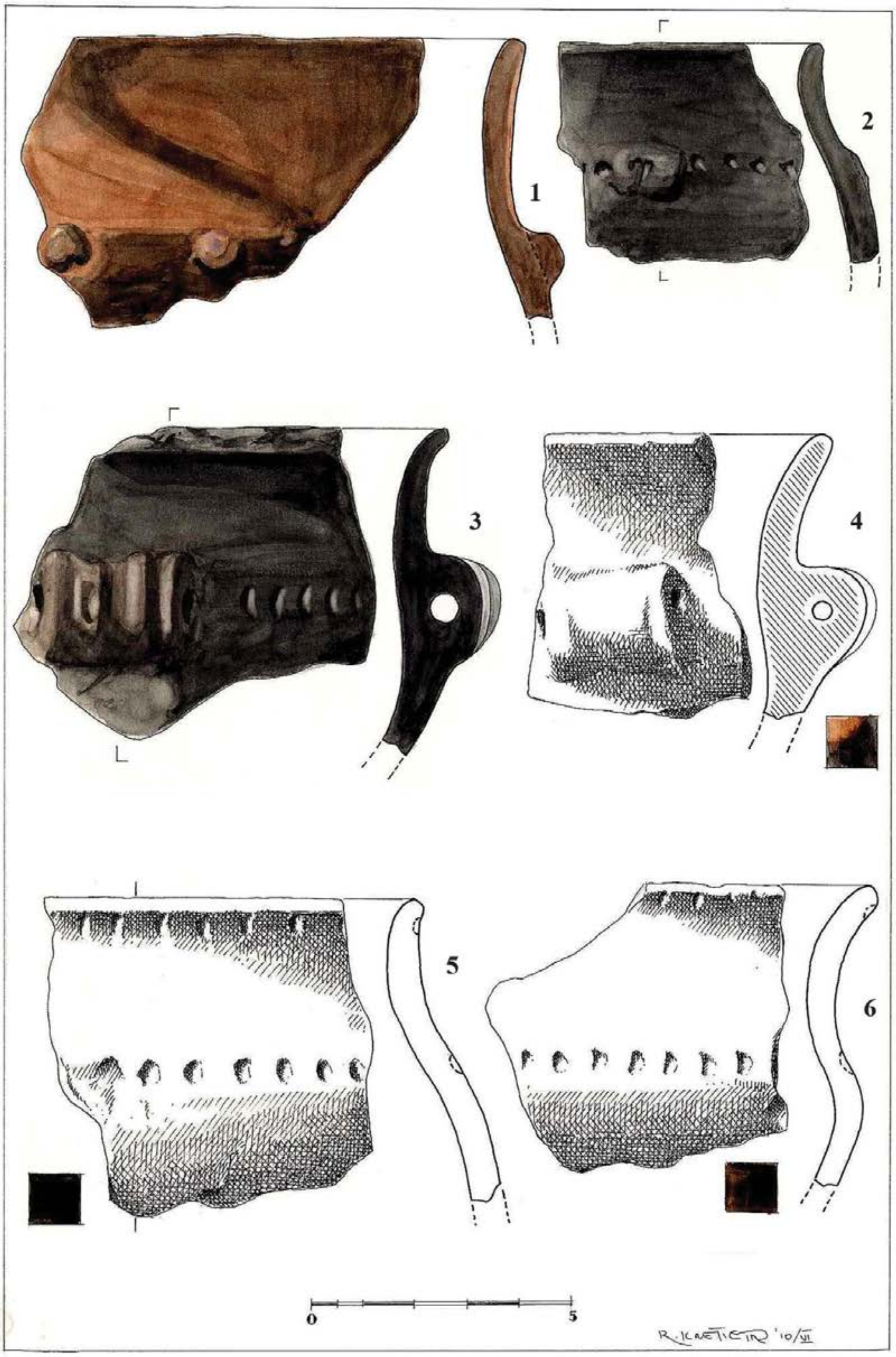

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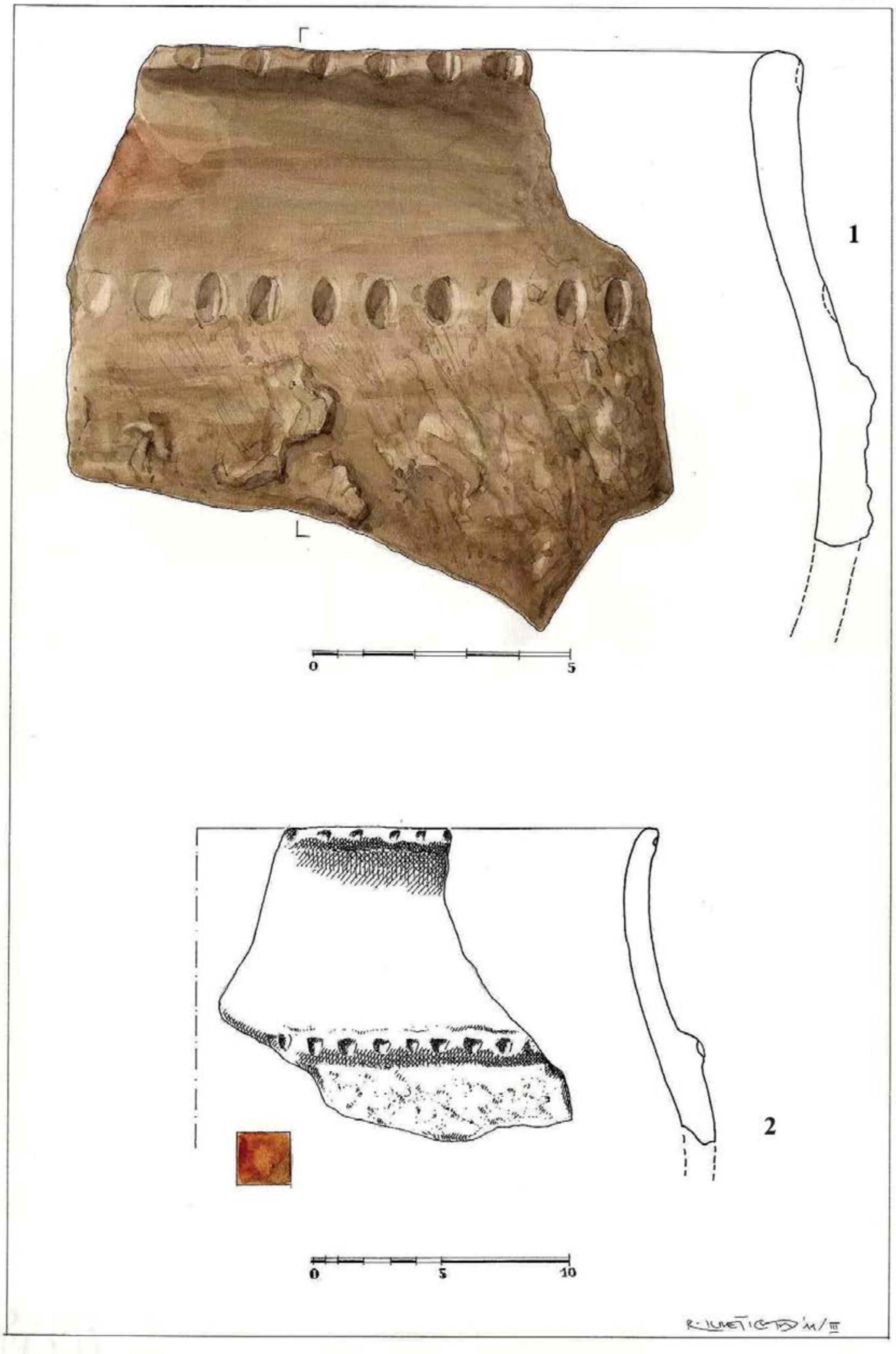

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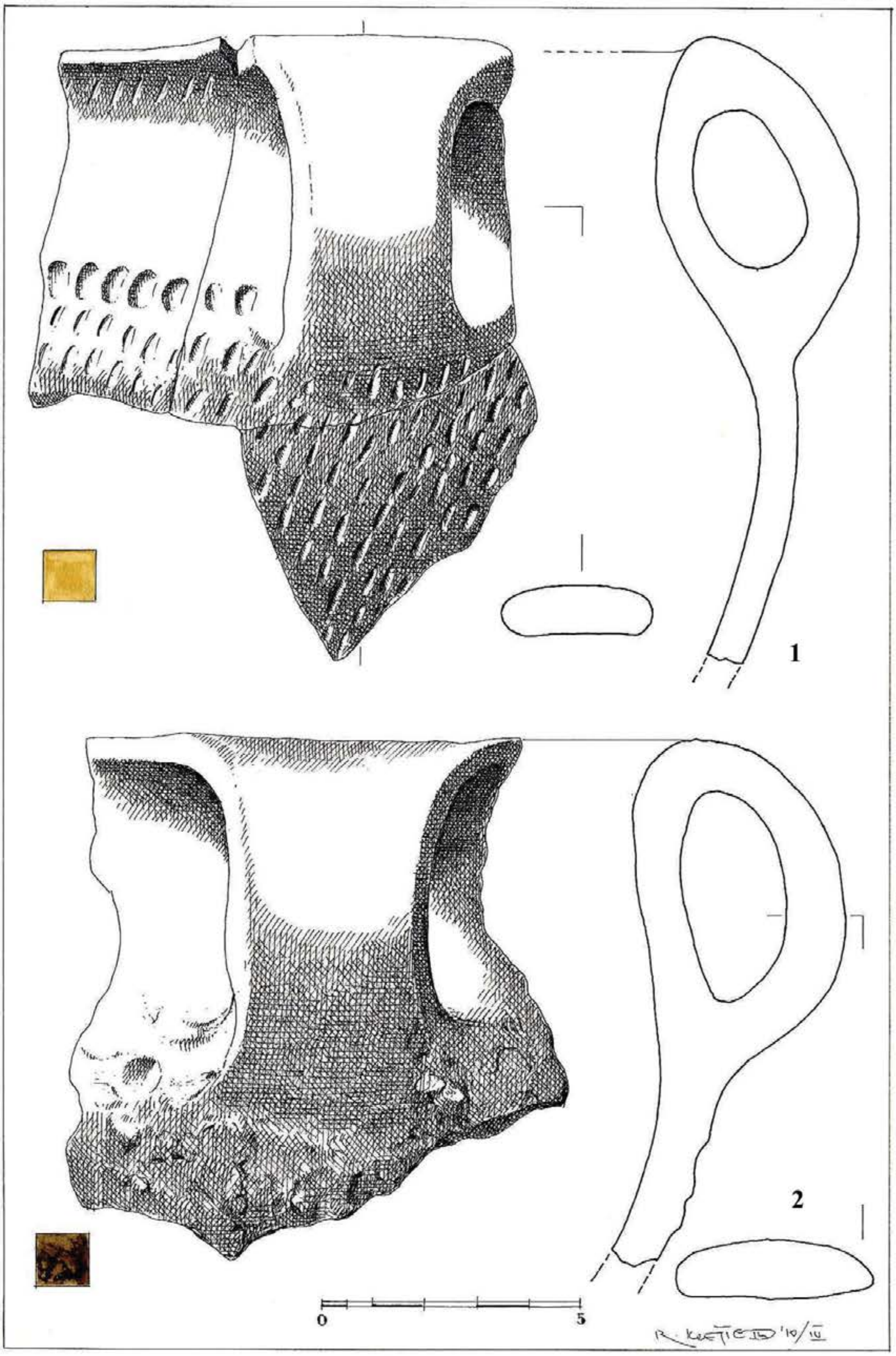

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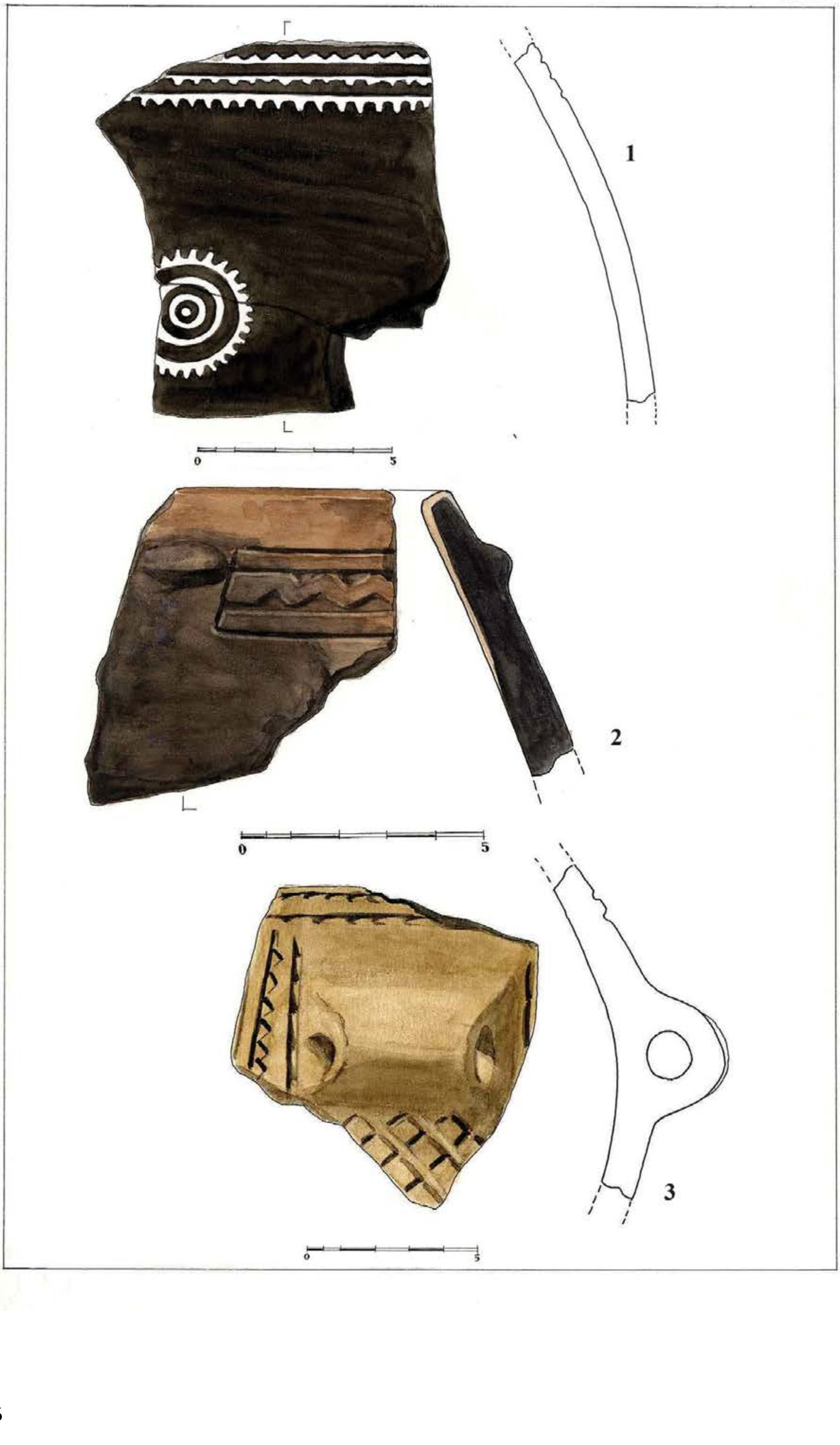

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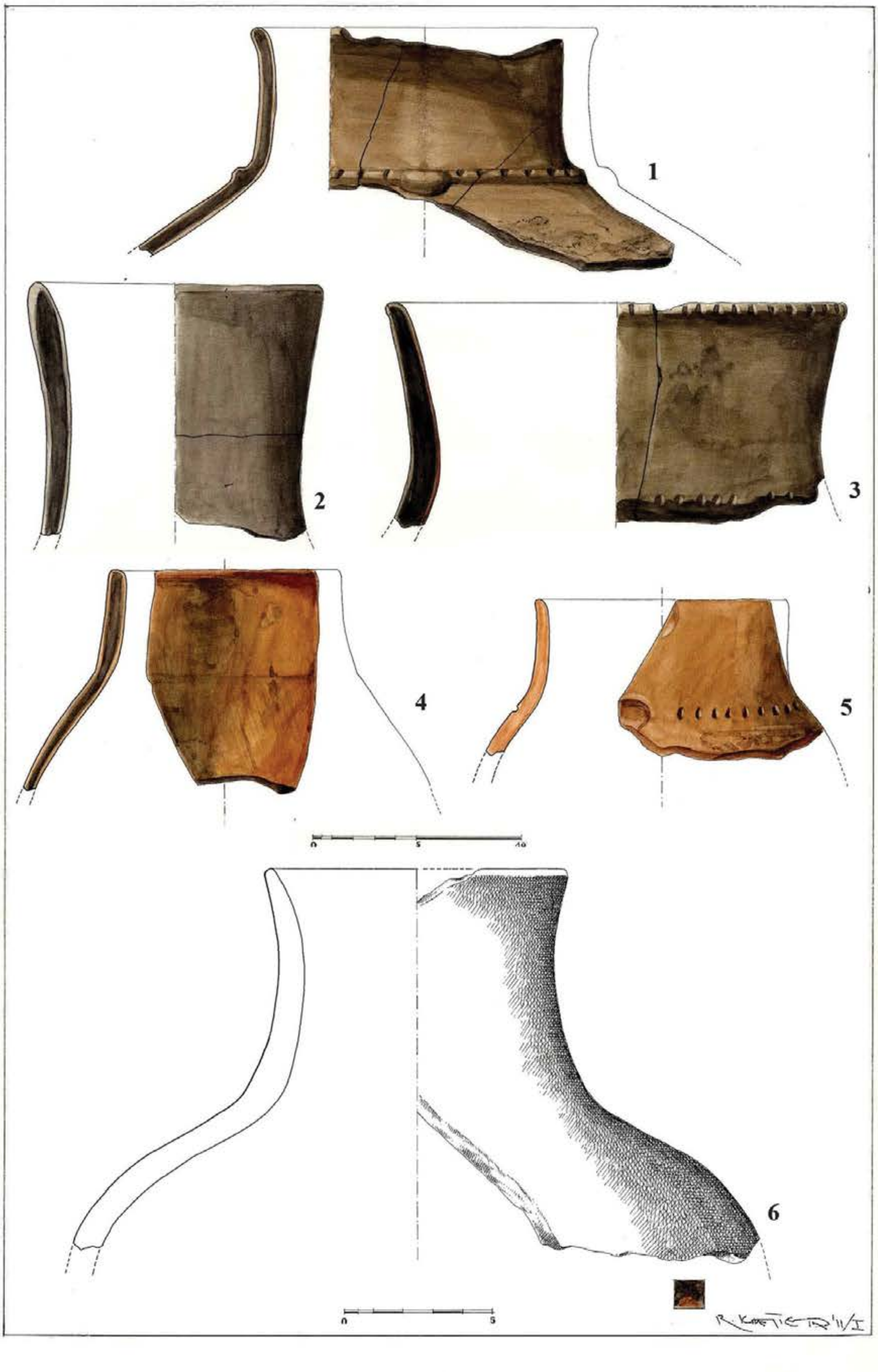

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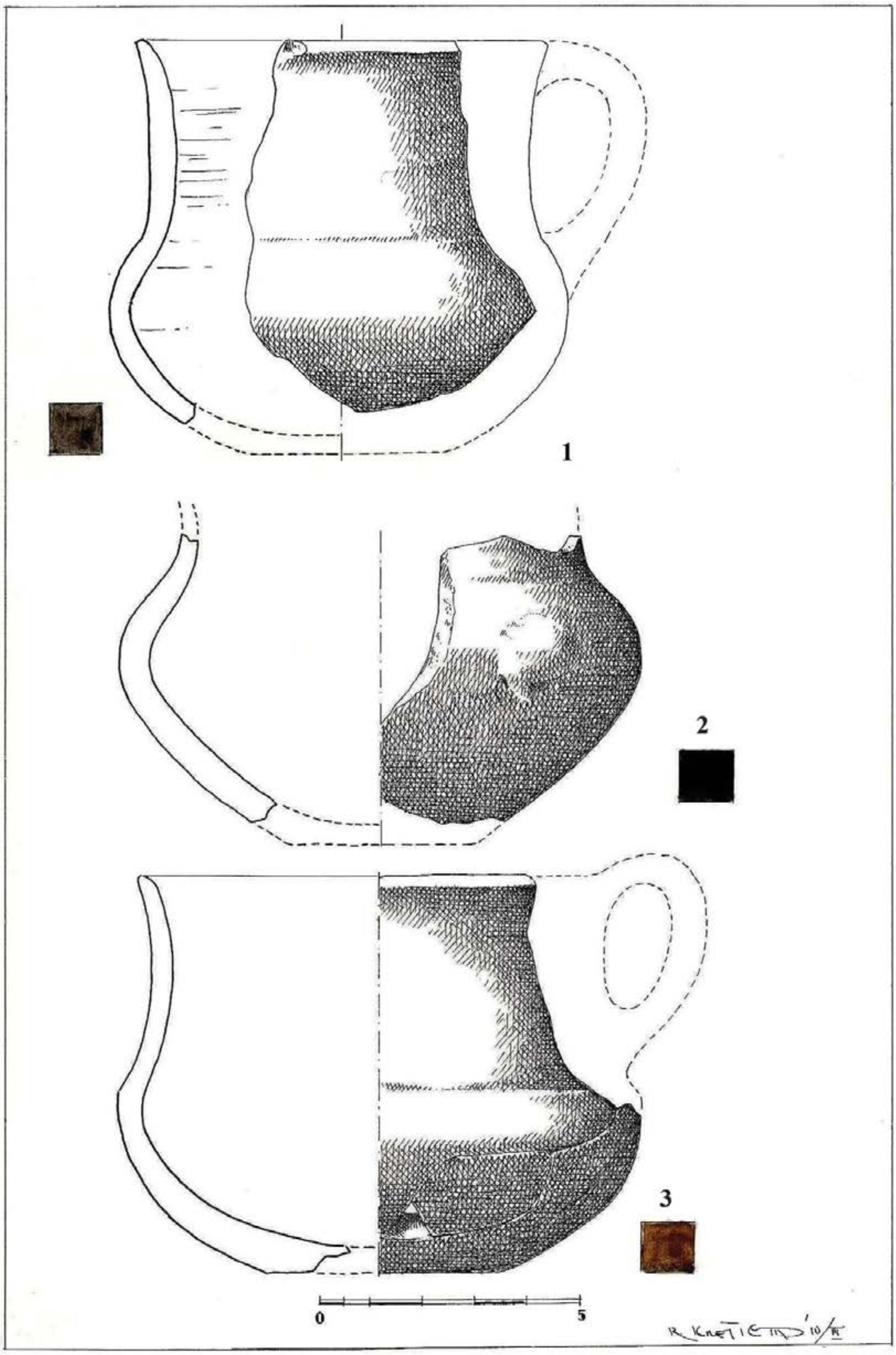

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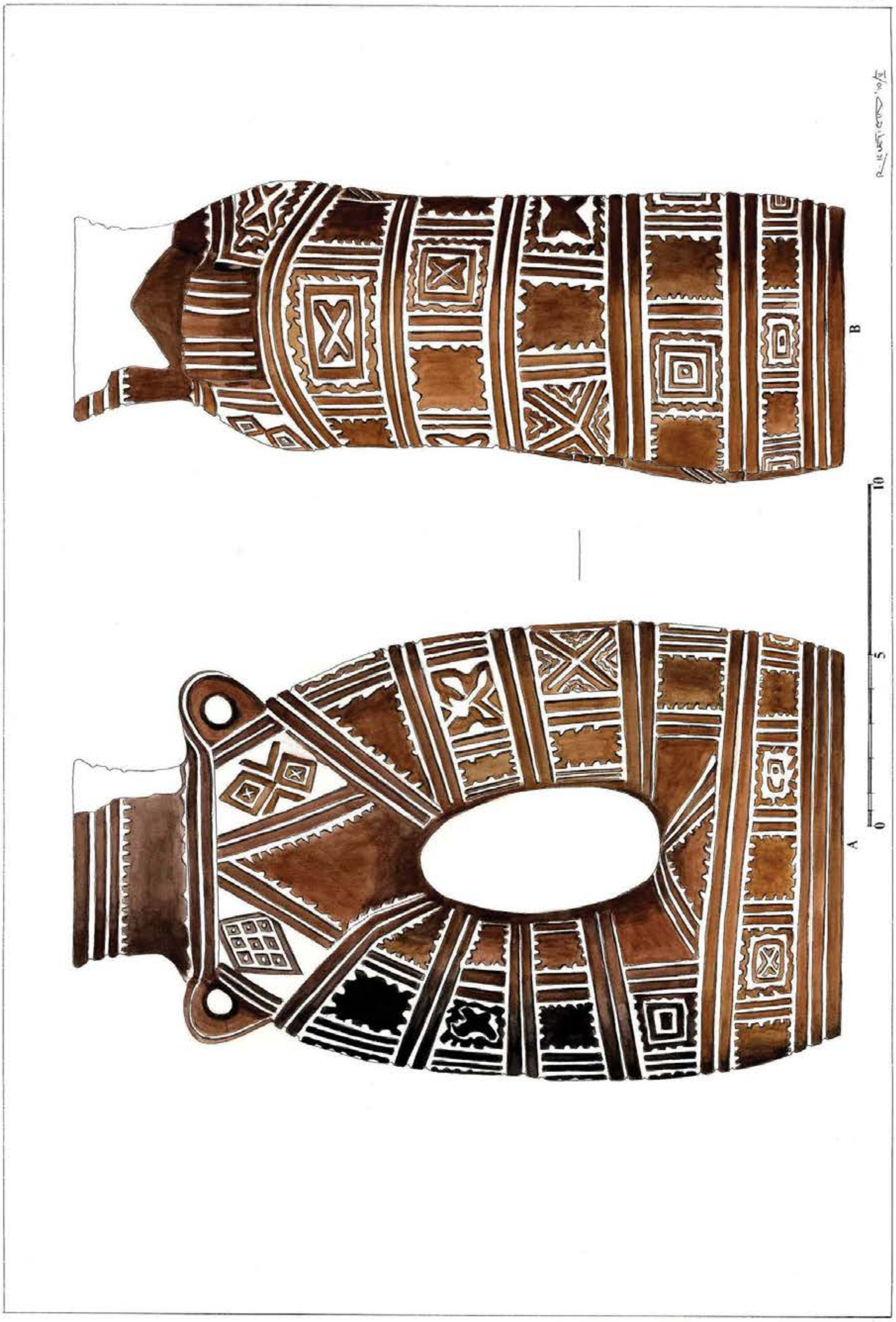

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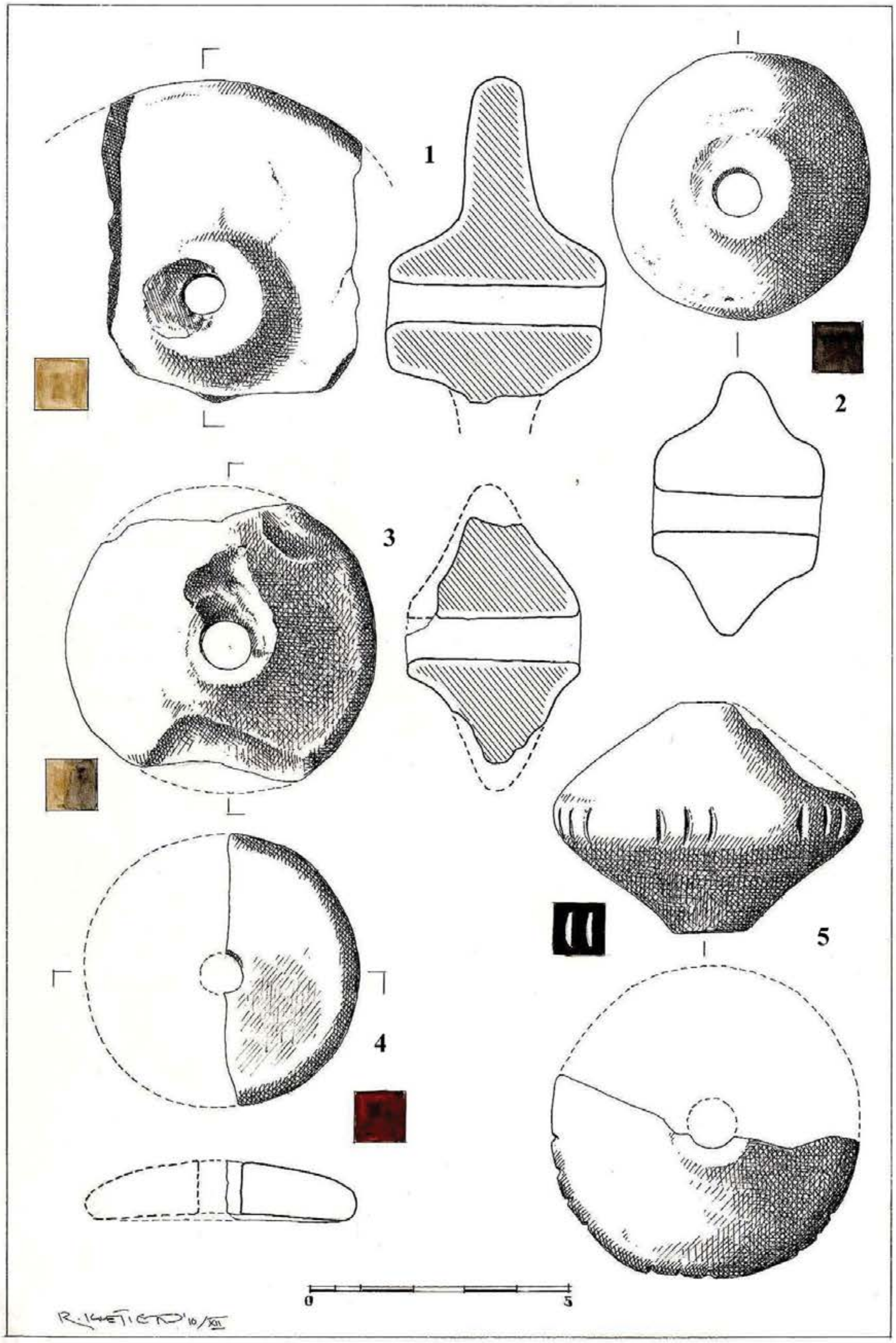

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