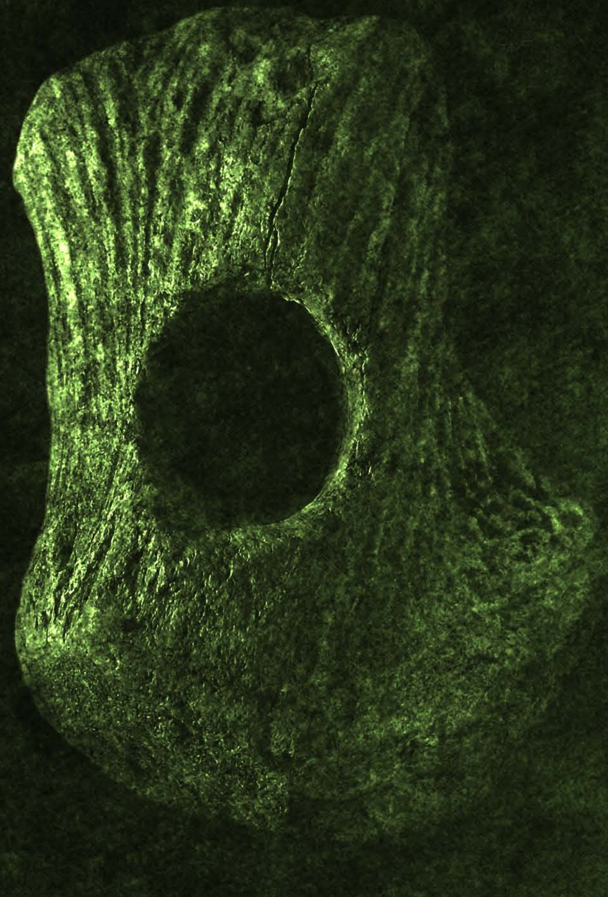
ARCHAEOTECHNOLOGY

studying technology from prehistory to the Middle Ages



Editors

Selena Vitezović

Dragana Antonović

ARHEOTEHNOLOGIJA:
proučavanje tehnologije od praistorije do srednjeg veka

Urednici:
Selena Vitezović
Dragana Antonović

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Selena Vitezović
Dragana Antonović

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ARCHAEOTECHNOLOGY: STUDYING TECHNOLOGY FROM PREHISTORY TO THE MIDDLE AGES

Technology is a fascinating material expression of human culture, commonly regarded as an evidence of human triumph over nature. The human past was seen as a constant progress from "primitive" to "technologically advanced", and even classified after what is thought to be a dominating technique in a given period (e. g. Childe 1944, see also Greene 2006). Technological innovations were considered the main, if not the only driving forces that shape societies and cultures (cf. Pfaffenberger 1988).

Technology, as a conceptual approach to material culture studies, derived from the Greek word **τέχνη,** meaning skill, implies all human actions upon a matter (Inizan et al. 1995: 13). Everything is technological around us, and this includes not only artefacts, but all structures, buildings, and even nature modified by human hand (cf. Lemonnier 1992b, Greene 2006). The term technology includes a full range of topics from those related to individual level (body gestures, embodied knowledge in crafting) to social and cultural settings of production.

Archaeological studies are indistinguishable from studies of technology; material remains constitute the core of archaeological evidence, regardless of the period, region, methodological approaches or theoretical frameworks, and even studies in beliefs, religion, etc., rely on analyses of diverse artefacts. Artefacts represent our source for "reading" past lives – by studying them, we can make conclusion about people who made them and used them, what their meaning and value were, how they were used, reused and discarded. They may have both functional and symbolic roles, and a special meaning for the society or individuals within it, that may change and/or became more complex over time. During its lifetime, an object can be used in many different contexts and have diverse, even contradictory meanings and values. Objects can also be rare and luxury, or occasional, craft-produced objects, or common, functional, mass-produced industrial objects; furthermore, one class of artefacts may have examples of rare, crafted and mass-produced specimens (cf. Caple 2006, Miller 2007).

Ideas from social anthropology had an important influence on the theoretical advances in studies of technology. The work of Malinowski and Radcliffe-Brown, for example, showed that a complex social structure was invariably reflected within objects (cf. Caple 2006). Theories of a French anthropologist Marcel Mauss, who was interested in how *culture* (as opposed to nature) influences and shapes human behaviour, are particularly important as well. His starting point was that something generally perceived as *natural* (for example, body posture, way of walking, etc.), was in fact *cultural*. The way a person eats, walks, sleeps, even holds and uses tools, differs, depends on their culture, age and sex. The accent of these studies is on the impact of a group on individuals, their relationships, as well as the questioning of the *cultural* and the *natural* in human behaviour (Deliège 2012 [2006]: 82-84, Lévi-Strauss 1982 [1973]: 13-15, cf. also Inizan *et al.* 1995: 14).

A wider concept of technology, which goes beyond artefact analyses, which regards technology as a *practice*, as ways of doing or making something, which also includes social and cultural components into the studies, is more and more accepted by many researchers. Henry Hodges (1976) distinguished technology from the study of stylistic details of artefacts, implying that technology was about the *process* of production rather than the endpoint (objects).

Ursula Franklin (1992) understood technology as ways of *doing* something rather than simply ways of making (creating) something (an object), so that there are technologies of prayer and of storytelling as well as of pottery production and weaving, while for Robert Merrill (1977: vi) technology is "the culture surrounding the actions or activities involved in making or doing things". For M.-A. Dobres and C. Hoffman (1999) technology is "an ever unfolding *process*", and their view of technology "stresses the dynamic, ongoing and socially constituted nature of sociotechnical activities" (Dobres & Hoffman 1999: 3).

Heather Miller, in her book dealing with archaeological approaches to technology, defined it as a "set of actions and relationships: from production itself, to the organization of the production process, to the entire cultural system of processes and practices associated with production and consumption" (Miller 2007: 4). Furthermore, she defines the production as "the actual process of fabrication or creation, including both the material objects and the techniques and gestures used", organization of production as "the organizational arrangement within which production takes place", and the technological system as an active system of interconnections between people and objects during the creation of an object, its distribution, and to some extent its use and disposal. In other words, technology or technological systems can be roughly described as processes and practices associated with production and consumption, from design to discard (Miller 2007: 5).

Diverse concepts have been developed, and probably the most important contribution to the study of technology was the work of André Leroi-Gourhan (1964, 1965, 1971), who created the concept of *chaîne opéra-*

toire (see also Lemonnier 1992a). This is an analytical tool for studying the mode of creating, using and discarding an artefact, starting with raw material acquisition, mode of manufacture, final form, use (including caching, breaking and repairing) up to final discarding, with the main goal of reconstructing the organization of a technological system and of describing and understanding all cultural transformations that a specific raw material had had to go through. It is a chronological segmentation of actions and mental processes required in the manufacture of an artefact and its maintenance in the technical system of a prehistoric group (Inizan *et al.* 1995: 14, cf. also Sellet 1993). The concept is not only about reconstructing the algorithmic sequence of operations in creating one object, but it is a complex analysis of operational chain within one society, which includes the analysis of technological choices. The analyses of technologies today include a variety of different approaches, most of them putting the emphasis on cultural and social aspects of technology.

Methodology also went through significant changes, especially in the field of interdisciplinary and experimental work. Studies of diverse artefacts, such as stone, flint or metal, cannot be imagined without careful identification and detailed analyses of raw material origin. Interdisciplinary researches became particularly emphasized by the processual archaeology since the 1960s, and today they constitute an integral part of almost every archaeological research, regardless of the chronological period. They are irreplaceable for the determination of raw material origins and can also contribute to identifying diverse transformative processes certain raw material had undergone.

Experimental and ethnoarchaeological studies also constitute a very important segment of technological studies. Although present in archaeological research since its early days (e.g., Martin 1910), they are more diverse, more common and more scientifically based since the mid-20th century. Again, processual archaeology and its demands for scientific rigor contributed greatly in developing new methods, but the work of soviet archaeologist Sergei A. Semenov has the most prominent place in the history of experimental archaeology, due to the diversity of research questions he dealt with and the wide range of chronological periods and materials he covered (Семенов 1957, 1968, Semenov 1976; cf. Korobkova 2008 for an overview, also Skakun & Longo eds. 2008 for an overview of current research in this field).

Most archaeological technology studies focus on an individual technology – flint knapping, metallurgy, etc. Archaeologists usually classify technologies into “crafts” or “industries” based on material or end-product type: clay (pottery) production, metal working, basket making, stone object (lithics) production, woodworking, textile manufacture. Such material groupings are very useful from both the theoretical as well as a practical perspective, however, they may be counterproductive sometimes (cf. Miller 2007), or better put, the study should not end with analyses of a single technology only. Although this is necessary for a deeper understanding of particular technologies, given the complexity of the topics, a wider approach is needed, namely a multiple technologies perspective (Lemonnier 1992b, 1993, see also Inizan et al. 1995).

All techniques in a given society refer to one another – they can share the same resources, same knowledge, same tools, same actors. Moreover, some techniques use the products of others, as well as the existence of operational sequences or technical principles in common, creating multiple relations of interdependence, which gives them a systemic character. All technologies have systemic aspects, and we can talk about technological systems in the same way as, for example, ethnologists talk about kinship systems. Technological systems can be analysed on three levels. Firstly, we can discuss how these five components interact with each other to form a technology. Secondly, if we consider all the technologies of a given society, we can analyse how they are interrelated. And finally, the third level of discussion is the relation between technologies and other social phenomena. Analyses of multiple technologies, therefore, can expand the range of studied cultural phenomena and at the same time provide a better understanding of a given culture and society (Lemonnier 1992b, 1993).

* * *

This book is a result of a session organized at the XXXVI Annual meeting of the Serbian Archaeological Society, held in Novi Sad, from 30th May to 1st June 2013. The aim of the session was to promote the technological perspective on different aspects of material culture and to encourage multiple technology studies. Papers include studies on artefacts from stone (M. Lopičić, D. Antonović, D. Rajković et al., V. Dimitrovska), bone (C. Beldiman et al., D.-M. Sztancs et al., S. Vitezović), clay (I. Atanasova, J. Vuković, V. Bikić) and metal (M. Radivojević et al.), but also include more complex technologies, such as constructions of thermic structures (A. Đuričić), the making of mosaic substructures (G. Jeremić) and water supply systems (T. Mihailović). Also, studies cover a large time span, from Late Palaeolithic/ Mesolithic to the Middle Ages.

We would like to thank all the participants of the session and the audience as well, the contributors of the book, reviewers, and, last but not least, to Jelena Vitezović and Ivan Bugarski for their help with English translations and proofreading.

Selena Vitezović,
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ARCHAEOLOGICAL EVIDENCE OF POTTERY FORMING SEQUENCE: TRACES OF MANUFACTURE IN LATE NEOLITHIC VINČA ASSEMBLAGE

Jasna Vuković
Department of Archaeology, Faculty of Philosophy, University of Belgrade

Abstract: *Pottery forming sequence and archeological methods for identification and analysis of markings and traces originated during this process are examined. Late Neolithic Vinča pottery assemblage from final phases of the settlement have been analyzed. Analysis revealed that Neolithic potters applied different shaping techniques, depending on vessel size and function.*

Key words: *forming sequence, technology, Vinča, pottery, breakage patterns, fracture, surface markings*

Apstrakt: *U radu se razmatraju sled operacija u procesu oblikovanja keramičkih posuda i arheološki metodi za identifikaciju i analizu tragova koji na keramici nastaju za vreme tog postupka. Analizirana je keramika iz finalnih slojeva kasnoneolitske Vinče, a rezultati su pokazali da su neolitski grnčari primenjivali različite tehnike oblikovanja za posude različitih dimenzija i funkcije.*

Ključne reči: *koraci u oblikovanju, tehnologija, Vinča, grnčarija, obrasci lomljenja, prelomi, tragovi na površini*

177–198.

Late Neolithic Vinča pottery is widely known from numerous archaeological sites in Southeastern Europe. Unfortunately, it was rarely analyzed from point of view other than cultural history: researchers were often focused on stylistic and analyses of supposed evolution of shapes and ornamental techniques in order to develop detailed chronological systems (for example Garašanin 1978). Many published works were based on elaborated typologies (e.g. Schier 1996; Bogdanović 2004), but our knowledge about many other aspects of pottery - production, distribution, use and discard - is still very limited. Considerations about Neolithic pottery technology are still lacking, although they should have a central position in the study of ancient crafts, and essential in reconstruction of some aspects of social relations. Pottery assemblage examined in this paper is excavated during 2001-2007. excavation campaigns at Vinča. Sherds and whole vessels originate from different contexts, from structures - houses as well as from archaeological layers. Assemblage is chronologically consistent: it belongs to the final layers of Neolithic settlement, i.e. Vinča-Pločnik phases; therefore it can be dated to the very end of the Neolithic. Before considerations about Vinča vessels forming sequence, it is necessary to define the terms, briefly overview various aspects and definitions of technology itself and present methods for identification of particular procedures.

System, sequence and choice: What is technology?

Technology has been the subject of many discussions in various disciplines of humanities (for overview see: Dobres 2000; Loney 2000; Miller 2007). "Sociotechnical systems" (Pfaffenberger 1992), "technological systems" or, in short, "technology" are defined in the broadest sense, as "the processes and practices associated with production and consumption (including distribution, use, and disposal), from design to discard" (Miller 2007: 4). Some authors stress that technology does not imply only manipulation of objects, but is also comprised of certain (un)conscious "technical" knowledge, which constitutes the bridge between techniques and society (Lemonnier 1986). Similarly, "technological knowledge" is comprised of three components; recipes of action, or rules for processing raw materials into finished products, teaching frameworks and techno-science, principle refering to reasons why recipes of action lead to specific product and why that product can perform its function(s) (Schiffer and Skibo 1987). Technology is often seen as a set of choices depending on different (social, ideological, economic, functional) factors (for example Pfaffenberger 1992). Technological choices (Lemonnier 2002a, b) are affected by a variety of social, utilitarian and symbolic factors and processes. The notion of "technical choice" is a bit narrower; it refers to design processes of objects and how they affect and/or depend on their performance characteristics (Skibo and Schiffer 2008: 11). Studies of technology based on "technological choices" approach are most common in archaeometry; in other words, materials and physical scientists are involved in various analyses in order to reconstruct and explain procedures applied by craftsmen in the past (Sillar and Tite 2000; Tite et al. 2001). It should not be forgotten, however, that some of technological or technical choices, such as identification of tools or forming techniques, can be revealed during archaeological investigation. That leads us to the production sequence analysis. Traditional archaeological approach to technology is based on reconstruction of operational sequence in artefact's production, i. e. Leroi-Gourhan's *chaîne opératoire* (e.g. Dobres 2010). Other aspects of technology can not be interpreted if steps in production sequence are not identified. In pottery craft these are: raw material procurement, raw material separation and preparation, preparation of clay body, forming, drying, firing, cooling and post-firing treatments. Potter must make decisions in each step; therefore, variations in *chaîne opératoire* are also relevant in reconstructing social aspects of pottery production, i.e. pottery "traditions" or "styles" (van der Leeuw 2002). In order to discuss potters' choices or traditions and social implications of their crafts, first it is necessary to determine methods of identification of each step. This paper will focus on forming sequence of Vinča pottery.

Step by step: Forming Sequence

Similarly with other steps in pottery production, forming sequence comprises three steps:

1. Shaping. Pottery made without means of rotation is formed by using several different techniques. Pinching is the simplest technique; it involves squeezing clay between fingers and thumb or between fingers of opposing hands; this procedure can be repeated several times in order to thin the walls and increase the height of the vessel. Drawing is a bit elaborated technique and it is applied by forcing the fist into the lump of clay and squeezing the clay between the hands while simultaneously pulling it upward. Slab building technique is based on joining slabs or more or less flattened lumps of clay by pressing. Coiling is accomplished by placing rolls or coils of uniform thickness around the circumference, thus gradually increasing height of the vessel. Molding involves pressing plastic body into or over the mold (concave or convex). Ethnographic and ethnoarchaeologi-

cal, as well as archaeological research revealed that combination of several techniques was widely accepted, especially for manufacture of large vessels. Finally, beating or paddling - repeatedly striking the clay with or without opposing pressure - is considered a secondary forming technique (Rye 1981: 84; Rice 1987: 137), because it is usually performed to modify roughly shaped vessel's form, size, and surface characteristic or to compact the clay body. However, "paddle and anvil" technique - beating the clay with opposing pressure - can sometimes be primary forming technique (Bankes 1985).

2. Scraping. Primary and/or secondary shaping of the vessel in the production sequence are followed by additional shape fashioning, usually in order to thin the walls or remove excess clay from the vessel. This is done by scraping the surface of vessel at a leather-hard stage with a tool with hard, sharp edge. Tools used for scraping can be smooth-edged, serrated or toothed (for example a shell). Scraping can be considered as a kind of surface/shape modification.

3. Surface treatment. Surface finishing is a final treatment of a vessel before firing. The major techniques are texturing and smoothing. The latter involve rubbing a tool against leather-hard clay to even the surfaces and improve its light-reflecting qualities. Every archaeologist is familiar with three grades of surface finishing - smoothing, burnishing and polishing.

It is very important to stress that steps 2 and 3 can easily be mixed up, especially by unexperienced researchers. Since both procedures leave markings on the vessel surface, they are usually regarded simply as surface treatments. Important step of shape modification, i. e. scraping, is omitted, thus leading researchers to draw wrong conclusions (to assume presence of unexperienced potters or imperfect, undeveloped technology, for example). Inability of recognizing shape modification step and therefore whole production sequence can affect interpretations of other, especially social aspects of technology. However, these two steps can be easily distinguished, as it will be shown below.

Markings and attributes: Identification of forming sequence steps

While other steps in production sequence cannot be reconstructed without contribution of physical sciences, identification of forming sequence steps is very simple and based upon macroscopic identification of markings on the vessels or their fragments; these markings originated during forming, shape modification and finishing. In the study of vessel forming, two kinds of data are important: attributes and sequence of execution (Rye 1981: 58). Attributes are various kinds of markings and traces on the surfaces or particular form of fracture; sequence of execution refers to determination of sequence in which techniques are applied. Important factor in marking forms is degree of clay plasticity, so the principle that marks made in plastic, wet clay are earlier than those made in leather-hard or dry stages can be drawn.

Some difficulties, however, can occur during the analysis. Some techniques or steps in the sequence cannot be identified because they are "erased" by later steps or treatments. The best example is presence of slip; in that case, surface treatment hid earlier procedures and markings. Also, some markings are not visible on external surfaces, since these surfaces were easily accessible to the potter and therefore subjected to various treatments; in the case of restricted forms, some traces left during the forming sequence usually "survived", since their closed profiles restricted access to the potter.

Usually, it is not possible to identify all kinds of traces on one vessel. Furthermore, whole vessels are not always suitable for analysis, because many pieces of information about forming procedures are obtained by examination of fracture. On the other hand, regarding the fact that different kinds of traces occur on different parts of the vessel, examination of sherds does not reveal all applied procedures either. In sum, sources of information about forming procedures are usually fragmentary. However, when careful analysis is conducted, it is possible to set some assumptions and draw some conclusions. Three kinds of attributes are important in production sequence analysis: breakage patterns, fracture, and surface markings.

Breakage patterns

Cracks and fractures can occur on pottery during different steps of production or during use; therefore they usually do not reveal forming procedures, but rather firing techniques or originate as a consequence of thermal shock during use. Vessel will break, however, in a pattern, depending on forming technique applied: they are prone to "selective breakage" because of the differences in shape, wall thickness, and stresses during forming (Rye 1981: 59). It is already shown that Vinča vessels of large dimensions break in a clearly distinguished zones along horizontal axis; that means that vessel was made in several steps, including partial drying of finished parts before building of the vessel continued; points of stress occurred on the zone where parts of vessel in different stages of plasticity were joined together (Вуковић 2011б, figs. 2,5).

Fractures

When examining fractures, two attributes are important: shape of fragment's edge and fracture itself. Some of forming techniques have no influence on breakage: fracture of vessels made by pinching, for example, have no special characteristics (Rye 1981: 70). As it was pointed out earlier, vessels usually break on the points of stress, where pieces of clay were joined together, especially if they were in different stages of plasticity. Fractures of this origin are to be expected on the vessels made by coiling, slab building and moulding. In this case, sherd's edges are usually rounded. Additionally, so-called "laminar fractures" parallel to the surface must be mentioned (fig. 1); they are manifested by removal of a flat layer of the vessel wall and sometimes occur when vessels made by slab building break.

Regarding the fact that coiling probably have been widely accepted forming technique during Late Neolithic (and in later periods) it is important to emphasize that it cannot be identified on the cross-section of the sherd; later procedures such as shape modification - thinning the walls and surface finishing erased traces of coils, except in the case of coils that were joined when too dry (Rye 1981: 67-68).

Fig. 1 Base of a vessel showing laminar fracture
Sl. 1 Dno posude sa laminarnim prelomom

Surface markings

Vessel surface in many cases may "preserve" traces originated during certain operations of vessel forming. They cannot reveal primary forming techniques, however, because later steps of forming sequence completely remove all possible traces, such as spots where coils were joined together. Instead, surface markings indicate steps 2 and 3 - shape modifications and surface finishing. Four kinds of markings can be distinguished on Vinča pottery:

1. Depressions on the walls left by tool or hand. They usually occur on the interior surfaces, since the exteriors are usually finely fashioned. Finger traces can occur during vessel shaping, especially by pinching, but also during surface modification or smoothing when potter used wet fingers as tools.

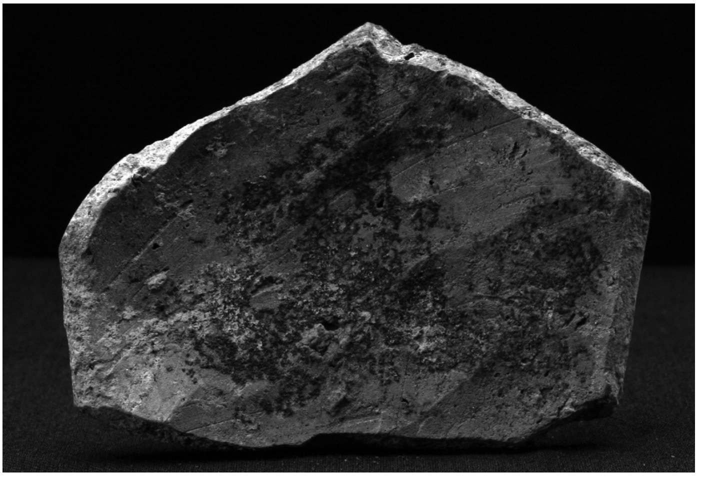

Fig. 2 Interior walls with traces made by smooth-edged tool in the process of wall thinning/shape modification
Sl. 2 Unutrašnji zidovi posude sa tragovima poteza alatke sa ravnom ivicom nastalim stanjivanjem zidova u procesu modifikacije površine

Traces of tools of different profiles represent important evidence of thinning of the walls. This operation is executed using a sharp tool, in a movement perpendicular to the surface, when vessel was still in plastic or leather-hard stage. Traces left by this procedure are in the form of deeper grooves, which indicate the shape of the tool; the tool can be smooth-edged (fig. 2), or toothed; both are identified in Vinča assemblage. The latter is interpreted as shell (fig. 3). Movement direction can be reconstructed by depths of the grooves: if the operation have been performed in a leather-hard stage, beginning of the action is manifested by shallower grooves, and by the end of the movement grooves gradually became deeper, and opposite if performed on a plastic stage. These markings are not oriented in some pattern, but rather distributed in different directions, and they are usually visible on the interior surfaces. It also must be stressed that in some cases potter did not perform finishing treatment, so somewhat rough (if inclusions included bigger particles) or irregular (with finer particles in fabric) surface remained.

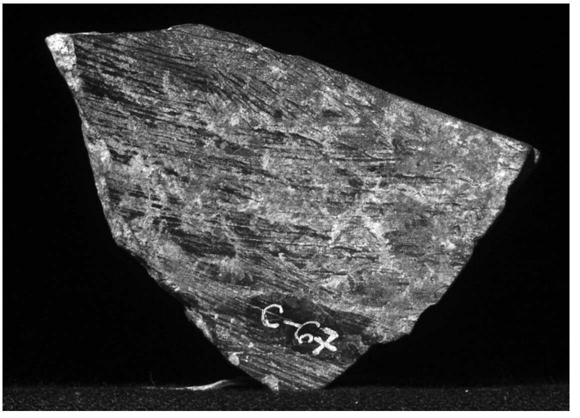

Fig. 3 Interior walls with traces made by toothed tool in the process of wall thinning/shape modification
Sl. 3 Unutrašnji zidovi posude sa tragovima izvedenim nazubljenom alatkom u procesu modifikacije površine

2. Facets. Surface finishing treatments are executed using the same tools, but in somewhat different manner. For polishing of the surfaces, soft materials can used (cloth or skin); resulting surface is therefore regular, even and shiny - there are no traces left. On the other hand, using of tools will leave markings. Burnishing of the surface using hard tool, such as pebble, bone or antler creates typical narrow parallel linear facets (Rice 1987: 138). They are often seen on both exterior and interior surfaces of Vinča pottery (fig. 4).

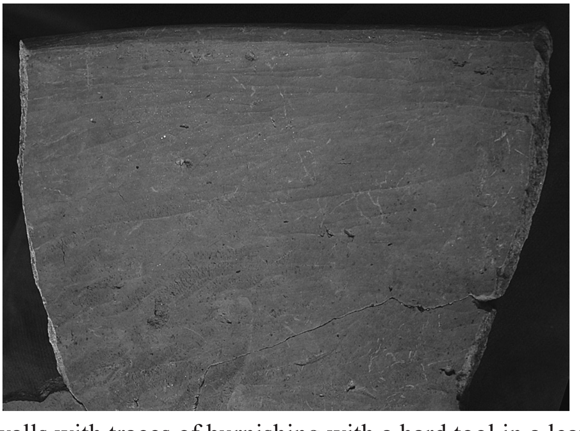

Fig. 4 Interior walls with traces of burnishing with a hard tool in a leather-hard stage
Sl. 4 Unutrašnji zid posude sa tragovima glačanja tvrdom alatkom dok je glina u kožnom stanju

3. Drag marks, caused when inclusions with bigger particle size are dragged across the surface; usually the grain may remain at the end of the line (Rye 1981: 59). Dragged particles leave traces in the form of incisions; they particularly occur on the vessels of rough fabric (fig. 5) during the processes of shape modifications/thinning of the walls or surface finishing.

Fig. 5 Interior surface of a vessel with drag marks oriented in different directions occured during the processes of shape modifications/thinning of the walls or surface finishing

Sl. 5 Unutrašnja površina posude sa tragovima u vidu kanalića u raznim pravcima nastalim povlačenjem čestica primesa tokom procesa modifikacije ili finalne obrade površine

4. Impressions of supports used during shaping of the vessel. They occur on the bottoms of the vessels. Impressions of cloths and mats on the bottoms are very common in Vinča pottery. It seems that such supports allowed the potter to turn the vessel during building. In other words, it allowed potter to sit while working instead of moving around the vessel. However, most of the bases are plain, without any impressions. This could mean that artisans used flat supports as well or that they deliberately erased cloth impressions. Although both solutions are possible, one specimen with its remarkable markings strongly suggests the latter (fig. 6). Impressions of a cloth are present in the centre, but on the periphery various traces are visible: deeper grooves oriented in different directions, and drag marks, suggesting action while the clay body was still in the stage of high plasticity. They are positioned over mat impressions, suggesting specific sequence of execution - they occurred later. Therefore, they can be interpreted as deliberate erasing of cloth impressions, made when clay was still wet.

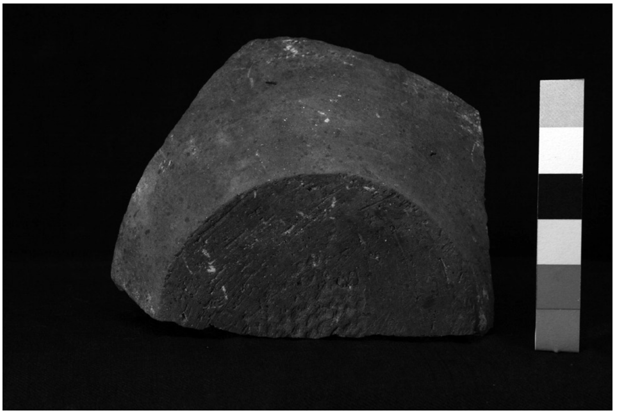

Fig. 6 Base of a vessel with traces in the form of deep incisions occured during action of "erasing" cloth impressions
Sl. 6 Dno posude tragovima u vidu dubljih kanalića nastalim za vreme brisanja otiska podloge od tkanine

Vinča pottery

Vinča pottery exhibits many clues implying distinct procedures and shaping techniques. It seems that the forming sequence of Vinča pottery is pretty complex, and it is very likely that different functional classes of pottery were manufactured by applying different techniques or their combinations. Therefore, each functional class with specific traces and markings originated during forming sequence will be considered separately, and then the attempt to reconstruct the whole process will be made.

Large vessels: amphorae and pythoi

Amphorae and pythoi, large vessels belonging to functional class for storage of solids and liquids can be divided in many groups according to different shape typologies. All of them, however, share several crucial characteristics: flat bottoms, biconical shape with significantly higher lower cone, shoulder diameter is usually much greater that bottom diameter and profiled narrow or wide rim and neck.

Breakage patterns are significant. These vessels usually break in two zones. First is the zone of the shoulder (fig. 7); it is very common that after initial refitting two groups of joined sherds are standing out: first is comprised of lower vessel parts, and the second of upper vessel parts. Besides, fragments of bellies are, by the rule, thin walled and flattened, indicating meticulous thinning of the walls. All these features indicate that building of the vessels was executed in several stages: lower parts have been shaped first, and they have been left to dry before the upper parts were added. This procedure was necessary for the vessels of larger dimensions; if the whole vessel have been built continuously, lower parts would not have sufficient strength to withstand pressure of the weight of upper parts, and the risks of collapsing would be substantial. That is why the shoulder represents point of stress - most vulnerable part of the vessel, since it is a spot where clays in different stages of plasticity were joined together: lower are dried and hard, while the rest is soft, wet and plastic; therefore they cannot be firmly attached to each other. Second zone of breakage is spot where the neck is joined with upper part of the vessel.

Fig. 7 Breakage in the zone of a shoulder on an amphora
Sl. 7 Lomovi u zoni ramena amfore

Fracture may, but not necessarily, exhibit clues for identification of forming techniques. Sometimes, pottery sherds have rounded edge, feature that indicates coiling building technique (fig. 8). These sherds in most cases belong to lower parts of the vessels. Bottoms sometimes exhibit laminar fracture, typical for slab building. Finally, in rare cases of fragments secondary burnt in the fire, stratified fracture is visible, also suggesting slab building (Вуковић 2011б, fig. 3).

Fig. 8 Fragment of a base with a rounded edge, indicating coiling
Sl. 8 Fragment dna posude zaobljenog preloma, što ukazuje na tehniku "kobasica"

Markings made by tool strokes during shape modification step (fig. 2) are often visible on interior surfaces. Some specimens exhibit extremely rough, deep traces, along with small lumps of excess clay which have not been removed (fig. 9). Tool strokes are not patterned, but distributed in different directions, most often parallel with the bottom. Sometimes they leave very deep incisions and grooves; it is not uncommon that forced pressure of the tool caused removal of larger parts of vessel wall. These traces are left by the procedure of shape modification and wall thinning after coil building of the vessel. It is not surprising that the markings are visible only on the interiors, close to the bottoms, and surface finishing is lacking. After the vessel was made, potter could not reach its interiors any more, especially bottom (because of the closed shape - narrow neck), therefore leaving them unfinished. Besides, burnishing of inner surfaces probably was not essential functional requirement. In functional sense, burnishing eliminates high porosity, and is therefore performed on the containers used for storage or transport of liquids. Consequently, vessels with function of storage of solid foodstuffs could be suitable for their intended function without this kind of surface treatment. Parallel facets caused by burnishing the surface with a hard tool - pebble are always present on exterior surfaces; their appearance suggests that they were executed on a vessel in a leather-hard or dry stages.

Bearing in mind different traces on manufacture present on pottery, forming sequence for large vessels can be assumed:

1. Shaping of the base. Bases could have been shaped using different techniques. According to ethnoarchaeological research (for exam-

ple Frank 1994), the most common way was to form a flat, pancake form. Thicker bases could have been shaped also by slab building, by pressing several lumps of roughly preshaped clay to each other, as specimens with laminar fracture prove. Shaping of the bottom by spiral coil twisting is not certain in Vinča assemblage. Shaped bottom was set on a support (mat, cloth or some flat surface).

2. Coils were gradually added around the circumference, gradually increasing height. Only lower part of vessel is built in this stage. Vessel was removed from the support; cloth/mat impressions were removed by some hard, sharp tool; then it was left to dry.

3. Walls are thinned, leaving markings on interior surface.

4. Upper part of the vessel was added. This could have been done by slab building, as it was shown for the case of pythoi (Вуковић 2011б). In the case of amphorae, there is no sufficient evidence, but we can assume coiling technique. Handles were also added. Shaping of smaller vessels could have been finished in this stage; in case of larger ones it is possible that only middle part of the vessel was formed, and after it have been dried to at least leather-hard stage, neck and rim were added. Breakage patterns suggesting breakage in the zone where neck and shoulder were joined, confirmed in case of several narrow-necked amphorae, support this scenario.

5. Burnishing of outer surface, using hard tool, was performed.

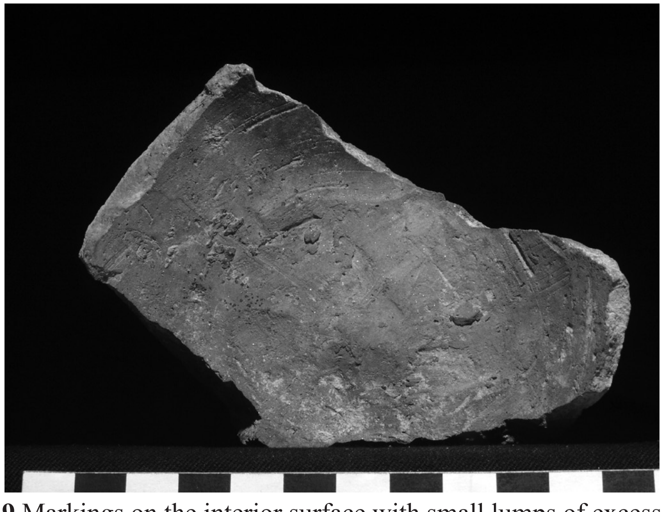

Fig. 9 Markings on the interior surface with small lumps of excess clay which have not been removed indicating shape modification step
Sl. 9 Unutrašnji zid dna posude sa tragovima poteza alatkom i česticama istisnute gline koje nisu skinute u procesu modifikacije površina

Small vessels: bowls

There are several types of bowls in late Vinča phases, but considerations about their forming sequence in this paper will be focused on two specific types: bowls with inverted rim and biconical bowls with pronounced carinated shoulder. There are two reasons for this selection: first, these two types are predominant in late Vinča assemblage. Second, they have already been subjected to standardization analysis and therefore become the main argument for the assertion of Vinča pottery standardization (Vuković 2011a).

Bowls with inverted rim are characterized by simple profilation: (slightly) biconical shape, without profiled neck and rim; the joint of two cones, i.e. the most protruded part of the vessel is always very thick. Breakage patterns do not exhibit any strict regularity. However, the most common breakage occur exactly on the joint of the two cones (fig. 10); the edges are always rounded. This point of stress located on the most protruded part of the vessel clearly indicates forming procedure of joining together two parts in different stages of plasticity. Thick walls on the point of stress further confirm this assumption: larger area will ease applying of the procedure to the potter; it will also allow two lumps of clay to better stick to each other.

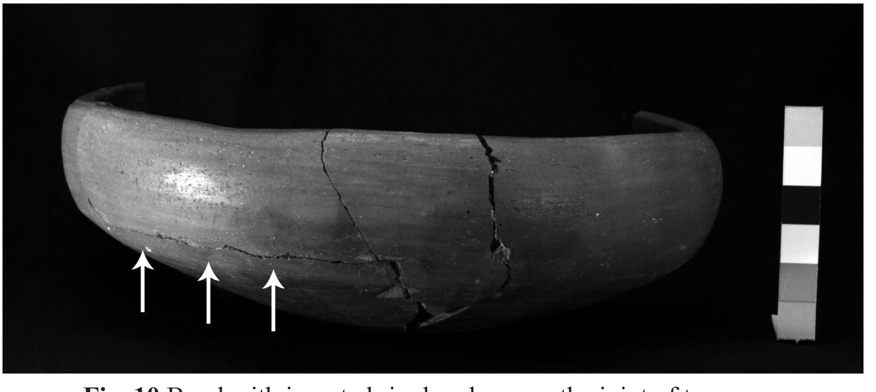

Fig. 10 Bowl with inverted rim breakage on the joint of two cones
Sl. 10 Zdela sa uvučenim obodom koja pokazuje obrazac lomljenja na spoju dva konusa

Conclusion that bowls with inverted rim were shaped in two steps, i. e. that two cones were shaped separately and then joined together, can be drawn with certainty. However, the issue of technique applied still remains open. One of the main clues in resolving this issue are their standardized dimensions and very thin walls (3 mm). The questions, however, arise: is it reasonable to shape small vessels by coiling and is it possible to achieve standardized dimensions by applying this technique? For experienced and skilful potter it is certainly possible, but it seems to be harder and more time-consuming method. Particular kind of markings, however, can be essential in identification of forming technique. Sometimes the lower cones of bowls, especially near the bases, have uneven, slightly wavy surfaces. They are visible only on specimens without careful burnished or polished surfaces. Such markings may occur during forming using the convex mould: clay pancake is pressed over the mould, and gently beaten with a tool. Since the beating is executed from the outside of the vessel, uneven surfaces are not visible on interior walls. This technique is faster and more efficient than coiling; thin walls are more efficiently executed by applying this technique; moreover, usage of moulds easily leads to standardized dimensions of the entire assemblage. It should be beard in mind that Vinča potters had abundance of broken or damaged vessels on disposal; their secondary use as moulds is highly probable and ethnoarchaeologically confirmed (e.g. Deal 1998). Upper cones (their height is usually 2-3 cm) in the form of one thick coil were added on already formed lower parts of the bowl; this is confirmed by smooth and rounded fractures. Since the rims were not profiled, shaping of the upper cone did not require additional effort; its inverted position was executed by simple hand movement towards the interior. Possible irregularities could have been easily eliminated by hand while the clay was still wet. Thinning of the walls was not necessary, since the walls were thinned during beating on the mould. Vessels were then left to dry; when leather-hard, they were burnished or polished with some hard tool, probably pebble of suitable size.

It seems that forming technique applied to the other type, biconical bowls with pronounced carinated shoulder, does not differ to a great extent from the one previously described. However, since bowls of this type are of more elaborated shape, they exhibit some unique characteristics, causing particular breakage patterns. Their most prominent feature is their shoulder, which, when viewed from the outside, gives the impression of biconical shape. Interior walls are not carinated, though; they are slightly rounded. These facts indicate procedure where the shoulder, in a form of band, was applied along the joint between two cones of already shaped vessel. The joint of band and the walls cannot be observed in most cases; it often looks like the band was an integral part of the wall. It is visible only on specimens secondarily burnt in a fire (fig. 11). Therefore it can be assumed that the band/shoulder was added when the vessel was in a plastic stage, i.e. wet, and firmly pressed to the walls with the fingers; similarly to the coiling technique, the joint between the band and the wall cannot be seen after firing of the vessel.

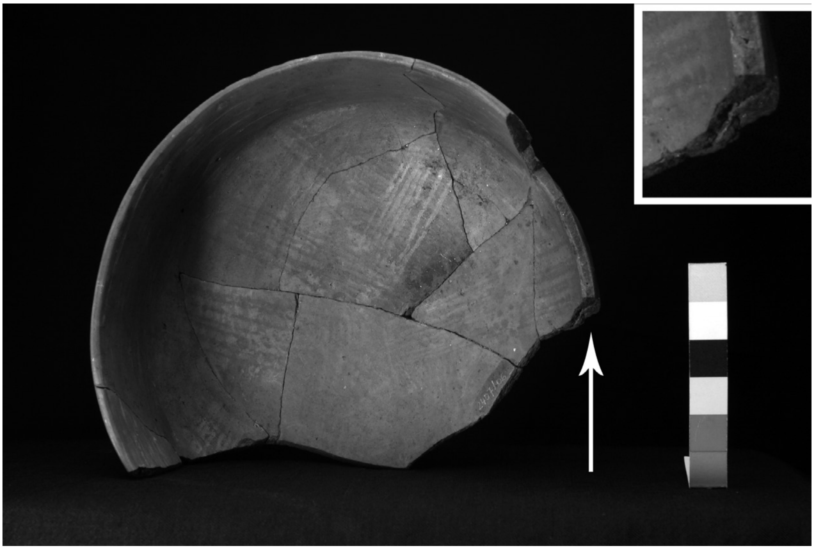

Fig. 11 The joint of band/shoulder and the walls on a biconical bowl with pronounced carinated shoulder
Sl. 11 Zdela sa plastično naglašenim ramenom na kojoj se vidi mesto spoja trake kojom se formira bikonija

The most common breakage occur just above the shoulder. Sometimes, shallow finger impressions are visible on the interior surface, suggesting firmly pressure of both potter's hands in order to assure that band/shoulder and wall will be strongly attached. In other cases, breakage occur just below the shoulder.

Forming sequence of biconical bowls with pronounced carinated shoulder is much harder to reconstruct. Probably, the lower cone was shaped similarly to the procedure of bowls with inverted rims, but the issue of the upper parts triggers many doubts and uncertainties about the sequence of execution. First of all, the purpose of "carination" executed by attaching a band along the joint between two cones, is not clear. One possibility is that it represents a form of reinforcement, which additionally secures firmly joining of upper and lower sections of the vessel. The fact that breakage does not occur in the zone of the shoulder supports this assumption. Sometimes, shallow grooves are visible on the spots where band/shoulder was attached to the upper cone (fig. 12). They may represent traces of a tool used for additional pressing of the band to the vessel walls. This procedure would strengthen the point of stress, but also could create a new one, just above it, as breakage patterns suggest. If this was the case, band attachment was conducted as the last step in forming sequence.

Fig. 12 Shallow grooves caused by pressing the band/shoulder to the upper cone with a tool
Sl. 12 Zdela sa platično naglašenim ramenom sa žljebovima nastalim pritiskanjem alatke na traku koja formira bikoniju na spoju ramena i vrata

Conclusion

Analysis of markings on Vinča pottery revealed that variety of techniques were applied, depending on the size and function of the vessels. Large vessels were formed using combination of techniques, but most commonly coiling and slab building; they were shaped in several steps, since lower parts would not have sufficient strength to withstand pressure of the weight of upper parts. Markings indicating the process of bowls' shaping are rare and bowls' forming sequence is therefore still uncertain. However, it can be assumed, with little doubt, that the bowls were made in at least two steps, in a procedure where lower and upper parts were formed separately using moulds and/or slab/coil building, then joined together in different stages of plasticity. Choice of particular techniques and decisions that potters made were, for certain, caused by economic and/or social pressure. Therefore the importance of pottery forming sequence as one aspect of technology studies must be emphasized in order to encourage more research in that field with final goals of understanding social relations and change in past societies.

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Jasna Vuković
Odeljenje za arheologiju, Filozofski fakultet, Univerzitet u Beogradu

ARHEOLOŠKA ANALIZA PROCESA OBLIKOVANJA GRNČARIJE: TRAGOVI IZRADE NA KASNONEOLITSKOJ VINČANSKOJ KERAMICI

U ovom radu je razmotren proces oblikovanja keramike koja potiče iz finalnih slojeva neolitskog naselja u Vinči. Proces oblikovanja uključuje tri koraka: oblikovanje u užem smislu, modifikacija oblika, tj. stanjivanje zidova, i obradu površina. Druga dva koraka se retko kad razlikuju u arheološkoj literaturi, što često rezultira pogrešnim zaključcima. Identifikacija procesa oblikovanja zasniva se na makroskopskoj identifikaciji pojedinih operacija, koje ostavljaju karakteristične tragove na posuđu. Osim toga, ponekad je moguće utvrditi sled operacija izrade. Razlikuju se tri vrste atributa koji su važni za analizu: obrasci lomljenja, prelomi i tragovi na površini. Obrasci lomljenja ukazuju na tehniku izrade i "tačke stresa" na posudi. Na vinčanskoj keramici tragovi na površini javljaju se u četiri osnovna oblika. Udubljenja nastala pokretima ruke ili alatke; treba istaći ona koja su nastala upotrebom ravne (slika 2) ili nazubljene alatke (slika 3) u procesu stanjivanja zidova. Facete nastaju u procesu obrade površina - glačanja ili priglačavanja (slika 4); tragovi u vidu kanalića kojima su povlačene čestice primesa (slika 5) koji nastaju u jednom ili oba procesa i otisci podloge na dnu posude, tkanine ili asure. Na nekim fragmentima dna ostali su vidljivi tragovi izravnavanja i brisanja otisaka (slika 6). Tragovi često pokazuju dublje ureze u različitim pravcima, koji su verovatno nastali povlačenjem većih čestica primesa u glinenom testu dok je ono još uvek sasvim plastično.

Posude većih dimenzija (amfore i pitosi), koje pripadaju funkcionalnoj klasi skladištenja karakterišu specifični obrasci lomljenja. Naročito često se lome u zoni ramena (slika 7); ispod te zone zidovi su pažljivo stanjeni, a na unutrašnjim površinama po pravilu imaju tragove poteza nazubljenom alatkom, korišćenom u različitim pravcima u procesu stanjivanja zidova kad je posuda bila u kožnom stanju. Na nekim posudama se pri dnu vide veoma grubi tragovi, kao i čestice gline koje nisu skinute sa površine (slika 9). To sve ukazuje da je posuda građena u nekoliko etapa: donji delovi su prvi oblikovani, gornji delovi su dodati tek pošto su prosušeni i očvrsli. Ovo je neophodan postupak, jer ukoliko bi se posuda gradila odjednom, donji delovi ne bi imali dovoljnu čvrstinu da izdrže pritisak i težinu gornjih, pa bi se posuda urušila. Zbog toga su najčešći lomovi upravo u zoni ramena. Sa velikom sigurnošću možemo da tvrdimo da su posude oblikovane tako što je prvo izrađeno dno, a zatim su se zidovi gradili u visinu. O tome svedoči veliki broj fragmenata dna čiji su prelomi ravni i zaobljeni (slika 8). To su tipični tragovi koji ukazuju na slaganje „kobasica“. Samo dno je verovatno oblikovano izjedna, kao velika palačinka ili spiralnim uvijanjem jedne duže „kobasice“, a zatim su sa strane dodavane nove. Neka deblja dna su oblikovana verovatno lepljenjem više komada gline jedan za drugi, pa se prilikom lomljenja, posebno posle sekundarnog gorenja, ti komadi jasno odvajaju u vidu laminarnog preloma (slika 1). Gornji delovi su, sudeći po jednom primeru (Vuković 2011b), mogli biri građeni tehnikom pločica. Ukoliko je posuda građena iz tri etape, vrat i obod su dodavani na kraju, već oblikovani.

Zdele sa uvučenim obodom karakterišu jednostavni profili. One su bikonične ili blagobikonične forme, bez profilisanog oboda i vrata. Spoj dva konusa, tj. najistureniji deo posude uvek je veoma debelih zidova. Često se lome upravo na spoju dva konusa (slika 10). Prelom je uvek zaobljen i gladak. Iz ovakvih obrazaca lomljenja sasvim je sigurno da su zdele sa uvučenim obodom rađene iz dva dela, tj. da su konusi oblikovani odvojeno. Treba istaći veoma tanke zidove donjeg konusa, najčešće 3 mm. Osim toga, zdele sa uvučenim obodom pokazuju relativno ujednačene dimenzije, što su potvrdile analize standardizacije (Vuković 2011a). Putokaz za razrešenje tehnike izrade može biti vrsta tragova koja se sasvim retko pojavljuje, ali svakako zavređuje pažnju. Naime, na donjim konusima, posebno na dnu i neposredno iznad njega, ponekad su površine neravne, blago talasaste; to je vidljivo samo na fragmentima koji nisu posebno brižljivo polirani. Takvi tragovi mogu da budu posledica izrade na konveksnom kalupu, kada se „palačinka“ od testa postavi preko kalupa i blago tapka da bi na njega bolje prionula i dobila željeni oblik; zato su neravne površine vidljive sa spoljne, a ne sa unutrašnje strane. Takav način izrade sigurno je brži i efikasniji od slaganja „kobasica“, a korišćenje kalupa može da dovede do povećane standardizacije dimenzija čitavog asemblaža. Na taj način postižu se i izuzetno tanki zidovi, bez potrebe da se posle oblikovanja dodatno stanjuju. Gornji konusi su dodavani na formirani donji deo posude, najverovatnije u formi samo jedne deblje „kobasice“. O tome svedoče glatki i zaobljeni prelomi.

Čini se da se postupak oblikovanja bikoničnih zdela sa plastično naglašenim ramenom ne razlikuje drastično od prethodno opisanog. Ipak, zdele ove vrste, s obzirom na to da su nešto razuđenijeg profila, imaju i neke jedinstvene osobine. Njihova najupečatljivija karakteristika je rame, koje, kada se posuda posmatra spolja, daje zdeli bikoničan izgled. Sa unutrašnje strane, međutim, zidovi su u najvećem broju slučajeva ravnomerno zaobljeni, što ukazuje na postupak kojim je rame u formi trake naknadno aplicirano na zid posude. Na prelomima se, međutim, mesto spoja trake vidi samo u izuzetnim slučajevima, i to na fragmentima koji su sekundarno goreli (slika 11). To ukazuje na postupak kojim se traka koja formira rame aplicira na još vlažnu posudu i dobro pritiska, tako da se tragovi spoja posle pečenja uopšte ne prepoznaju. Donji konus je verovatno prvo oblikovan, dok oblikovanje gornjeg dela ostavlja nedoumice u pogledu redosleda operacija. Nije sasvim jasan smisao bikonije koja se postiže apliciranjem trake. Verovatno je da je ta traka u stvari jedan vid ojačanja, kojim se dodatno osigurava čvrsto spajanje gornje i donje partije posude. Ponekad su na mestu spoja ramena i vrata vidljivi nemarno izvedeni žlebovi (slika 12), koji možda predstavljaju trag alatke kojim je traka dodatno pritiskana za vrat. Tim postupkom bi se ojačala tačka stresa na spoju konusa, ali bi se stvorila nova, na prelazu vrata u rame. U tom slučaju, apliciranje trake bi se obavljalo kao poslednji korak u oblikovanju.

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