Technological analysis of Boian-Vidra pottery from Sultana

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Abstract: *The site at Sultana is located on the high terrace of the Mostiștea Lake, Southern Romania, and it belongs to the Eneolithic period (ca. 5000-3900 cal. BC). The site consists of an Early Eneolithic flat settlement (Boian-Vidra), a Middle Eneolithic* tell *settlement (Gumelnița), and a common cemetery used by both communities. The aim of this paper is to study the technological characteristics of the Boian-Vidra pottery from Sultana by performing a macroscopic analysis on pottery sherds discovered in three pits. At a site scale, interesting results were obtained on paste recipes, forming sequences, surface treatments, decoration, and firing. At a macro-regional scale, some of the results can be seen as significant transformations of pottery technology from the Late Neolithic to the Early Eneolithic period in the Lower Danube region.*

Rezumat: *Situl de la Sultana este situat pe terasa înaltă a lacului Mostiștea, în sudul României și aparține perioadei eneolitice (cca. 5000-3900 cal. BC). Situl este alcătuit dintr-o așezare plană din eneoliticul timpuriu (Boian-Vidra), o așezare de tip* tell *din eneoliticul mijlociu (Gumelnița) și un cimitir comun folosit de ambele comunități. Scopul acestei lucrări este de a studia caracteristicile tehnologice ale ceramicii Boian-Vidra de la Sultana prin efectuarea unei analize macroscopice asupra fragmentelor ceramice descoperite în trei gropi. La o scară locală, s-au obținut rezultate interesante despre rețetele de pastă, modalitățile de modelare, tratamentele suprafețelor, decorare și ardere. La scară macroregională, unele dintre ele reprezintă transformări semnificative ale tehnologiei ceramice de la perioada neolitică târzie la perioada eneolitică timpurie în regiunea Dunării de Jos.*

Keywords: *Eneolithic, Boian, Vidra, pottery, technology.*

Cuvinte cheie: *eneolitic, Boian, Vidra, ceramică, tehnologie.*

◈ 1. Introduction

The beginning of the Boian culture is dated at the end of the Middle Neolithic (ca. 5200 BC), but its last phases (Vidra and Spanțov) correspond to the beginning of the Early Eneolithic period in the Lower Danube area (Vl. Dumitrescu 1973, p. 28; P. Haşotti 1997, p. 72). The former ^{14}C dates for Vidra and Spanțov phases show a general period that spam between 5000 and 4500 BC (C. Bem 2001, p. 39-43; D. Bailey *et alii* 2002, p. 352; S. Bréhard, A. Bălășescu 2012).

The discourse of Romanian archaeologists about the Boian material culture was dominated by the cultural-history approach. Thus, the pottery was "*a specific and essential element in determining the phases of Boian culture*" (E. Comșa 1954, p. 372). The most known division is the four phases model (Comșa 1974). In chronological order, these phases are known as Bolintineanu, Giulești, Vidra and Spanțov (or transitional phase to Gumelnița

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culture). A relatively new model (S. Pandrea 2000; M. Neagu 2003) suggests that the former was a culture by its own and thus the Boian culture remain only with the last three phases (Giulești, Vidra and Spanțov).

Characteristic for the Boian-Vidra phase are the vessels with cylindrical body and lids with sizeable central handle in the shape of a "mushroom", carved with excisions encrusted with white paste, organized into geometric patterns as rhombus, squares and circular motifs (D.V. Rosetti 1934; D. Berciu 1961; E. Comșa 1974). Another characteristic shape invented in this period is the rectangular stand having two holes on the top plate for supporting other objects (E. Comșa 1974, p. 109; V. Opriş, C. Lazăr 2015). The painting with graphite is first attested in the Romanian area on Boian-Vidra pottery, but only in a few cases (D. Berciu 1961). Small vessels were polished on both surfaces, and very often the exterior was decorated with *plissé* (E. Comșa 1974).

Boian pottery was published in few recent comprehensive studies focused on topics such as technology from the contextual perspective (C. Micu 1999; A. van As *et alii* 2006; V. Opriş *et alii* 2012; L. Thissen 2014; V. Opriș, C. Ștefan 2016). Extensive work of synthesis from the past century often provides information on stylistic classification, used mainly for chrono-cultural framing, while the technological features were generally mentioned only where the authors would have found it appropriate (V. Christescu 1925; D.V. Rosetti 1934; D. Berciu 1961; E. Comşa 1974, 1990).

Besides establishing the relative chronology and outlining of culture or cultural "development", archaeological pottery can also provide other information about the people who created, used and abandoned objects in question. But to get answers to specific questions, those questions should be formulated first. Thus, in this study, we decided to address one essential question about prehistoric human activities on Boian-Vidra ceramic vessels from Sultana: "how have the vessels been created?"

◈ 2. The site

The archaeological site of Sultana is located on the high terrace of the Mostiștea Lake (fig. 1), on the right side of the watercourse, in the eastern edge of the Mostiştea Plain and 7 km north from the Danube, in Southern Romania (R. Andreescu, C. Lazăr 2008). The site belongs to the Eneolithic period (ca. 5000-3900 BC) and consist of a flat settlement (Boian) at Sultana-*Gheţărie*, a tell settlement (Gumelnița) at Sultana-*Malu Roșu*, and a common cemetery used by both communities, between this settlements (C. Lazar *et alii* 2012).

The Mostiştea River Basin is now one of the most anthropogenic water systems in the eastern Romanian Plain with the landscape radically changed from multiple facilities of dams, lakes, canals and pumping stations. In Sultana-Ulmeni sector of the Mostiștea Valley, the rising of water levels and the action of aeolian factors have led to the widespread erosion of western banks in a short period of time (approximate 30 m within 30 years) (C. Ghiță 2008).

The presence of human communities who have used Boian-Vidra pottery is attested at Sultana site by a series of discoveries on the high terrace of the Mostiştea Lake, in the points referred as *Necropolis I*, Sultana-*Gheţărie* and the area between them (D. Şerbănescu, G. Trohani 1978; R. Andreescu, C. Lazăr 2008; V. Opriș *et alii* 2012; V. Opriș, C. Lazăr 2014). Features containing pottery investigated so far have been limited exclusively to pits with variable sizes and compositions, and with uncertain function.

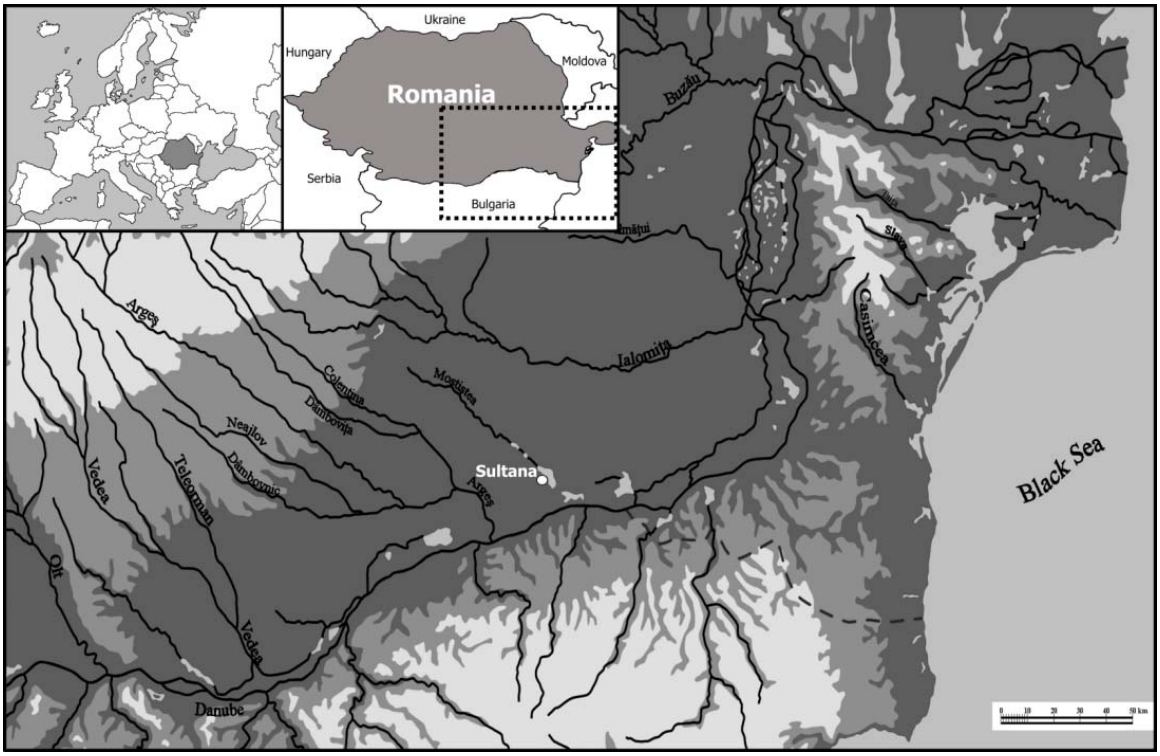

Fig. 1. Location of the Sultana site.
Poziția sitului de la Sultana.

The AMS radiocarbon dates obtained for Sultana-*Gheţărie* (n=2) span 4956 to 4654 cal BC (95.4% probability), with some minor difference between the dates from those two dated features (tab. 1). This results comes to complete those already available for some graves in the cemetery (*Necropolis I*)[1], which were also framed in the Boian culture, presented in the same table (tab. 1).

Context	Sample material	Lab no.	^{14}C years (BP)	2σ calibration (cal BC)	References
C20-pit	Animal bone	Poz-78730	5970 ± 40	4956-4729	Unpublished
C13-pit	Animal bone	Poz-78731	5870 ± 40	4839-4654	Unpublished
M35-grave	Human bone	Poz-40267	6020 ± 40	5011-4799	Lazăr *et alii* 2012
M11-grave	Human bone	LTL8096A	5939 ± 50	4943-4712	Hervella *et alii* 2015

Tab. 1. AMS radiocarbon dates obtained for the site of Sultana-*Gheţărie* and some ^{14}C dates from the cemetery (*Necropolis I*).
Date radiocarbon obținute pentru situl de la Sultana-*Gheţătie* și unele date ^{14}C din cimitir (*Necropola I*).

Calibration (2σ) of the BP dates was made through the OxCal 4.3.2 software (P.J. Reimer *et alii* 2013; C. Bronk Ramsey 2017).

[1] Until now, 65 radiocarbon dating are available for the Sultana cemetery (*Necropolis I*). Here we mainly used only those published, the rest being in the process of publishing.

◈ 3. Pottery assemblages and their discovery contexts

An agglomeration of pits with Boian-Vidra pottery was investigated on the western edge of the terrace, in the area denoted as Sultana-*Gheţărie*. The upper layers of this area contain abundant prehistoric materials, and the entire edge of the terrace is considered the periphery of an Early Eneolithic settlement (V. Opriş *et alii* 2012, p. 81). Among the investigated pits, two caught our attention in particular, and the pottery found in their filling will be discussed in the present study (the pits noted as C13 and C20). The feature indicated as C3/2012 is another pit discovered in *Necropolis I* area and the whole context was the subject of a separate study (V. Opriş *et alii* 2012, p. 66-73), including the analysis of pottery (tab. 2).

Site, Trench	Feature	Period/Phase	No. of fragments	Weight (grams)
Necropolis I, Son 1/2012.	C3/2012	Boian-Vidra	293	6791
S. *Gheţărie*, Son 21/2012	C13	Boian-Vidra	77*	4414*
S. *Gheţărie*, Son 3/2013	C20	Boian-Vidra	1308	20696

Tab. 2. Analyzed Boian-Vidra pottery assemblages from Sultana (*54 fragments (3604 g) from 3 vessels).
Lotul de ceramică Boian-Vidra analizată de la Sultana (*54 fragments (3604 g) de la 3 vase).

Feature C13 is a pit discovered in the trench denoted as S21/2012, 7-8 squares, at a depth between 1.60 and 1.85 m, relative to a point "0" set on the terrace. The shape is approximately circular with a diameter of 1.70 m, and the profile has cylindrical walls, slightly tapering towards the base. It was registered a single stage of filling with yellow-gray sediment (SU 1031) containing materials such as animal bones, shells, stones, pottery, all in small quantities. Small fragments of charcoal and sometimes traces of ash and yellow sediment were also identified. On the bottom of the pit were discovered pottery fragments from three different vessels that have been partially restored (tab. 3): a conical vessel with slightly curved walls (V5001), a pedestaled dish (V5002) and a parallelepipedic stand (V5000). Their distribution over the entire base of the pit indicated a waste deposition characteristic. This assumption is supported by the fact that all the 18 fragments from the parallelepipedic stand, discovered scattered, have joined together to form a compact body (V. Opriş, C. Lazăr 2014).

In addition to these three vessels, another 23 disparate shards were discovered. Overall, the pottery from pit C13 has a mass of 4414 g of which 3604 g (82%) weighed the fragments from the three vessels partially restored.

Complete profiles	No. of fragments	Weight (g)	% from the vessel	Feature
V5000	18	1387	40	C13
V5001	14	661	30	C13
V5002	22	1556	60	C13

Tab. 3. Pit C13: number of fragments, weight and approximate percentage of the three complete vessel profiles.
Groapa C13: număr de fragmente, greutatea și procentul aproximativ de restaurare a celor trei profile de vase.

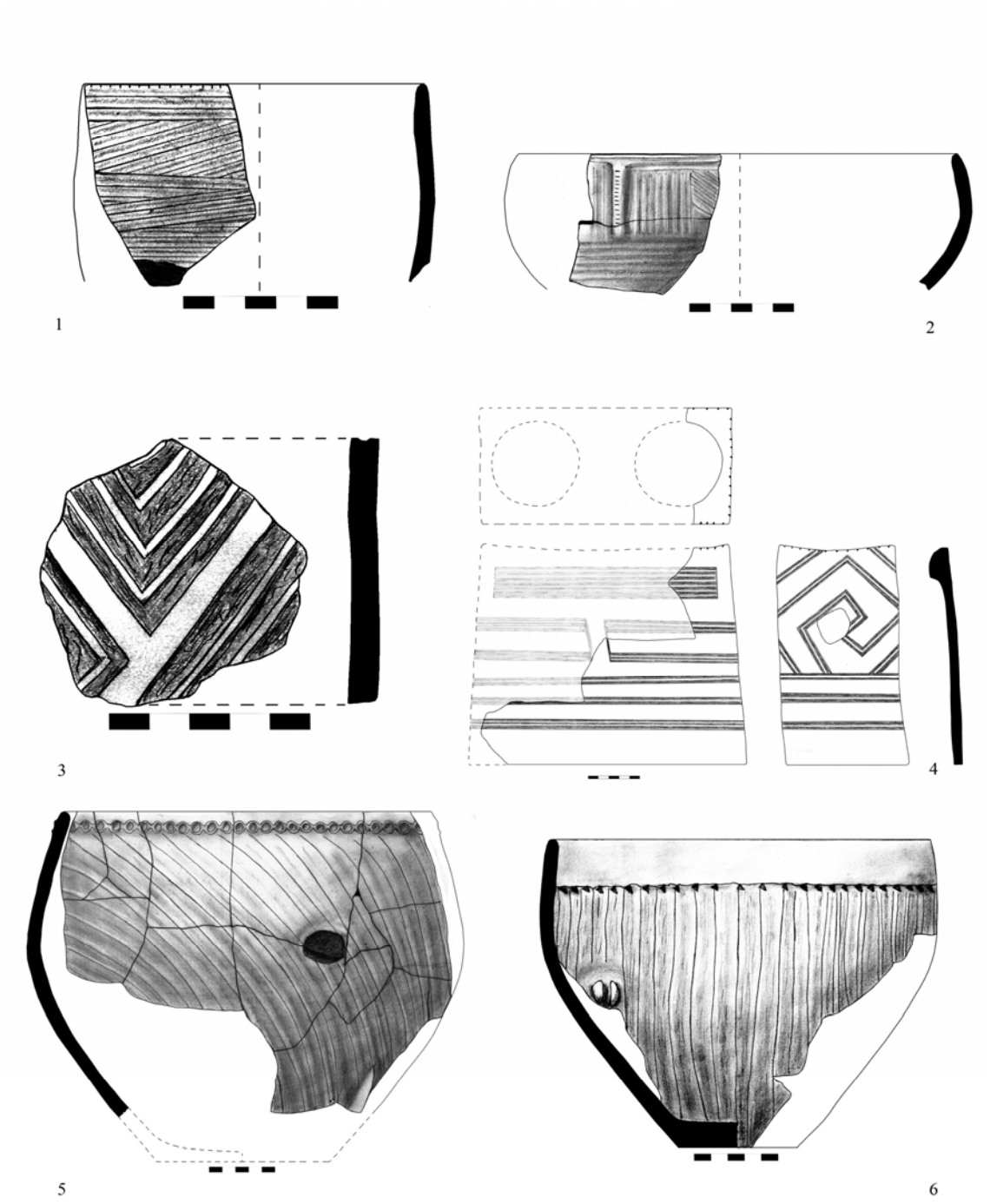

Fig. 2. Boian-Vidra pottery from Sultana. Grooved beaker (1) and bowl (2). Excised decoration on cylindrical vessel (3) and on a parallelepipedic stand. Holemouth pots with barbotine (5, 6) (1, 2, 3, 5 – C20; 4, 6 – C13).
Ceramica Boian-Vidra de la Sultana. Pahar cu caneluri (1) și castron (2). Decor excizat pe un vas cilindric (3) și pe un suport paralelipipedic. Oale cu barbotină (5, 6) (1, 2, 3, 5 – C20; 4, 6 – C13).

Feature C20 is another pit discovered in the trench denoted as Son3/2013 and was partially researched. Altimetry is between 0.83 and 1.63 m compared to the same point "0" mentioned above. The contour of a horizontal plan was impossible to be determined in the field, and its bottom has an irregular shape. The investigated part was filled with sediment (SU 1049) containing various materials (bones, shells, small stones, flint tools, charcoal) including a significant amount of pottery fragments summing up 1308 with a total mass of 20696 g.

Differences of dimensional classes between the minimum and maximum rates are negligible in the lower part of the filling. However, there is an increase of the large pottery fragments in the upper part (tab. 4). The high percentage of small fragments and the rounded edges observed suggest the second deposition for a part of the pottery fragments (M.B. Schiffer 1987).

All the bases discovered had abrasion traces that indicate an intensive use of the vessels before their disposal.

Features	Size (cm)				Total	
	≤2.5	≤5	≤7.5	>7.5	no.	%
C3/2012	36	140	81	36	293	18
C20	296	681	246	85	1308	80.4
C13	1	12	2	11*	26	1.6
Total (no.)	333	833	329	132	1627	100
Total (%)	20.5	51.2	20.2	8.1	100	

Tab. 4. Size distribution of ceramic fragments analyzed from the three assemblages from Sultana (complete profiles were quantified as a single individual).
Distribuția pe clase de dimensiuni a celor trei loturi ceramice de la Sultana (profilele complete au fost considerate ca un singur individ).

◈ 4. The geological framework of Sultana

The local geomorphology framework is composed of two main formations: Mostiştea sands and loess deposits. On the Mostiştea Valley appear the so-called "Mostiştea sands" formed in the Upper Pleistocene, with a thickness of 8-20 m, which is a small and fine, yellowish, sands horizon, infilled with sandstone or calcareous concretions (T. Bandrabur 1966, p. 19). In the Mostiştea, Bărăgan, and Gănvanu Burdea plains these Mostiştea sands support some of loess deposits, consisting of sandy dust, yellowish clay with calcareous concretions, with a thickness of 15-20 m (T. Bandrabur 1966, p. 20). During Holocene, the current meadows were created accumulating deposits with gravel and sand on the base and fine sand and argillaceous sediments on top (C. Ghiță 2008).

◈ 5. The paste analysis

A total of 1678 sherds have been analyzed regarding the paste composition. Inclusions were observed with the aid of a magnifying glass (×2.25) with LEDs white light. Inclusions of calcareous concretions are ubiquitous in Boian-Vidra ceramic paste from Sultana (fig. 3). Their shape is rounded and more rarely, sub-rounded. The frequency of granules is variable, generally between 1% and 5%. The dimensions of this type of inclusions may vary within the paste of the same vessel from 0.1 to 10 mm (fig. 3). Shape, frequency, and size of carbonate

concretions observed indicate their natural character, being the most likely collected with clay that was used for pottery. A sieve (O.S. Rye 1981, p. 31) or the levigation method (P. Quinn 2013, p. 156) could be used to obtain the fine clay for small beakers and cups. Larger granules could be removed by the potters using their hands.

Fig. 3. Sherds from feature C20: paste with fine calcareous inclusions (left) and paste with large calcareous inclusions (right).
Fragmente ceramice din complexul C20: pastă cu incluziuni calcaroase fine (stânga) și pastă cu incluziuni calcaroase mari (dreapta).

Calcareous concretions are a constant presence in the geological deposits near the archaeological site of Sultana. Morphological variability may be due to the use of multiple sources of local clay with slightly different compositions or due to the different methods to prepare the paste recipes. The rounded and sub-rounded shapes of the calcareous inclusions can be the result of the movement of particles in an abrasive environment, like the river valley or more probably washed on secondary valleys by pluvial water. Besides calcareous concretions, other small natural non-plastics were observed, as muscovite and iron oxides. This types of natural inclusions mentioned were identified both in the paste without tempers and in combination with added tempers (grog or/and chaff).

Paste type	C3/2012	C13	C20	Total no.	Total %
Without temper	2	2	210	214	13%
Grog	276	24	1005	1305	81%
Chaff	0	0	93	93	6%

Tab. 5. Distribution of the main types of tempers found in the paste of Boian-Vidra pottery from three features discovered at Sultana.
Distribuția principalelor tipuri de degresanți din ceramica Boian-Vidra din cele trei complexe descoperite la Sultana.

Grog is a type of inclusions intentionally added to pottery paste (O.S. Rye 1981, p. 33) and we refer to it as a temper. In the batch of Boian-Vidra pottery from Sultana grog was observed in 81% of the specimens analyzed (tab. 5). The size varies between 0.1 and 10 mm, and the frequency is high, in some cases up to 40%. Grog granules shape is usually angular.

Another category of temper is represented by vegetal remains denoted here as chaff. This type of temper was visible in the paste of a total of 93 fragments discovered in the pit C20 from the Sultana-*Gheţărie* site (tab. 5). Only a few fragments from the same feature (C20) had both grog and chaff in the paste composition.

◈ 6. Forming sequence

Construction techniques of prehistoric vessels can be identified by remaining marks left on the plastic clay during the making of pots, and on the partially hardened clay on which various operations have been performed (O.S. Rye 1981, p. 58; J. Vuković 2014).

Boian-Vidra vessels from Sultana were all hand manufactured. Constructed shapes vary from small polished beakers to large cylindrical vessels with excised decoration (fig. 5). The horizontal-coils technique is the most frequent and noticeable from the fractures of several fragments (fig. 4). Horizontal fractures mostly occur at joints between different parts of the vessel (feet, lower/upper body, rims). This type of fractures was observed on most types of shapes well represented in the analyzed assemblages and cannot be linked to a particular type of paste or temper.

Fig. 4. Fragments of vessels from feature C20 built using horizontal-coils technique (left) and slabs technique (right) (without scale).
Fragmente de vase din complexul C20, modelate în tehnica colacilor orizontali (stânga) și tehnica plăcilor (dreapta) (fără scară).

Another method observed was the slab technique indicated by laminar fractures (B. Vandiver 1987; J. Vuković 2014), related with open vessels made from coarse paste (fig. 4). Even if the construction of an open vessel using the slabs technique is almost impossible, recent experiments made with Early Eneolithic ceramics discovered in Transylvania (A. Bințințan 2014) showed that the use of slabs in a clay mold is a handy way to build open or closed vessels. In some fragments from Sultana-*Gheţărie* were have seen fractures indicating that both slab and horizontal-coils techniques were used for the modeling of the same vessel. For the small vessels, which do not have traces for the use of coils or slabs, we have considered that their primary forming was realized by pinching or/and drawing a single piece of clay (L. Thissen 2014, p. 99).

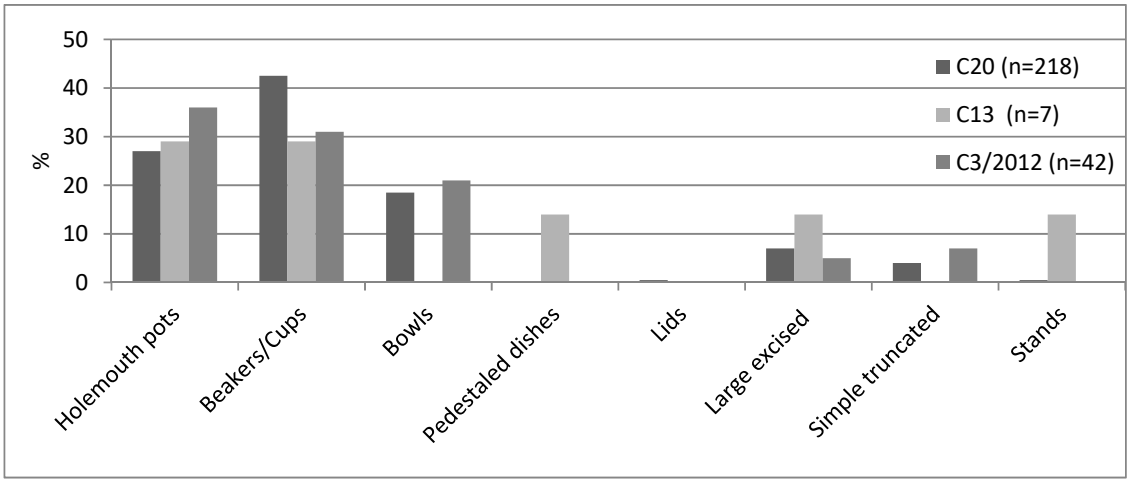

Fig. 5. The distribution of constructed shapes in the Boian-Vidra pottery batches discovered in three features from Sultana.
Distribuția vaselor Boian-Vidra din cele trei complexe de la Sultana, pe categorii de formă.

Besides trained hands, potters have also used tools to create vessels. After partial drying, the thickness of the walls was adjusted as such that some fragments have marks of clay removal, using tools of hard materials for scraping. Based on specific traces remained during the scraping process, we were able to identify the use of hard tools made of vegetal fibers, most probably stalks or wood (fig. 6). Vessels fractured during drying process were subject to repairs. One such case was observed on a highly decorated vessel from the pit C13 at Sultana-*Gheţărie* (fig. 6): a cross fracture on the whole bottom was repaired by addition of a clay coat. The whole operation was not successful, and the fracture has widened after the firing process.

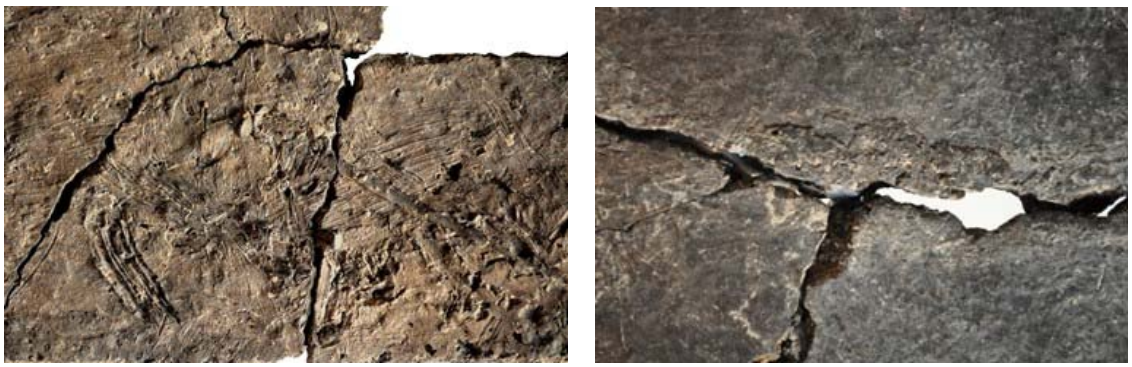

Fig. 6. Traces of a tool made from vegetal fibers on the inside surface of a parallelepiedic stand from feature C13 (left) and the repaired crack on the bottom of a pedestaled dish (right) (without scale).
Urme ale unei unelte din fibre vegetale pe suprafața interioară a unui suport paralelipipedic din complexul C13 (stânga) și reparația unei fracturi pe baza unei străchini cu picior (dreapta) (fără scară).

◈ 7. Surface treatments and decorative styles

The production of Boian pottery was divided into three major categories (D. Berciu 1961, p. 384; E. Comşa 1974, p. 93) characterized not so much of paste, shapes or types of combustion, but primarily by the decorative style seen in relation to the treatment of surfaces. These three associations between the type of surface treatment and decoration are recurring and conspicuous, even if they were rarely quantified in the former studies (L. Thissen 2014). Those three associations are: a) cups and beakers polished on the inside and with *plissé* on the outside (especially on the neck); b) hole-mouth pots well smoothed or even polished on the inside and with rough surfaces or barbotine on the outside; c) large cylindrical and pedestal vessels barely smoothed or scraped on the inside and with excised/incised decoration on the outside, filled with white paste.

A quarter of the total number of shards from Sultana was decorated (fig. 7). In relation to the manufacturing technique we have identified flutes (*plissé*) made by shallow polished carvings, impressions and alveolar girdles performed by pressing by means of objects or fingers, the barbotine accomplished by applying a layer of clay on the outer surface, followed by creating lines with the fingers, and incisions or excisions made with sharp objects.

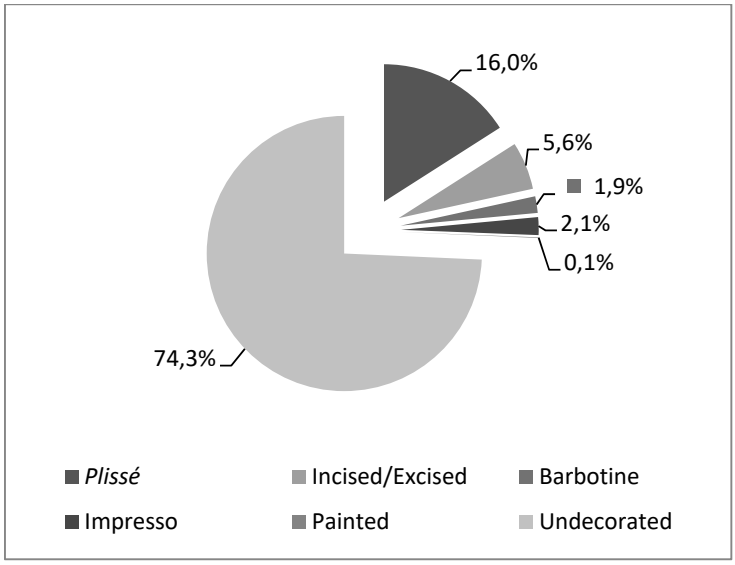

Fig. 7. Distribution of decorative types in the pottery batches from features C13 and C20.
Distribuția pe tipuri decorative a ceramicii din loturile din complexele C13 și C20.

The *plissé* decoration is the most frequent of those batches and is specific for small vessels, such as beakers, cups, and bowls. The flutes are often disposed horizontally on the vessel neck, and vertically, obliquely, or in a *zig-zag*, sometimes covering the whole external surface of the vessel (fig. 2.2). Impressions of the type of successive stitches are very rare; they appear on small vessels and in correlation with flutes decoration. Alveolar girdles are reserved exclusively for hole-mouth pots, being attached below the rim and sometimes followed by a barbotine decoration. The barbotine is poorly represented in all batches and is also specific for hole-mouth pots. Painting with graphite is absent, while the painting with red after firing is present on a single specimen.

The incised decoration was observed on few fragments of bowls, but most often have been observed on fragments from large vessels with the cylindrical body, in correlation with the excised decoration. The encrusted white paste was preserved only on three fragments with the excised decor.

◈ 8. Firing

Until now, at Sultana have not been identified installations for firing Eneolithic pottery. In the whole Boian culture area there are only two pits discovered at Cernica that could be used for burning pottery (F. Tencariu 2015, p. 74-75). In this context and without laboratory analyses, the firing methods can be only presumed based on colors of the cross-section (O.S. Rye 1981, p. 115-117). The inoxidized/reducing firing is most common in the analyzed batches, with a slightly larger share in the feature C3/2012, found in the necropolis area. Fragments from incomplete oxidized vessels are also very common. Fully oxidized and irregular fired shards were very rarely observed (tab. 6, fig. 8).

Features	Reducing/ Unoxidized	Incompletely oxidized	Completely oxidized	Irregularly fired
C 20	609	601	86	12
C 13	10	10	2	2
C3/2012	155	89	34	0*
Total	774	700	122	14

Tab. 6. Distribution of firing categories for pottery from three features from Sultana (* not separately quantified and included in the incompletely oxidized category).
Distribuția pe categorii de ardere a ceramicii din cele trei complexe de la Sultana (*necuantificate separat și incluse în categoria oxidant incomplet).

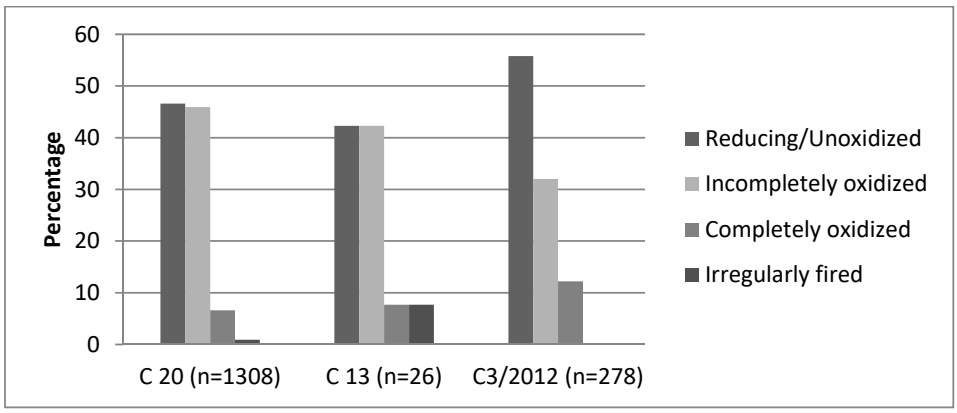

Fig. 8. Graphic display of the percentages of firing categories for the pottery batches from three features from Sultana.
Reprezentare grafică a procentajelor categoriilor de ardere a ceramicii din cele trei complexe de la Sultana.

The abundance of calcareous concretions and the absence of lime spalling can be interpreted as a clue for a firing temperature below 800° C, but only for the oxidized pottery (M. Tite 1972). Regardless the firing temperature, the lime spalling reaction is not expected to be observed on pottery fired in reducing conditions (R. Leicht 1977). Microscopically observations made on Boian pottery samples from different sites and cultural phases indicated temperatures of firing between 500° C and 700° C (E. Stoicovici 1974; 1990).

◈ 9. Discussions and conclusions

The Boian-Vidra pottery from Sultana was most probably made with local clays that contain calcareous concretions. The paste recipes were prepared according to the shape and size of the future vessel. For most of the small vessels, such as beakers and cups, the clay was used without the adding of any temper. For the medium and large vessels, the paste was tempered mostly often with grog, and only a small percent from feature C20 were tempered with chaff. This kind of temper was not observed in the two other pottery batches from pit C13 and C3/2012. If we correlate this information with the ^{14}C dates obtained from features C20 and C13 (tab. 1), one can make the supposition that chaff was rarely used as temper only in the early stages of making Boian-Vidra pottery at Sultana, while after few generations the only temper used was grog. There were two primary forming techniques observed: horizontal-coils and slab building (probably in a mold). Secondary forming implied the adjusting of the walls thickness by scraping with tools made of vegetal fibers and was followed by the treatment of the surfaces by smoothing, polishing or excising according to the vessel shape and destination. In the case of large excised vessels, a fine coat of clay (1-2 mm thick) was added to the external surface. The black pottery was fired in a controlled atmosphere where the access of the oxygen could be stopped, probably in firing installations as pits. The oxidized pottery was most often incomplete fired. After the firing process, excised vessels were subject to decoration with white pigment encrusted in the excisions and in one case the surfaces of a parallelepiped shape stand were partially covered with a red pigment.

The technological observations made on the Boian-Vidra pottery from Sultana are of interest at a macro-regional scale, some of them representing significant transformations from the Late Neolithic to the Early Eneolithic period in the Lower Danube region. The most remarkable change is the gradual replacement of organic tempers with mineral ones based mostly on crushed pottery (grog) (E. Comșa 1974, p. 107). These two categories of tempers have different effects on vessels properties (J. Skibo *et alii* 1989; J. Skibo 2013) and therefore some different needs in pottery function can be presumed, probably linked with new culinary behaviors. Also, the rise of grog as predominant temper was made simultaneous with the first development of *tell*-type settlements in the Romanian Plain. As a cultural choice, grog is a re-used material that may be understood as a way of maintaining continuity (A. Kreiter 2007, p. 130).

Regarding the forming sequence, the slab technique observed at Sultana is not mentioned until now in the former studies that refer to the manufacture of Boian-Vidra pottery (E. Comșa 1974, p. 107; V. Opriș *et alii* 2012, p. 66; C.E. Ștefan 2014). Nevertheless, close inspections of breakage patterns, made on Late Vinča pottery from Vinča mound (J. Vuković 2014) and another study made on Boian-Spanțov pottery from Nanov-Vistireasa (V. Opriș, C.E. Ștefan 2016), led to specific identification of slab technique as manufacturing method for Early Eneolithic pottery in the region.

Percentage of incised/excised decoration from Boian-Vidra ceramic batches from pits C20 and C13 from Sultana-*Ghețărie* (5.6%) is almost identical to that of II-III levels of the site

from Polyanitsa, Bulgaria, estimated at 5% (H. Todorova 1978, p. 34). The excised decoration was considered specific for the pottery from the Early Eneolithic communities in the Lower Danube area (S. Pandrea 2000), but quantitative analyses show that this type has a very low representation within the pottery production.

The radiocarbon dates from Sultana are noteworthy in the big picture of the absolute chronology of Early Eneolithic at the Lower Danube. Firstly, because these are the first Boian-Vidra published dates at the moment. Secondly, because they are overlapping the postulated timespan of Boian-Spaţov phase (S. Bréhard, A. Bălăşescu 2012, tab. 1).

In a classic manner, this situation can be explained by the maintained regional differences in contemporaneous pottery production sites. Therefore, the successions of Boian culture phases, defined on ceramic typology, were not the same over a vast area. A long tradition of about 500 years of Boian-Giulești pottery was already proved in the Northeast of Romanian Plain (S. Pandrea 1999). It can also be the case with the Boian-Vidra pottery at Sultana, a site where the last phase of Boian culture (according to pottery typology) was not identified. Certainly, the validation of this assumption can be done if we deliberately accept the cultural-historical constructions.

However, the things have moved forward and currently the available data is more numerous than pottery fragments selected from specific contexts in order to define cultural phases. Thus, recent aDNA analyses have demonstrated that the Boian and Gumelnița populations have similar genetic features[2], due to a common origin in Southwestern Anatolia from where they arrived in the Balkans after a slow migration process (M. Hervella *et alii* 2015). Under these circumstances, new questions arise in connection with the material culture of those past populations (including pottery) demonstrating that a new type of approach is required.

The situation identified at Sultana, based on pottery technological characteristics correlated with radiocarbon dates, can prove that the so-called Spanțov phase reflects a development of ceramic technology/fashion, visible only in certain communities (sites). At the level of classical interpretation these changes (e.g., the appearance of the new pottery styles) were seen as specific features of a different culture (Gumelnița in the present case). This process of pottery development was identified in some tell settlements from Romania and Bulgaria (e.g., Ovcharovo, Radovanu or Vlădicească) dated in the 5th millennium BC (H. Todorova *et alii* 1983; E. Comșa 1990; D. Șerbănescu 2013), but unfortunately, very poorly explained and interpreted. In fact, the pottery realities regarding this situation were also observed by some cultural-historical archaeologists, which motivated them to discuss the *Boian-Gumelnița ceramic complex* (V. Dumitrescu *et alii* 1983) or the *transition phase from Boian to Gumelnița* (E. Comșa 1990).

Under these conditions, the in-depth study of ceramics at the technological level, correlated with other interdisciplinary data, can be a viable tool for redesigning the interpretations of the past, to overcome previous tendencies limited only to the definition of cultures and cultural phases.

[2] This paleogenomic study included samples from individuals in the Sultana-Malu Roșu cemetery (*Necropolis I* – both Boian and Gumelnița), Sultana-Valea Orbului cemetery (Boian), and Vărăști cemetery (Gumelnița), and its results have been confirmed by a recent study on the aDNA of the Neolithic and Eneolithic populations in Southeast Europe, made on the largest batch of skeletons in the area (I. Mathieson *et alii* 2018).

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◈ References

R. Adreescu, C. Lazăr 2008	Valea Mostiştei. Aşezarea gumelniţeană de la Sultana *Malu Roşu*, *CA*, XIV-XV, p. 55-76.
A. van As *et alii* 2006	A. van As, L. Jacobs, L. Thissen, Preliminary data on Boian and Gumelniţa pottery from Teleor 008 and Măgura-Bran respectively, Teleorman River Valley, Southern Romania, *Leiden Journal of Archaeological Ceramic Studies*, 22, p. 137-147.
D.W. Bailey *et alii* 2002	D.W. Bailey, R. Andreescu, A. Howard, M. Macklin, S. Mills, Alluvial landscapes in the temperate Balkan Neolithic: transition to tells, *Antiquity*, 76, p. 349-55.
T. Bandrabur 1966	București, L-35-XXXIII (Notă explicativă), *Harta Geologică a României*, Scara 1:20000, București.
C. Bem 2001	Noi propuneri pentru o schiță cronologică a eneoliticului românesc, *Pontica*, 33-34 (2000-2001), p. 25-122.
D. Berciu 1961	*Contribuţii la problemele neoliticului în România în lumina noilor cercetări*, Editura Academiei Republicii Populare România, Bucureşti.
A. Binținţan 2014	Arheologie experimentală. Arderea în instalație verticală – o altă posibilă modalitate de obținere a efectului cromatic *black-topped*, *Buletinul Cercurilor Ştiinţifice Studenţeşti*, 20, p. 5-16.
S. Bréhard, A. Bălăşescu 2012	What's behind the tell phenomenon? An archaeozoological approach of Eneolithic sites in Romania, *Journal of Archaeological Science*, 39(10), p. 3167–3183.
C. Bronk Ramsey 2017	Methods for Summarizing Radiocarbon Datasets, *Radiocarbon* 59(2), p. 1809-1833.
V. Christescu 1925	Les stations préhistoriques du lac de Boian, *Dacia*, 2, p. 249–276.
E. Comșa 1954	Consideraţii cu privire la evoluţia culturii Boian, *SCIV*, 5, 3–4, p. 361–392.
E. Comşa 1974	*Istoria comunităţilor culturii Boian*, Editura Academiei Republicii Socialiste România, Bucureşti.
E. Comșa 1990	*Complexul neolitic de la Radovanu*, CCDJ, VIII, 126 p.

Vl. Dumitrescu 1973	În legătură cu o nouă sinteză despre neo-eneoliticul sud-est și central-est-european, *Mem. Ant.*, 4-5 (1972-1973), p. 25-47.
Vl. Dumitrescu *et alii* 1983	Vl. Dumitrescu, A. Bolomey, F. Mogoșanu, *Esquisse d'une préhistoire de la Roumanie jusqu'à la fin de l'âge du bronze*, Editura Stiințifică și Enciclopedică, București.
C. Ghiță 2008	The microrelief as result of morphohydroclimatic conditions in Mostiștea river basin, *Revista de geomorfologie*, 10, p. 103-111.
P. Hașotti 1997	*Epoca eneolitică în Dobrogea,* Biblioteca Tomitană I, Editura Ex Ponto, Constanţa.
M. Hervella *et alii* 2015	M. Hervella, M. Rotea, N. Izagirre, M. Constantinescu, S. Alonso M. Ioana, C. Lazar, F. Ridichie, A. D. Soficaru, M. G. Netea, C. de-la-Rua, Ancient DNA from South-East Europe Reveals Different Events during Early and Middle Neolithic Influencing the European Genetic Heritage, *PLoS ONE*, 10 (6), e0128810. docaradi:10.1371/journal.pone.0128810.
A. Kreiter 2007	*Technological Choises and Material Meanings in Early and Middle Bronze Age Hungary*, BAR (IS), 1604, Oxford.
C. Lazăr *et alii* 2012	C. Lazăr, M. Voicu, G. Vasile, Traditions, Rules and Exceptions in the Eneolithic Cemetery from Sultana-Malu Roşu (Southeast Romania), in R. Kogalniceanu, R. Curca, M. Gligor, S. Stratton (eds.), *Homines, Funera, Astra. Proceedings of the International Symposium on Funerary Anthropology, June 5-8, 2011, Alba Iulia*, BAR (IS), 2410, Archaeopress, Oxford, p. 107-118.
R. Leicht 1977	Calcium Carbonate Inclusions In Pottery: Some Cautions For The Archaeologist, *Transactions of the Nebraska Academy of Sciences and Affiliated Societies*, Paper 428, p. 1-3.
C. Micu 1999	Ceramica fazei Boian-Spanţov din aşezarea de la Isaccea-Suhat, *Pontica*, 32, p. 235-242.
M. Neagu 2003	*Neoliticul mijlociu la Dunărea de Jos. Cu privire specială asupra centrului Munteniei*, CCDJ, XX, Editura Daim, Călăraşi.
V. Opriş *et alii* 2012	V. Opriş, A. Bălăşescu, C. Lazăr, Consideraţii privind un complex aparţinând culturii Boian descoperit în necropola de la Sultana-Malu Roşu, jud. Călăraşi, *SP*, 10, p. 61-84.
V. Opriș, C. Lazăr 2014	Notă privind un suport specific culturii Boian, faza Vidra, descoperit la Sultana-*Gheţărie*, *CA*, XXI, p. 371-384.
V. Opriș, C. Lazăr 2015	Suporturile paralelipipedice din eneoliticul timpuriu de la Dunărea de Jos, *BMJT*, 7, p. 67-84.

I. Mathieson *et alii* 2018 — I. Mathieson, S. Alpaslan Roodenberg, C. Posth, A. Szécsényi-Nagy, N. Rohland, S. Mallick, I. Olalde, N. Broomandkhoshbacht, O. Cheronet, D. Fernandes, M. Ferry, B. Gamarra, G. González Fortes, W. Haak, E. Harney, B. Krause-Kyora, I. Kucukkalipci, M. Michel, A. Mittnik, K. Nägele, M. Novak, J. Oppenheimer, N. Patterson, S. Pfrengle, K. Sirak, K. Stewardson, S. Vai, S. Alexandrov, K.W. Alt, R. Andreescu, D. Antonović, A. Ash, N. Atanassova, K. Bacvarov, M.B. Gusztáv, H. Bocherens, M. Bolus, A. Boroneanţ, Y. Boyadzhiev, A. Budnik, J. Burmaz, S. Chohadzhiev, N.J. Conard, R. Cottiaux, M. Čuka, C. Cupillard, D. G. Drucker, N. Elenski, M. Francken, B. Galabova, G. Ganetovski, B. Gely, T. Hajdu, V. Handzhyiska, K. Harvati, T. Higham, S. Iliev, I. Janković, I. Karavanić, D.J. Kennett, D. Komšo, A. Kozak, D. Labuda, M. Lari, C. Lazar, M. Leppek, K. Leshtakov, D. Lo Vetro, D. Los, I. Lozanov, M. Malina, F. Martini, K. McSweeney, H. Heller, M. Menđušić, P. Mirea, V. Moiseyev, V. Petrova, T.D. Price, A. Simalcsik, L. Sineo, M. Šlaus, V. Slavchev, P. Stanev, A. Starović, T. Szeniczey, S. Talamo, M. Teschler-Nicola, C. Thevenet, I. Valchev, F. Valentin, S. Vasilyev, F. Veljanovska, S. Venelinova, E. Veselovskaya, B. Viola, C. Virag, J. Zaninović, S. Zäuner, P.W. Stockhammer, G. Catalano, R. Krauß, D. Caramelli, G. Zariņa, B. Gaydarska, M. Lillie, A.G. Nikitin, I. Potekhina, A. Papathanasiou, D. Borić, C. Bonsall, J. Krause, R. Pinhasi, D. Reich, The Genomic History Of Southeastern Europe, *Nature*, 555, p. 197-203.

V. Opriș, C.E. Ștefan 2016 — The Boian-Spanțov pottery from two pits researched at Nanov-*Vistireasa 3* (co. Teleorman), *BMJT*, 8, p. 33-57.

S. Pandrea 1999 — Observații referitoare la evoluția culturii Boian în nord-estul Câmpiei Române, *Istros*, IX, p. 13-46.

S. Pandrea 2000 — Câteva observații referitoare la periodizarea culturii Boian, *Istros*, X, p. 35-70.

P. Quinn 2013 — *Ceramic petrology. The interpretation of archaeological pottery&related artefacts in thin section*, Archaeopress, Oxford.

P.J. Reimer *et alii* 2013 — P.J. Reimer, E. Bard, A. Bayliss, J.W. Beck, P.G. Blackwell, C. Bronk Ramsey, P.M. Grootes, T.P. Guilderson, H. Haflidason, I. Hajdas, C. Hatt, T.J. Heaton, D.L. Hoffmann, A.G. Hogg, K.A. Hughen, K.F. Kaiser, B. Kromer, S.W. Manning, M. Niu, R.W. Reimer, D.A. Richards, E.M. Scott, J.R. Southon, R.A. Staff, C.S.M. Turney, J. van der Plicht, IntCal13 and Marine13 Radiocarbon Age Calibration Curves 0-50,000 Years cal BP, *Radiocarbon*, 55(4).

D.V. Rosetti 1934 — Săpăturile de la Vidra – raport preliminar, *PMMB*, 1, p. 6-65.

O.S. Rye 1981 — *Pottery technology. Principles and reconstruction*, Manuals on archaeology 4, Taraxacum, Washington DC.

M.B. Schiffer 1987 — *Formation processes of the archaeological record*, University of Utah Press, Salt Lake City.

J. Skibo 2013 — *Understanding pottery function*, Springer, New York.

J. Skibo *et alii* 1989 — J. Skibo, M.B. Schiffer, C. R. Kenneth, Organic-Tempered Pottery: An Experimental Study, *American Antiquity*, 54(1), p. 122-146.

E. Stoicovici 1974 — Analiza mineralogică a unor fragmente ceramice de tip Boian, in E. Comşa (ed.), *Istoria comunităților culturii Boian*, Editura Academiei Republicii Socialiste România, București, p. 259-260.

E. Stoicovici 1990 — Analiza mineralogică a unor fragmente ceramice de tip Boian, *CCDJ*, VIII, p. 120-121.

D. Șerbănescu, G. Trohani 1978 — Cercetările arheologice pe Valea Mostiştea, in V. Vrabie (ed.), *Ilfov. File de Istorie, București*, p. 18-32.

D. Șerbănescu 2013 — Research on the Eneolithic Tell of Vlădiceasca, Călărași County - Romania, in A. Comșa, C. Bonsall, L. Nikolova (eds.), *Facets of the past: the Challenge of the Balkan Neo-Eneolithic: Proceedings of the international symposium celebrating the 85th birth anniversary of Eugen Comşa*, The Publishing House of the Romanian Academy, Bucharest, p. 312-335.

C.E. Ștefan 2014 — Câteva date despre locuirea de tip Boian-Vidra de la Radovanu – La Muscalu, jud. Călărași, *Analele Banatului, S.N.,* XXII, p. 155-163.

F. Tencariu 2015 — *Instalații de ardere a ceramicii în civilizațiile pre- și protoistorice de pe teritoriul României*, Editura Universității „Al. I. Cuza", Iași.

L. Thissen 2014 — Boian period ceramics from Teleor 008, a site in South of Romania, *SP,* 11, p. 97-113.

M. Tite 1972 — *Methods of physical examination in archaeology*. Seminar Press, New York.

H. Todorova 1978 — *The Eneolithic Period in Bulgaria in the Fifth Millennium B.C.*, Oxford, *BAR*, Supplementary series, 49.

H. Todorova *et alii* 1983 — H. Todorova, V. Vasilev, Z. Janusevic, M. Kovacheva, P. Valev, P., *Ovcharovo*, Razkopki i Prouchvania IX, Sofia: Bulgarskata Akademiya na Naukite.

B. Vandiver 1987 — Sequential Slab Construction; A Conservative Southwest Asiatic Ceramic Tradition, ca. 7000-3000 BC, *Paléorient*, 13, p. 9-35.

J. Vuković 2014 — Archaeological evidence of pottery forming sequence: traces of manufacture in late neolithic Vinča assemblage, in S. Vitezović and D. Antonović (eds.), *Archaeotechnology. Studying technology from prehistory to the Middle Ages*, Srpsko arheološko društvo, Belgrade, p. 177-198.