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NEW EVIDENCE FOR PREHISTORIC COPPER METALLURGY IN THE VICINITY OF BOR*

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Abstract. – The last three years of archaeological investigations at the site Ružana in Banjsko Polje, in the immediate vicinity of Bor, have provided new evidence regarding the role of non-ferrous metallurgy in the economy of the prehistoric communities of north-eastern Serbia. The remains of metallurgical furnaces and a large amount of metallic slags at two neighbouring sites in the mentioned settlement reveal that locations with many installations for the thermal processing of copper ore existed in the Bronze Age. We believe, judging by the finds of material culture, that metallurgical activities in this area also continued into the Iron Age and, possibly, into the 4th century AD.

Key words. – Bronze Age, Iron Age, copper metallurgy, metallic slags.

The first steps in the field of modern investigations of archaeometallurgy in eastern Serbia were made at the end of 1960s, when the earliest copper mine in this part of Europe was discovered. It could be concluded, on the basis of relevant absolute dates from the site of Dnevni Kop at Rudna Glava, near Majdanpek, that organised exploitation of raw mineral materials commenced during the Vinča B phase, i.e. in the second half of the 6th and the first half of the 5th millennium BC (5400–5300/4650).² However, despite irrefutable evidence for prehistoric mining, with evidence of metallurgy at Pločnik and Belovode,³ actual finds of installations used in the process of copper ore smelting are still missing.

Archaeological investigations of prehistoric sites in north-eastern Serbia in the 1980s and 1990s were mostly aimed at the investigation of settlements and

necropolises from the Copper and Bronze Age. At almost all of them groups of finds have been encountered which, in one way or another, could be related to metallurgical processes. This mainly concerns Zlotska Pećina and Čoka lu Balaš, which date from the Middle and Late Eneolithic (Bubanj–Salcuța and Coțofeni–Kostolac).⁴ Certain amounts of metallic slags were

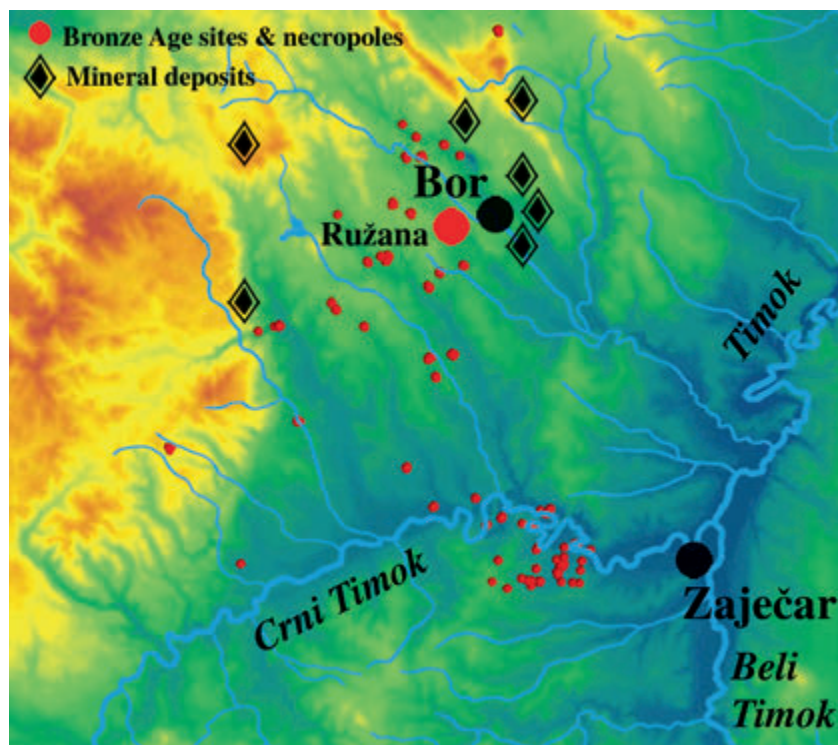
¹ We dedicate this treatise to the memory of our late colleague Borislav Jovanović who always had time to offer his help and support in the struggle with problems connected with studies in the field of archaeometallurgy.

² Borić 2009, 205.

³ Шљивар, Кузмановић-Цветковић 1997, 107; Šljivar et al. 2006.

⁴ Тастић 1990; *Ibid.* 1990a; *Ibid* 1995, 172.

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Map 1. Distribution of the Bronze Age sites between Bor and Zaječar

Карта 1. Дистрибуција локалитета из бронзане доба између Бора и Зajeчара

discovered in Zlotska Pećina, but, due to the disturbed stratigraphy, it was not possible to associate them stratigraphically to a distinct cultural horizon at this multi-cultural site,⁵ while at the site of Čoka lu Balaš pottery “pipes”, assumed to have been used for injecting fresh air in the metallurgical furnaces, were discovered,⁶ as well as pottery with traces of metallic slags.

In the last three decades, the collaboration between the Institute of Archaeology in Belgrade and the Museum of Mining and Metallurgy in Bor has resulted in the discovery of a certain number of settlements and necropolises in the immediate vicinity of Bor, dating from the Bronze Age.⁷ After the most recent site survey and small-scale systematic excavations we have recorded 20 settlements and 4 necropolises in total (Map I). Metallic slags coming from most of these sites and samples from ore deposits have been analysed by experts from the Mining Institute and Technical Faculty in Bor in a few articles, which corroborate the claim regarding the existence of metallurgical activities in the Middle and Late Bronze Age communities of this region.⁸

Metallic slags discovered in the cultural layers and on house floors (Trnjane) were also found in stone funerary structures as well as on the bones of deceased persons (Borsko Jezero and Hajdučka Česma).⁹

RESULTS OF ARCHAEOLOGICAL INVESTIGATIONS

The discovery of the new Bronze Age site in the vicinity of Bor happened by chance when Damnjan and Radovan Vasić discovered a rather large quantity of prehistoric pottery and slag while constructing foundations in their garden at Banjsko Polje, in 2013. It is not very often the case that archaeologists are fortunate enough to be summoned by the owners of an estate where a site has been discovered and even to be offered all the necessary help.¹⁰ It could easily be said that the investigation of that rare find of a prehistoric metallur-

⁵ Kapuran i dr. 2014, 123–143.

⁶ Tylecote 1987, Fig. 4.15.

⁷ Tasić 1995, 172; Kapuran 2014, Map. 13; Kapuran i dr. 2014, Map 4.

⁸ Bugarški et al. 1980; Bugarški et al. 1982; Bugarški, Živković 1984–1986; Krajčinović et al. 1995; Janković et al. 1987–1990.

⁹ Jovanović, Janković 1987–1990, 1; Kapuran, Mиладиновић-Радмиловић 2011.

¹⁰ Investigations were carried out by The Museum of Mining and Metallurgy in Bor in cooperation with The Institute of Archaeology in Belgrade. Members of the team were I. Jovanović, M. Jovčić and A. Kapuran.



Fig. 1. Banjsko Polje, position of the Ružana 1 and Ružana 2 sites

Сл. 1. Бањско Поље, позиције локалитетна Ружана 1 и Ружана 2

gical installation was realised mostly thanks to the Vasić family and the understanding of the Bor municipality.¹¹ An identical situation arose once again after the second year of investigations at Banjsko Polje, when the architect Sladjan Jorgovanović invited archaeologists to explore the grounds of his family house, around 100 meters from the Vasić estate. On that occasion the remains of yet another metallurgical structure were encountered (fig. 1). The analyses of the topography and stratigraphic situation made possible a more precise reconstruction of the metallurgical complex, which existed in the Bronze Age on the south-eastern fringes of Banjsko Polje.

Ružana is the name of a brook flowing some 1000 meters eastward of the site, and it empties into the Brestovačka river a short distance further on. Ružana, in the Wallachian language, means, among other things, “rust” and it could indicate that large quantities of slag with a considerable amount of iron oxide, which is characteristic of the Bronze Age, could have been found on its banks in the distant past. The topography of Banjsko Polje reveals that, in the very centre of the settlement, there is a natural elevation with a levelled

top, where fragments of antique and prehistoric pottery can be found, even today. Such a position and the discovery of prehistoric pottery suggest, with some certainty, that there was a prehistoric settlement of the hill fort type. Such settlements are, however, not frequent in the region of north-eastern Serbia. This elevation has only been surveyed so far and planned future archaeological investigations should confirm whether there are grounds for further assumptions regarding the hill fort settlement. In case that such a hill fort settlement had existed, it would be justified to claim that metallurgical activities took place outside the fort, i.e., on the steep right bank of the dried up brook flowing at its foothill. Eibner thinks that copper smelteries in prehistory were usually situated on land with a stepped relief structure, near a waterway, with deposits of good quality clay and areas suitable for the production of charcoal.¹²

¹¹ Kapuran, Jovanović 2013.

¹² Eibner 1982, 404.

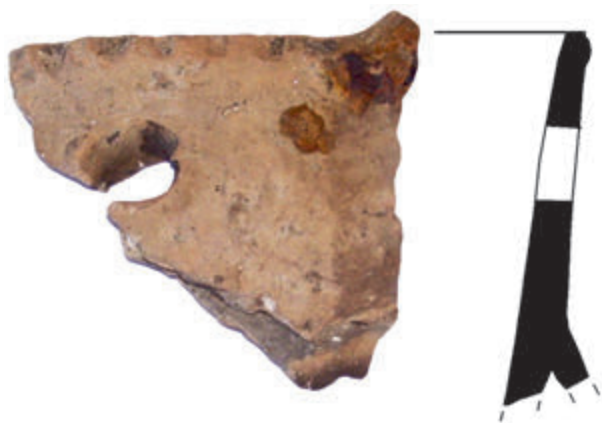


Fig. 2. Pyraunos with traces of the slag

Сл. 2. Фрагмент пирауна са остацима металног шљака



Fig. 3. Slag from slagpit in Trench 3

Сл. 3. Шљака из шљаконишта у сонду 3

Ružana 1, as the site at the Vasić family estate was called, had been investigated in 2013 and 2014, during three investigation campaigns (fig. 1). The problem was the fact that, after every stage of excavation, the investigated area had to be backfilled. As the investigated area expanded after each new campaign it resulted in the formation of a final picture of the metallurgical structure in the three segments. Investigations at Ružana 1 yielded a rather small quantity of finds from the Late Roman time (4th century AD) and Late Iron Age (La Tène) and more finds from the Early Iron Age (Zlot group and Basarabi) and Middle/Late Bronze Age (Paraćin culture/Verbicioara).¹³

The stratigraphy of the site is the consequence of the natural slope of the land from west to east, resulting in a secondary accumulation of finds which came from the mentioned elevated area in the centre of Banjsko Polje (fig. 7a). The stratigraphy consists of one older intact layer and two later cultural horizons (fig. 4). A considerable quantity of material from the Late Roman times (very small fragments of the wheel-made pottery and a few bronze coins, one of which was minted in the time of Licinius) was recorded in a horizon immediately below the surface, while pottery finds from the Early Iron Age (in fact in the same proportion as the pottery from the Bronze Age) prevailed in the lower cultural layer. The only undisturbed cultural layer was on top of the virgin soil, where large fragments of pottery exclusively of the Bronze Age date, a rather small amount of animal bones and a large quantity of metallic slag were encountered. The greatest slag concentration (over 10 kg) was lying *in situ* at the lowest points of the excavated area. All three cultural layers yielded,

more or less, metallic slag and fragments of mudhouse rubble and furnace walls. Characteristic of those finds is that they were exposed to high temperature (they are of a hard structure and compact) and certain round moulded pieces, whose edges were sintered as a result of very high temperature, might have been fragments of the furnace opening. The total investigated surface is 39 square meters and consists of three entities, the upper platform, the lower platform and the steep slope between them (figs. 6 and 7a). The metallurgical structure consists of a furnace floor of an approximately horseshoe shape (burnt soil with traces of intensive fire) and, at its foot, slag deposit, which is located opposite the assumed furnace opening (figs. 6 and 7b). The re-

¹³ The problem of the cultural determination of the Bronze Age communities in the Timok basin dates from the 1980s and 1990s when disagreements arose concerning the origin of prehistoric cultures inhabiting the middle Crni Timok basin. While B. Jovanović attributed settlements and necropoleis in the vicinity of Bor to the Paraćin culture, D. Srejskić and M. Lazić, after investigations at Magura and Banjska Stena near Gamzigrad, came to the conclusion that it is an original cultural phenomenon, which they identified as Gamzigrad culture. We are of the opinion that without a series of absolute dates from the sites in the vicinity of Zaječar and Bor, more detailed anthropological analyses of cremated individuals and an insight into all aspects of material culture and mortuary rituals, as well as the complete publishing of the results of the systematic investigations from the recent past, neither of the suggested solutions should be rejected. Jovanović, Janković 1987–1990; Срејковић, Лазич 1997; Лазич 1998; Капуран 2010.

¹⁴ Jovanović, Janković 1987–1990, 1.

¹⁵ Булатовић и др. 2011.

¹⁶ Капуран 2013.

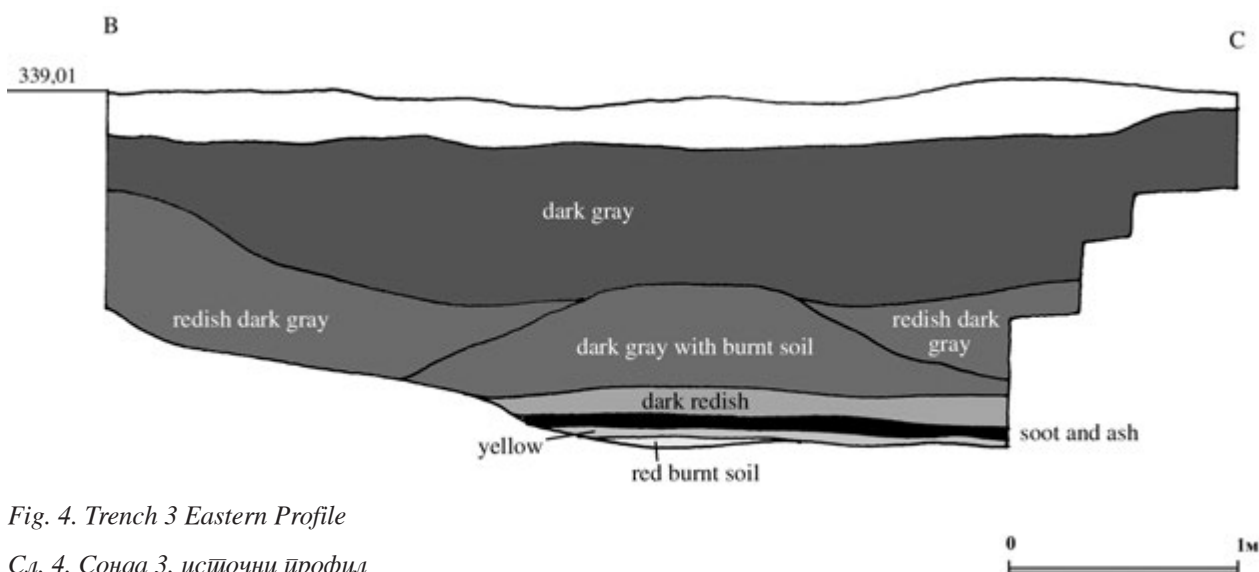


Fig. 4. Trench 3 Eastern Profile

Сл. 4. Сонда 3, источни профил

covered furnace segment is around 1 metre long, its opening is facing north and its walls are encountered only at the foundation level, because all the surrounding area had been exposed to strong erosion. Fragmented animal bones that are assumed, judging by their light blue colour and fissures, to have been exposed to exceptionally high temperatures, over 1,000 degrees C, were discovered *in situ* on the furnace floor. Scattered pottery vessels which, according to their shape and decoration, date from the Bronze Age, were discovered all over the area surrounding the furnace floor. Particularly interesting among them is one biconical beaker with a strap handle (Plate 2/7). A considerable portion of the Bronze Age pottery assemblage consists of fragments of cooking vessels, double vessels with openings for the inflow of air (pyraunos), for which B. Jovanović and N. Janković assumed played a part in the process of heating ore.¹⁴ Metallic slag with a high concentration of iron oxide was found attached to one fragment of the pyraunos rim (fig. 2).

The chronologically latest pottery discovered at the site of Ružana 1 included wheel-made vessels, some of which were decorated with wavy lines and dated to the Late Roman period (Plate 1/1), situla-type pots with combed ornamentation characteristic of the Late Iron Age (Plate 1/2)¹⁵ and thickened rims of rather large vessels decorated with engraved cross-like motifs that are, in eastern Serbia, related to the Zlot group (Plate 1/3, 4).¹⁶ The Early Iron Age is represented by channelled bowls with inverted or everted rims, beakers, pots and amphorae decorated with a series of “S” stamps, pseudo-cord ornamentation and white encrustation

(Plate 1/5–12) that have their closest analogies in the Basarabi culture group. Finds from the Bronze Age reveal characteristics of the Paraćin group with certain elements of the Verbicioara and Vatin group. These are mostly conical bowls with slanting everted rims decorated with horn-like appliqués (Plate 2/1–3), biconical pots and beakers with wide strap handles, some of which are decorated with protomes (Plate 2/6,7). Vessels for



Fig. 5. Animal bones coloured in malachite green

Сл. 5. Живошњске кости обојене зеленом бојом малахита

food storage are rather large-size pots and pithoi with a more or less pronounced “S” profile and decorated with applied bands with engravings and impressed ornaments (Plate 3). There were many vessels of the pyraunos type, which have already been mentioned (Plate 4).

As already highlighted, lumps of metallic slag were recorded in all three cultural horizons, but were of a smaller size in the upper accumulated horizons, while for the undisturbed Bronze Age horizon there are characteristically larger pieces, some weighing up to 3 kg (fig. 3). The shapes of the slag lumps are different as a result of there being amorphous slag, bowl slag (fig. 3) and tap slag.¹⁷ The greatest concentration of slag was lying on the floor of the lower platform, directly on top of the layer of red-burnt soil with large quantities of soot and ash, so it is most logical to assume that it was slag deposit (fig. 7). This deposit of slag, ash and soot was recorded in the east profile of trench 3 as a small protrusion of grey-brown earth with the addition of red-fired soil and with secondary deposits of pottery and animal bones (fig. 4). Particularly interesting was the green colour on animal bones discovered in this

deposit. These osteological finds have been examined so far by zooarchaeologists in order to determine the animal species, but functional analyses have not yet been performed in order to confirm or refute their role in the metallurgical process (cutting up the ore, slag etc.) (fig. 5). Preliminary zooarchaeological analysis of the bones from the slag deposit reveals that the animals in question are deer and roebuck. Also identified were bones of domesticated animals such as cattle, pig, sheep or goat.¹⁸ The raising of pigs particularly speaks in favour of the fact that metallurgical communities in the vicinity of Bor in the Bronze Age were of a sedentary character, considering that pig raising does not imply seasonal migrations.¹⁹

Rather interesting among other finds which could be associated with the process of metallurgy is the large quantity of small stone objects, which could fit into the hand and, at first glance, resemble pounders.²⁰ Although they are heavily damaged in most cases, we cannot be certain that they played any part in the metallurgy process before functional analysis has been performed. Besides the mentioned stones, many fragment-

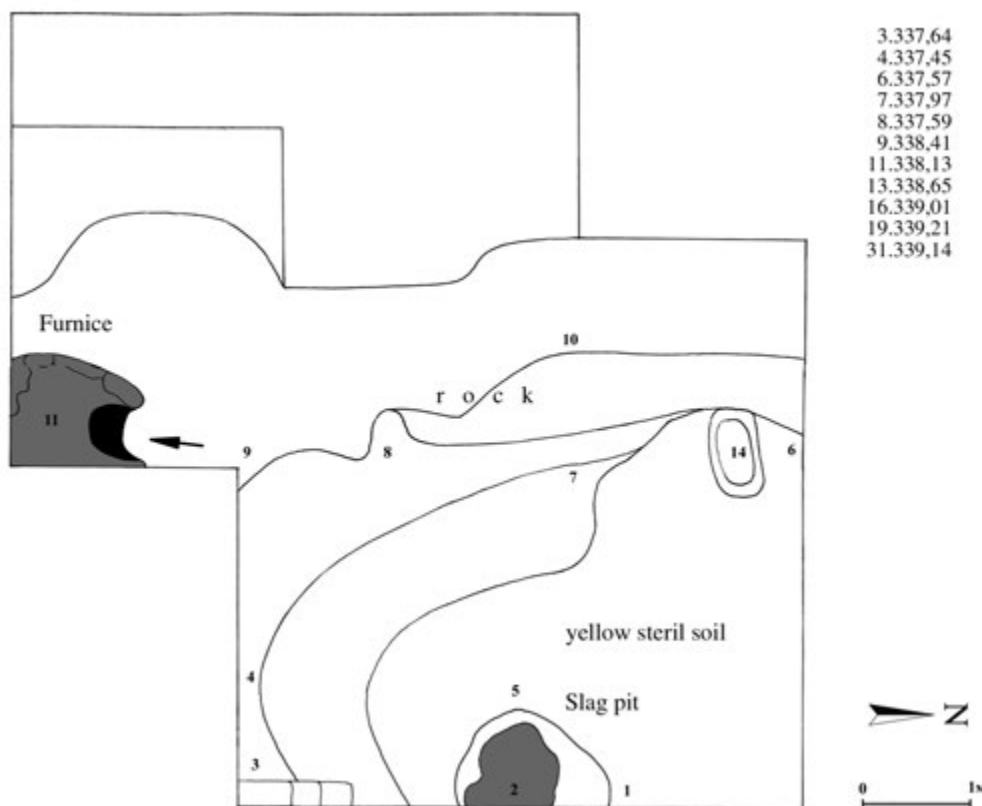


Fig. 6. Orthogonal projection of the metallurgical complex at Ružana 1 site

Сл. 6. Ортогонална пројекција металуршког комплекса на Ружани 1

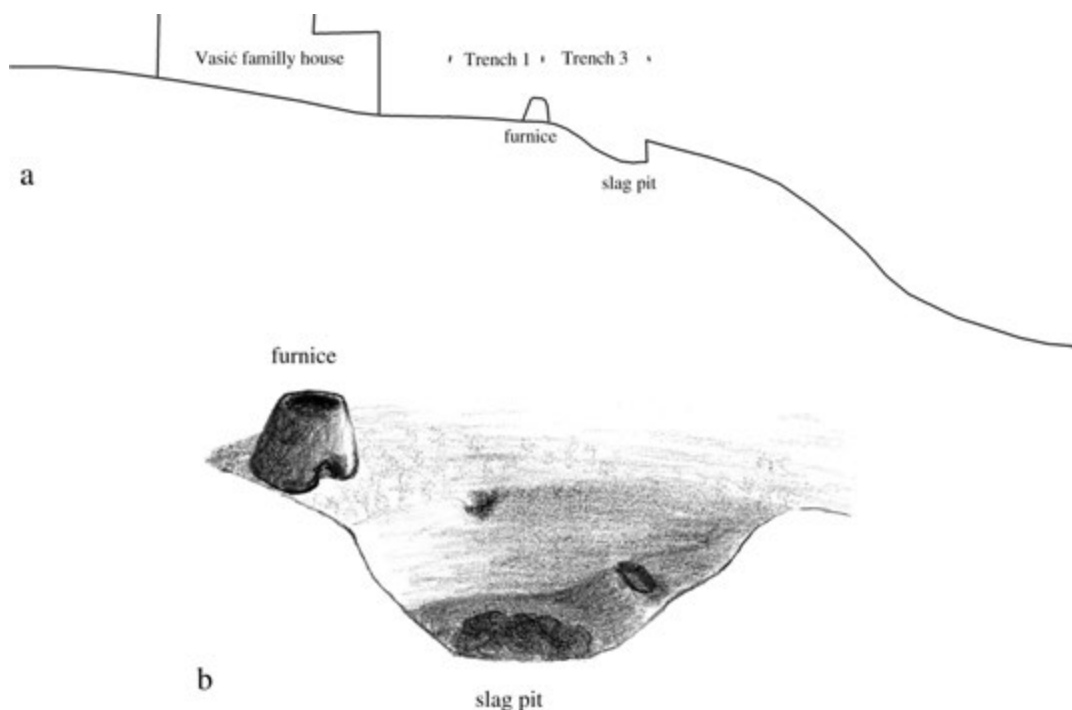


Fig. 7. a) Configuration of the Ružana 1 site; b) Ideal reconstruction of the copper smelting object

Сл. 7. a) Конфигурација терена на локалитету Ружана 1; b) идеална реконструкција објекта за шпољење бакра

ed rather large stones of a hemispherical cross section with a large cavity on the flat surface were also discovered. Traces of deformations noticed on these stones are assumed to have resulted from secondary burning and traces of oxidation were also recorded.²¹ Nevertheless, as in the previous case, we should not enter into a discussion about their function before detailed analyses of these finds have been carried out.

Ružana 2 is the site situated in the courtyard of the Jorgovanović family, also in Banjsko Polje, and rather small-scale systematic investigations were carried out there in July 2015.²² In Trench 2 (covering 22 square meters) the stratigraphic picture was different than at the site of Ružana 1. The land is gently sloping and the stratigraphy consists of the surface layer, then an accumulated layer with mixed material originating from many different cultures and, finally, an intact cultural horizon (above the virgin soil) yielding finds exclusively from the Bronze Age. One shallow pit with metal and pottery finds dates from the Late Roman period and also included a small number of pottery fragments. Most interesting of the metal finds are an iron knife and a fragmented iron sickle. Pottery finds of prehistoric provenance do not differ much from the site at Ružana 1,

but the Late Iron Age finds were completely missing. A large number of channelled bowls with an inverted rim decorated with engraving and a white encrustation comes from the Early Iron Age, i.e. the Basarabi culture (Plate 5/3). Interesting among the Bronze Age finds is pottery of the Vatin characteristics, including mainly carinated conical bowls with horn-like protomes (Plate 5/4,5) and also biconical beakers with wide strap handles (Plate 5/6,7). Vessels for storing food are of larger size and decorated with finger impressions and applied bands with engraved ornamentation (Plate 5/8,9). A rather large amount of vessels of the pyraunos type, decorated with engraving and applied bands, have also been recorded at the site of Ružana 2 (Plate 5/10).

¹⁷ Bachmann 1980, 103.

¹⁸ Analysis of animal bones was performed by S. Milošević from the Faculty of Philosophy in Belgrade.

¹⁹ Shennan 2002, 197.

²⁰ Pernicka et al. 1984, 598; T94/3; Wagner 1984–1986, fig. 4.

²¹ O'Brien 2015, 228.

²² We take this opportunity to express our thanks to family Jorgovanović who helped us in realization of the investigations in 2015.



Fig. 8. Furnace floor with slag remains from the Trench 1/2015

Сл. 8. Подница пећи са остацима шљаке у сонди 1/2015

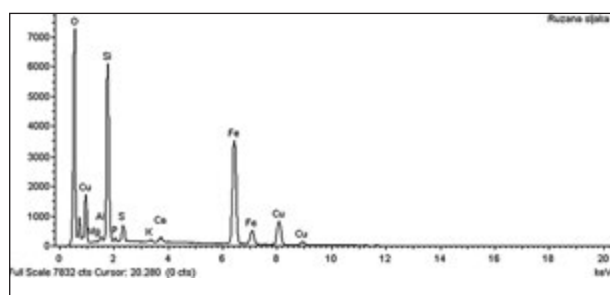


Diagram 1 Slag from the Ružana 1 site

Дијаграм 1. Шљака са локалитета Ружана 1

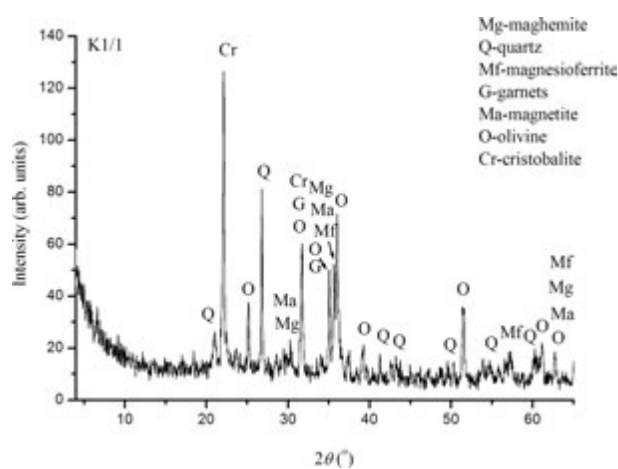


Diagram 2 Ružana 1 – XDR analysis of the sample K1/1

Дијаграм 2. Ружана 1 – XRD анализа узорка K1/1

Crucial evidence for the metallurgical activities, besides the many finds of slag in the cultural horizons, was one fairly large segment of the floor of the metallurgical furnace. The foundation of the floor was made of Bronze Age pottery and small pieces of broken stone and immediately next to it, at the same level as its edge, were a few pieces of tap slag (fig. 8). Detailed physicochemical analyses of the floor and slag lumps have not been performed so far, but considering the fact that this floor of most probably metallurgical furnace must have slid from the higher ground due to erosion, we should not perhaps neglect the possibility that furnace might date from some later period also recorded at this site (possibly the Iron Age?).

PHYSICOCHEMICAL ANALYSES OF SLAGS

The analyses of the discovered slags were performed on two sources working independently from one another. Preliminary analysis of finds from the first investigation season in 2014 was carried out by Nikola Vuković, from the Faculty of Mining and Geology in Belgrade, using a scanning electron microscope (SEM).²³ He analysed a slag sample from Trench 3 at the site of Ružana 1 (diagram 1).

Analyses of slag from the same group from the site Ružana 1 were also performed by Dr. Jovica Stojanović, from the Laboratory of the Institute for Technology of Nuclear and Other Mineral Raw Materials, using Roentgen diffractometry.²⁴ This method was used to examine

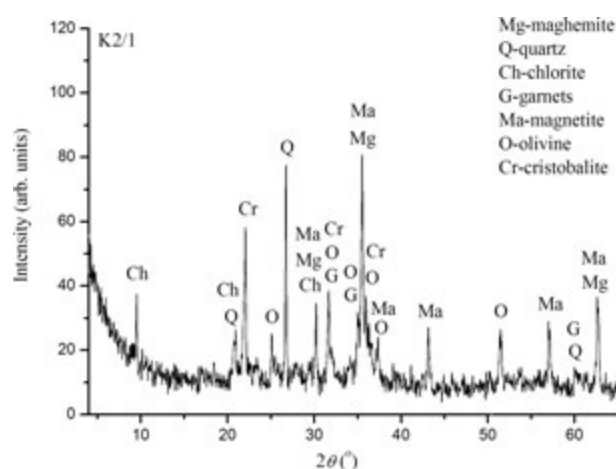


Diagram 3 Ružana 1 – XRD analysis of the sample K2/1

Дијаграм 3. Ружана 1 – XRD анализа узорка K2/1

Oxide								Ružana 1 slag	RTB Bor slag
Na ₂ O								0.00	0.08
MgO								0.08	0.69
Al ₂ O ₃								0.66	2.55
SiO ₂								32.37	41.52
P ₂ O ₅								0.85	0.00
SO ₃								3.87	1.16
K ₂ O								0.31	0.12
CaO								0.81	23.49
TiO ₂								0.00	0.40
FeO								42.41	29.43
CuO								18.43	0.56
BaO								0.21	0.00
Σ								100.00	100.00

Table 1. Slag from Ružana 1 and slag from RTB Bor

Табела 1. Шљака са Ружане 1 и из РТБ Бор

the Roentgen diffraction of a polycrystalline sample (powder) (Diagrams 2 and 3). Seven samples have been analysed from two groups denoted in the series from K1/1 to K/4 and from K2/1 to K2/3. Samples from the group K1 reveal the presence of magnetite (Fe₃O₄; 72.4% Fe and 27.6% O), maghemite (γ -Fe₂O₃ which can be created by atmospheric influences), magnesioferrite (MgFe₂O₄), garnet (X3Y2 (SiO₄), olivine (Mg, Fe) 2SiO₄, quartz (SiO₂; 46.99% SiO₂ and 53.01% O) and cristobalite (SiO₂). At the same time, analysis of the chemical composition of the samples was performed according to the EDXRF and X-ray method that is presented in Table 2 in percentages, but it should be emphasised that it is not possible to determine the content

	Ružana 1 K1/1	Ružana 1 K2/1
Fe	29,03	36,1
Cu	2,04	3,37
Mg	0,16	0,17
Al	1,83	0,66
Mn	0,019	0,013
Ba	0,335	/
Ca	1,85	0,84
Si	21,07	17,24
K	/	/
Ti	/	/

Table 2. Chemical composition of the samples K/1 and K/2 from the Ružana site

Табела 2. Хемијски састав узорака K1/1 и K2/2 са Ружане 1

of oxygen using this method. It is also important to mention that the absence of fayalite, i.e. its low crystallisation in the quoted diagrams should be understood as being the consequence of the high viscosity and faster cooling of the slag which, in this case, fell to the ground.

The physicochemical composition of the slags from Ružana 1 indicates that these were prehistoric slags originating from the process of non-ferrous metallurgy. The appearance of FeO and SiO₂ suggests that these were fayalite or iron-silicate slags.²⁵ According to the proportion of the identified components, they are most similar to the slags discovered at the site of Trnjane (Map 1) that Janković, Bugarski and Janjić analysed using atomic absorption spectrophotometry.²⁶ Also, certain slags discovered at many prehistoric sites throughout Europe (in Spain, Austria, Italy and Cyprus) revealed a similar composition.²⁷ In the prehistoric slags dating from the Eneolithic and Bronze Age, a smaller proportion of copper (Cu) has been identified, which could be explained by the fact that, after cooling, copper had been additionally separated by chopping the slag up. There are assumptions that sulphide copper ore was, before smelting, additionally roasting in the open air²⁸ or in special vessels (pyraunos).²⁹ A higher proportion of Cu in relation to S (10:1) in slags is obtained by oxide smelting, while incidence of iron, olivine and magnetite in all cases of copper slags is proportionally much higher in comparison to other elements and compounds. The occurrence of admixtures of iron and other metals in the prehistoric slags from Ružana, as well as the

²³ SEM model JEOL JSM 6610LV, connected with the energy dispersive spectrometer (EDS) produced by Oxford Instruments Xmax 20 mm² SDD. EDS analyses were obtained at an electron acceleration of 20 kV from a wolfram filament. The test was performed under low vacuum conditions (30 Pa), so the covering of the samples with a layer of conductors (C, Au and the like) was avoided.

²⁴ Samples were analysed by Roentgen diffractometry using "PHILIPS" equipment, model PW-1710, with a curved graphite monocromator and a scintillation counter. Intensity of the diffracted CuK α Roentgen radiation ($\lambda=1.54178\text{\AA}$), measured at room temperature in the intervals $0,02^\circ 2\theta$ at a time of 1 s, and within a range of 4° to $65^\circ 2\theta$. The Roentgen tube was under the voltage of 40 kV and a current of 30 mA, while slits for the direction of the primary and diffracted beam were 1° and 0.1 mm.

²⁵ Tylecote 1987, 293, 300.

²⁶ Janković et al. 1987–1990, Tab. 1 (see under Trnjane).

²⁷ Tylecote 1987, T. 8.6.

²⁸ Eibner 1982, Abb. 2.

²⁹ Janković et al. 1987–1990, 18.

absence of oxygen, sulphur and other harmful substances demonstrate in the best way the technological expertise of the Bronze Age metallurgists, who had been very well acquainted with methods of improving the quality of copper.³⁰

The results of the SEM analyses, when compared with modern slag obtained from the Mining and Smelting Basin at Bor (Table 1), indicate the absence of a catalyst, such as limestone (CaCO_3), and could suggest that in the case of slag deposits at Ružana 1 it was a primitive process of ore smelting. The conspicuously high

loss of copper of almost 15% of its content corresponds in modern circumstances to converter slags rather than slags obtained by direct ore smelting. It suggests that it is less probable that slag from Ružana 1 results from smelting copper ore, rather it was most probably a by-product of refining already obtained copper.³¹ Such claims remain to be additionally investigated and documented using more concrete finds, like moulds for metal objects or ingots and vessels for pouring metal, or metal moulds that have not been encountered at this stage of investigation.

³⁰ Eibner 1982, 405.

³¹ Kapuran et al., in print.

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Резиме:

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НОВИ ДОКАЗИ О ПРАИСТОРИЈСКОЈ МЕТАЛУРГИЈИ БАКРА У ОКОЛИНИ БОРА

Кључне речи. – бронзано доба, гвоздено доба, металургија бакра, металичне шљаке.

Из сарадње Археолошког института у Београду и Музеја рударства и металургије у Бору проистекла су током последње три деценије открића одређеног броја насеља и некропола из бронзаног доба у непосредној околини Бора. Након последњих рекогносцирања и мањих систематских ископавања дошло се до броја од 20 насеља и 4 некрополе (карта 1). Металичне шљаке су пронађене како у културном слоју, тако на подовима кућа (Трњане), а налазиле су се и у гробним конструкцијама од камена, као и на костима спаљених покојника (Борско језеро и Хајдучка чесма).

До открића новог локалитета Ружана 1 у околини Бора, који потиче из бронзаног доба, дошло је 2013. године случајно, када су Дамњан и Радован Васић, приликом изградње темеља у дворишту породичне куће у Бањском Пољу, открили већу количину праисторијске керамике и шљаке. Можемо слободно рећи да је истраживање овако ретког налаза праисторијске металуршке инсталације реализовано највише захваљујући породици Васић и разумевању Општине Бор. Идентична ситуација се поновила и након друге године истраживања у Бањском Пољу када је дипл. архитекта Слађан Јорговановић позвао археологе да истраже двориште његове породичне куће, која се налази на око 100 метара западно од куће Васића (Ружана 2), те су том приликом такође констатовани остаци још једног металуршког објекта (сл. 1 и 9).

Ружана на влашком језику значи „рђа”, што може да асоцира на то да се у далекој прошлости на њеним обалама могла налазити већа количина шљаке са повећаним присуством оксида гвожђа у себи, која је иначе карактеристична за шљаке из бронзаног доба? Стратиграфију локалитета Ружана 1 је условио природни пад терена, који се креће од запада ка истоку, што је довело до наслојавања налаза који потичу са простора претходно поменутог узвишења у центру Бањског Поља (сл. 8/а). Стратиграфију чине један старији, интактан хоризонт и два млађа, наслојена хоризонта (сл. 4). Површински хоризонт садржи у већем проценту материјал из касне антике, односно, веома уситњене фрагменте керамике израђене на витлу, као и неколико бронзаних новчића од којих је један ископан у време Лицинија, док у следећем хоризонту наслојавања доминирају налази из старијег гвозденог доба, заступљени у истом односу са керамиком из бронзаног доба. Непоремећени културни хоризонт се налази изнад здравице и у њему је откривена бројна керамика и нешто мање животињских костију, као и већа количина металичне шљаке која *in situ* лежи на најдубљим котима ископа (више од 10 kg). Истражена је површина од 39 m²,

а чине је три целине: горња платформа, доња платформа и између њих оштра косина (сл. 7). Металуршки објекат би представљао подница пећи, приближно потковичасте основе (запечена земља са траговима интензивног горења), са троскиштем у њеном подножју које лежи наспрам претпостављеног отвора пећи (сл. 7). У откривеном делу, пећ је дуга око 1 m, отвор јој је окренут ка северу, а њени зидови постоје само у основи, будући да је цео околни простор изложен јаком дејству ерозије. На подници пећи су *in situ* лежале фрагментоване животињске кости, за које претпостављамо, судећи према бледоплавој боји и пукотинама, да су морале бити изложене изразито високим температурама, вишим од 1000° C.

Хронолошки најмлађу керамику откривену на локалитету Ружана 1 представљају посуде израђене на витлу, од којих су поједине украшаване валовницама и могу се везати за касну антику (табла 1/1), ситуласти лонци са чешљастим орнаментом који су карактеристични за млађе гвоздено доба (табла 1/2),¹ као и веће посуде задебљаних обода, украшене урезаним покрсницама које се у источној Србији везују за злотску групу (табла 1/3, 4).² Старије гвоздено доба представљају канеловане зделе увученог или разгрнутог обода, затим пехари, лонци и амфоре украшени низовима „S” печата, лажним шнуром и белом инкрустацијом (табла 1/5–12), за које најближе аналогије постоје у Басараби културној групи. Налази из бронзаног доба показују карактеристике параћинске групе са одређеним елементима карактеристичним за Вербичоару и Ватин. То су претежно коничне зделе, са косим и оштро профилисаним ободом, украшене рожнатим апликацијама (табла 2/1–3), биконични лонци и пехари са широким тракастим дршкама, од којих су поједине украшене протомима (табла 2/6,7). Посуђе за складиштење намирница је већих димензија, а чине га лонци и питоси који имају мање или више наглашену S профилацију и украшени су аплицираним тракама са урезима и импресом (табла 3). Велики број посуда чине Ругаunosi, о којима је и раније било речи (табла 4).

Прелиминарна зооархеолошка анализа животињских костију из троскишта показује да се у овом случају претежно радило о дивљим врстама, као што су јелен и срндаћ, док су од домаћих врста заступљени говеч, свиња, овца или

¹ Булатовић и др. 2011.

² Kapuran 2013.

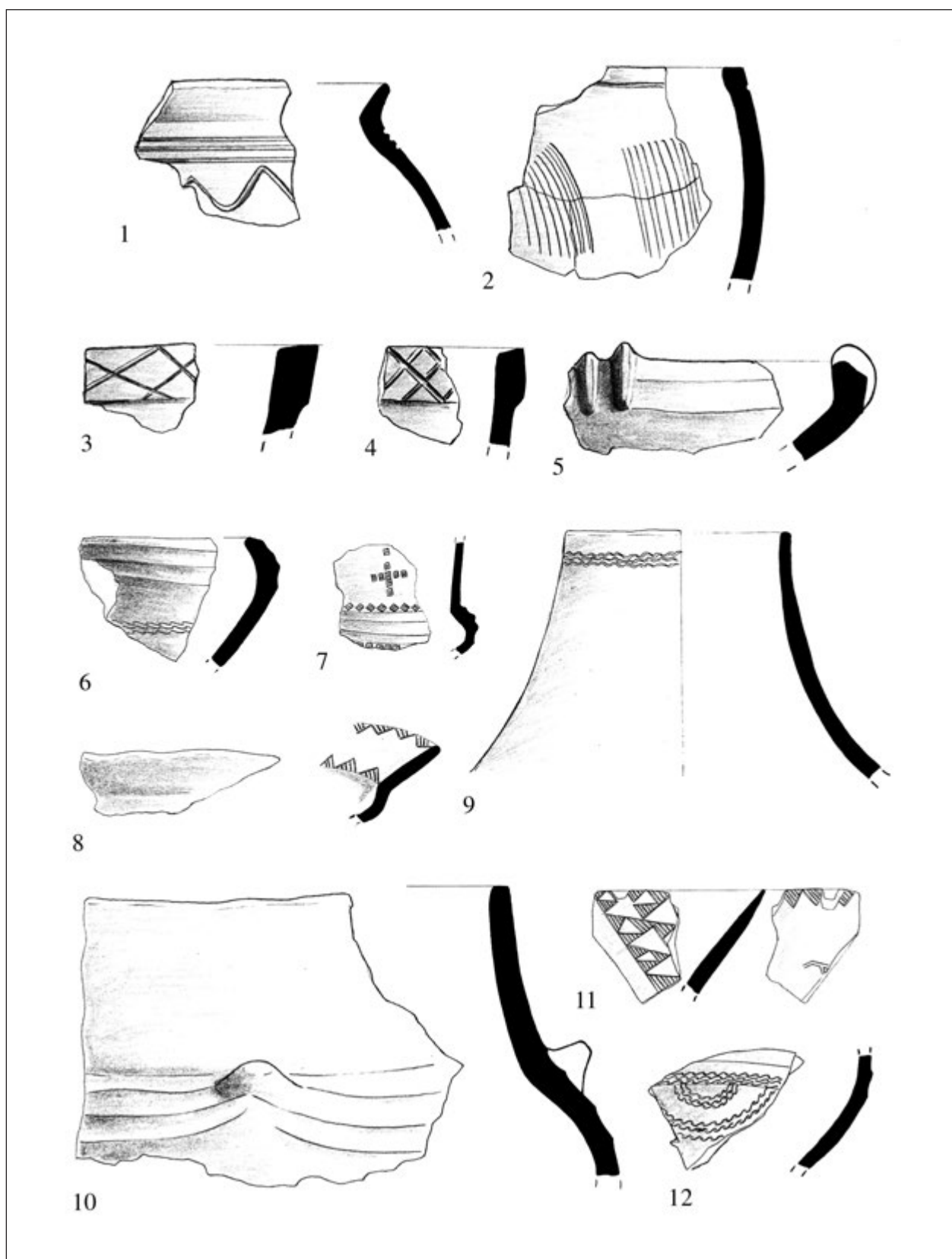
коза. Узгајање свиња иде нарочито у прилог чињеници да су металуршке заједнице бронзаног доба у околини Бора ипак биле седентарног карактера, с обзиром на то да се узгој свиња не може повезати са сезонским миграцијама. Од осталих налаза можемо поменути профилисани синтеровани леп који је могао да представља делове пећи, бројне растираче од камена, масивне камене подлоге за мрвљење руде или шљаке итд.

Ружана 2 представља локалитет који се налази у дворишту куће породице Јорговановић, такође из Бањског Поља, на коме су извршена мања систематска истраживања током јула 2015. године.³ У сонди 2 (површине 22 m²) констатована је другачија стратиграфска ситуација него на локалитету Ружана 1. Стратиграфију чине површински слој, затим наслојавање са помешаним налазима више култура и, на крају, интактни културни хоризонт, са налазима искључиво из бронзаног доба, који лежи на здравици. Корпус керамичких налаза из праисторије се не разликује много од локалитета Ружана 1, осим што недостају налази из млађег гвозденог доба. Старијем гвозденом добу, односно култури Басараби, припада већи број канелованих здела са увученим ободом, украшених урезивањем и белом инкрустацијом (табла 5/3). У налазе бронзаног доба са карактеристикама Ватина спадају првенствено коничне зделе са оштро профилисаним ободима и рожастим протомима (табла 5/3, 4), као и биконични пехари са широким тракастим дршка-

ма (табла 5/5, 6). Посуђе за складиштење намирница је већих димензија, а украшено је утискивањем прстом и аплицираним тракама са урезаним орнаментом (табла 5/7, 8). И на локалитету Ружана 2 је констатовано више налаза Руга-поса који су украшени урезивањем и аплицираним тракама (табла 5/9). Поред више налаза шљаке у културним хоризонтима, као кључни доказ металуршких активности сведочи већи део поднице једне металуршке пећи. Подница је фундирана керамиком из бронзаног доба и ситнијим ломљеним каменом, а непосредно уз њен обод и у његовом ниwoу лежало је неколико заравњених комада шљаке типа *tap slag* (сл. 9).

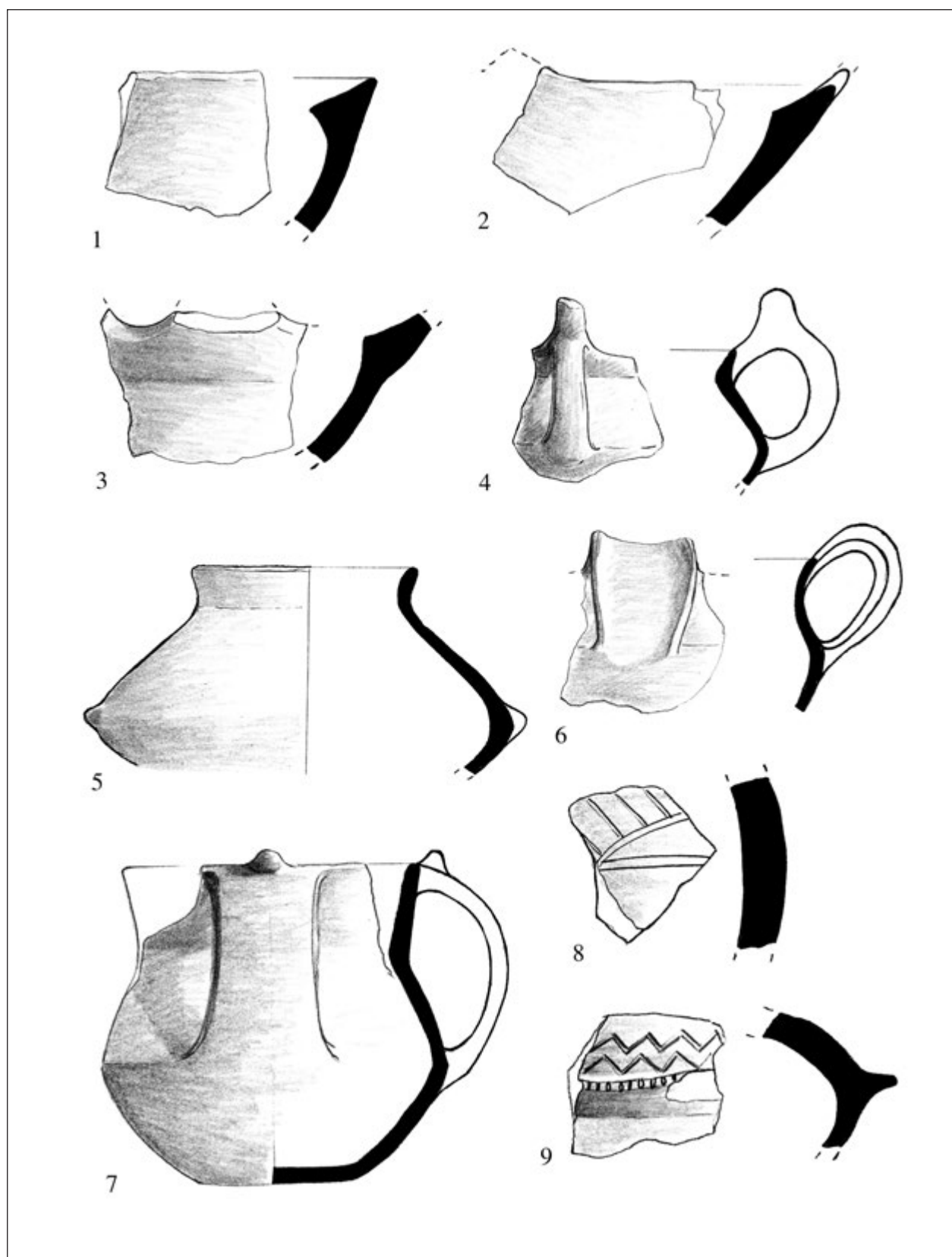
Резултати рендгенске дифракције и SEM анализа упоређени са модерном шљаком добијеном из Рударско-топионичарског басена Бор (табеле 1 и 2, дијаграми 1–3) указују на то да се у случају троскишта на Ружани 1 радило о примитивном процесу топљења руде бакра, односно обојеној металургији. То може да значи да је мање вероватно да је шљака са Ружане 1 добијана топљењем бакарне руде и да пре може да представља нуспроизвод рафинације добијеног бакра. Индиције за претпоставку да се у овом случају, можда, ради и о нуспроизводу рафинације добијеног бакра, које су такође у оптицају, остају да се додатно испитају и документују конкретним налазима, попут калуца за металне предмете или инготе, као и посуда за изливање метала или кокила, будући да они у овој фази истраживања нису констатовани.

³ Овом приликом желимо да захвалимо породици Јорговановић која нам је помогла у реализацији истраживања током 2015. године.



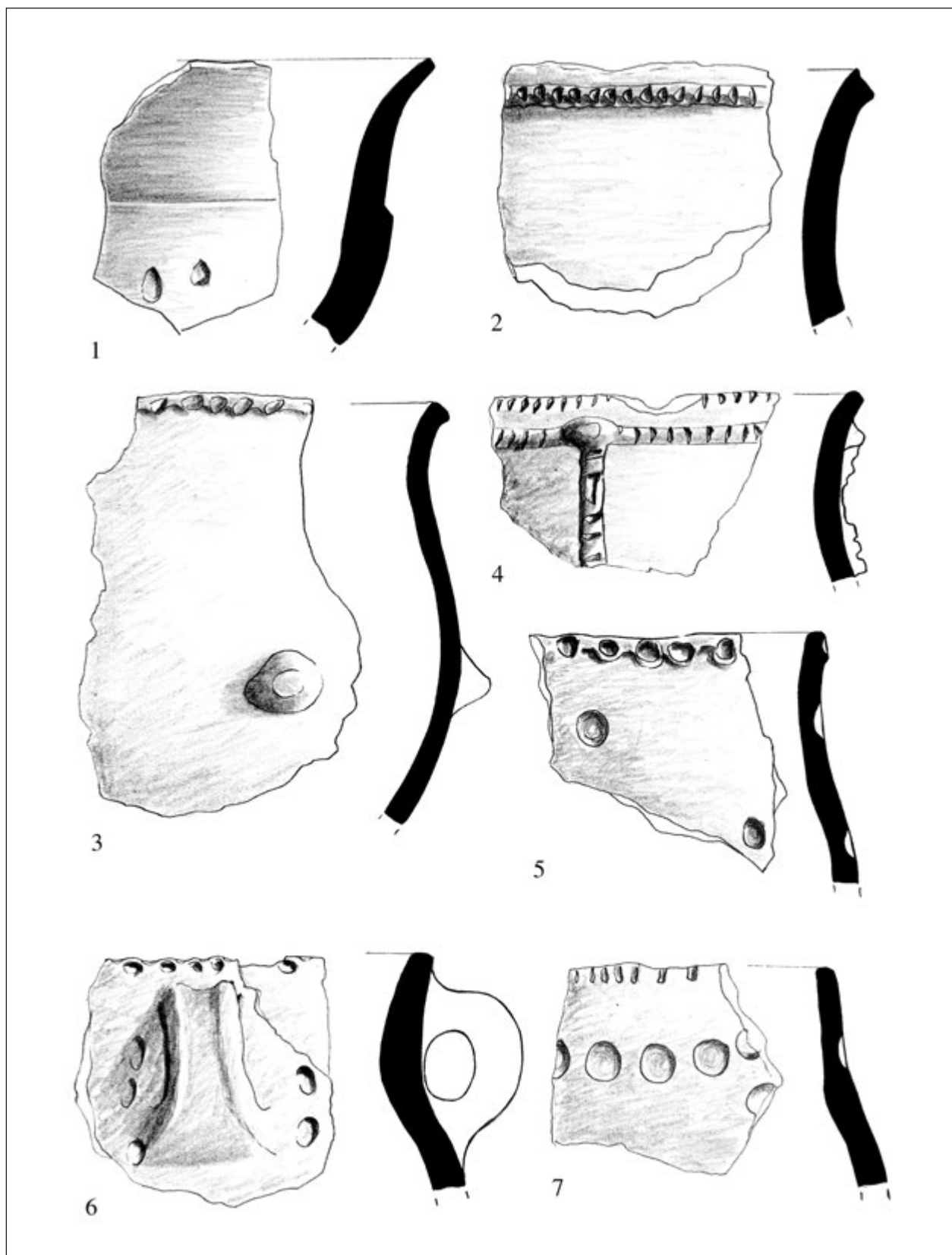
Табла 1 – Касноантичка и њезденодобна керамика са локалитета Руџана 1

Plate 1 – Late antiquity and Iron Age pottery from Ružana 1 site



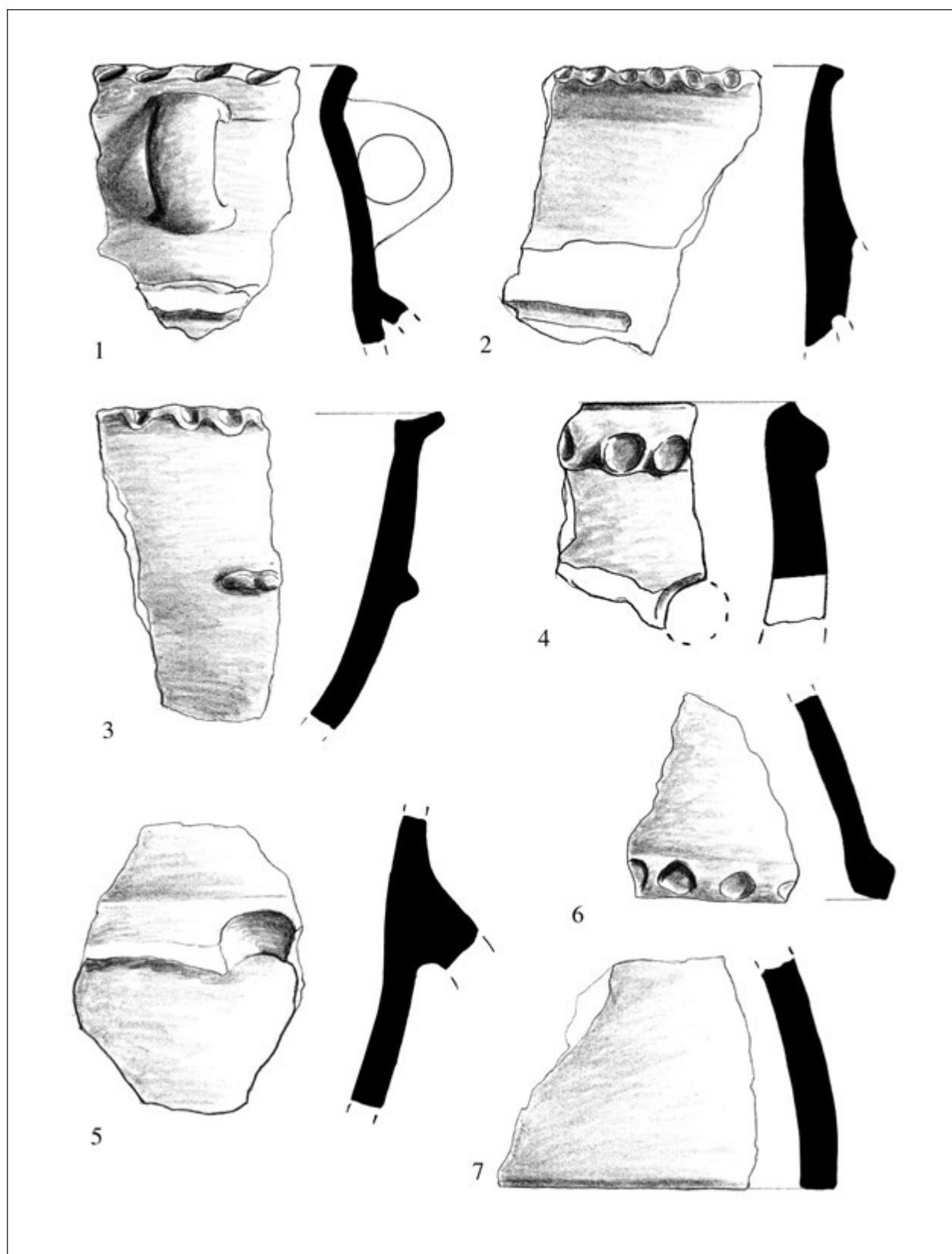
Табла 2 – Керамика бронзаног доба са локалитета Ружана 1

Plate 2 – Bronze Age pottery from the Ružana 1 site



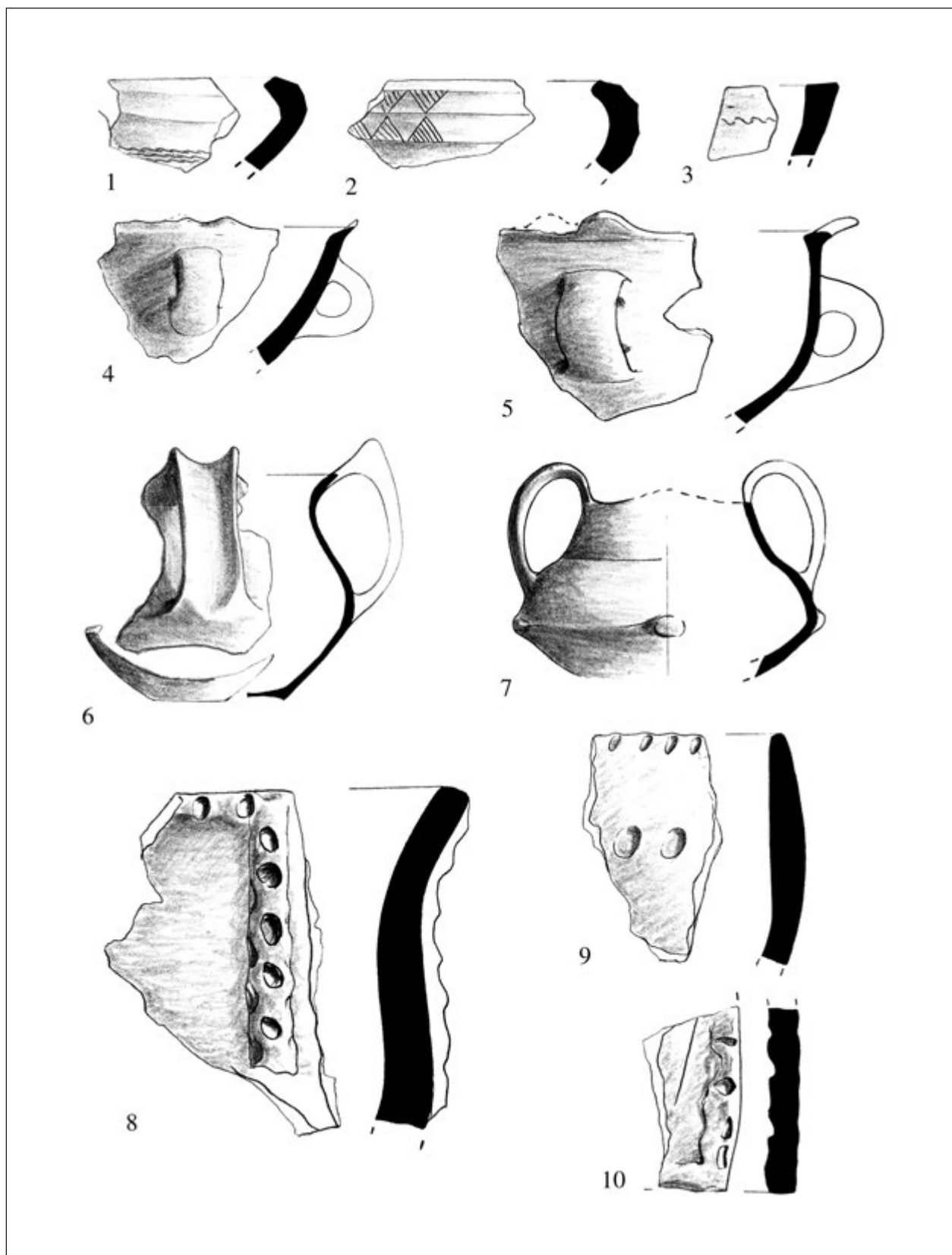
Табла 3 – Керамика бронзане добе са локалитета Ружана 1

Plate 3 – Bronze Age pottery from the Ružana 1 site



Табла 4 – Саџаци са локалитета Ружана 1

Plate 4 – Pyraunos from the Ružana 1 site



Табла 5 – Праисторијска керамика са локалитета Ружана 2

Plate 5 – Prehistoric pottery from Ružana 2 site