

THE EARLIEST COPPER METALLURGY IN THE CENTRAL BALKANS

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ABSTRACT

This work offers a summary of archaeometallurgical finds including special discussion of the recent finds from Belovode and Pločnik that absolutely affirm the thesis about origin and evolution of copper mining and metallurgy within Vinča culture even from its earliest phases.

Key words: Vinča culture, Pločnik, Belovode, malachite, azurite, metallurgy.

The Balkan Peninsula is renowned for its significant deposits of metals including copper, lead and zinc. These metals are always found together with silver and gold so it could be assumed and with reason that central and eastern Serbia where these ore deposits are concentrated had all geological predispositions for the emergence of the metallurgical activities (Gržetić A.I. – Jelenković J. R., 1995, 14).

Emergence and evolution of the copper mining and metallurgy is nowadays indubitably connected to the Vinča culture, which existed in the territory of central Balkans generally in the second half of the 6th and first half of the 5th millennium BC. First investigations at the eponymous site Vinča – Belo Brdo near Belgrade, conducted in the beginning of the last century, yielded finds and situations that Prof. M. M. Vasić associated with certain technological treatment of the cinnabar (M. M. Vasić, 1932, 6 - 8). His long-lasting investigations yielded, among other things, a series of finds, which indicate the presence of copper minerals (malachite and azurite) within entire vertical stratigraphy of this settlement (D. Antonović, 2002, T. 1 – 3). However, other also important elements of the material culture were crucial for the importance of Vinča and Vinča culture, which is considered until these days as one of the most significant cultural manifestations in the prehistory of the southeastern Europe. Archaeological investigations conducted in the few ensuing decades almost completed the picture of the Vinča culture, starting with its boundaries and territory and including regional differences and systematization and study of its material remains including the aesthetic and artistic as well as spiritual spheres of life of the Vinča culture population.

Depending on the scope of investigation, some sites, mostly settlements of this culture yielded different artifacts made of copper. We would like to mention just a few most important sites and finds. Pločnik near Prokuplje is the most

proliferate site with around forty finds – hammer-axes, chisels, bracelets and pins (Grbić M, 1929, Abb. 98 – 102; Stalio B, 1973, 157, T. 1 – 4). Fafos near Kosovska Mitrovica and Selevac near Smederevska Palanka with finds of malachite and small copper beads (B. Jovanović, 1984, 13 - 14; Glumac P. - Tringham R, 1990, 554, T. 15.3), Gomolava near Šid and Divostin near Kragujevac with finds of copper bracelets (Brukner B, 1980, 34 – 35, Fig. 17; Bogdanović M, 1990, 105, Abb. 12), Stapari near Užice and Gornja Tuzla in Bosnia with small artifacts including bracelets of copper wire, awls and beads (Jurišić A, 1960, 96, 97; Čović B, 1960 – 1961, 79 - 139), Zlotska pećina near Bor with finds of awls and chisels (Tasić N, 1982, 27, T. IV). However, only after systematic investigations and publishing of Rudna Glava near Majdanpek the archaeometallurgical characteristics of the Vinča culture gained in importance. Closed associations from a few shafts of this mine determined without doubt the time of exploitation in the Gradac phase of the Vinča culture (Jovanović B, 1982, 91 – 96, supplement 3, 4). Using interdisciplinary approach to this problem the archaeometallurgy contributed in establishing technological foundations for emergence and evolution of mining and metallurgy in this bygone epoch of the human past.

The man overcame two basic components of this process during the preceding centuries. The most of the material of the earlier prehistoric cultures includes pottery and various artifacts made of stone. Numerous and heterogeneous range of stone tools indicates a profound knowledge of this raw material. ‘Stone industry’ of the Vinča culture is acquainted with and uses over forty kinds of rocks of heterogeneous mineralogical structure and their characteristics determine to the great extent the function of the tool (Antonović D, 2003, 15 – 49). Even more important fact is that part of these raw materials was obtained by certain mining activities. In the opal mine Krivo Polje near Kragujevac were recorded oval pits clustered in the groups and making at some spots rather small open mines (Jovanović B. – Milić R, 1988, 58). Similar situations were also encountered at the sites in the vicinity of Kraljevo (Petrović V. B, 1999, 155 – 166). Analogous and much more explicit situations have been systematically investigated at few sites in the eastern and western Europe. There were recorded characteristic shallow open mines at the flint deposits often also with circular vertical shafts when deposits of flint were encountered deeper (Jovanović B. – Milić R, 1988, 59, note 5). Copper together with silver and gold belongs to the group of precious metals, which could be often found in the native state. Moreover, copper minerals malachite and azurite certainly attracted attention of the Vinča culture ‘geologists’ because of their coloristic traits as it is best confirmed in the shafts at Rudna Glava.

Another component necessary in the metallurgical process like high temperatures and structures for smelting – furnaces is also based on previous experiences. Large pottery production is recorded at every Vinča culture site. Pottery vessels could be classified into three groups according to quality. And

while first two groups including vessels of coarse and intermediary manufacture were produced in the open fire for the third luxurious and the highest quality group the pottery kilns were used. Technological analyses confirmed that in these structure could be reached the temperature of up to 900° (Yiouni P, 2000, 212). Although it is possible to achieve such high temperatures, even over 1000° that are necessary for smelting copper minerals and copper only by using wood as fuel the use of charcoal has been recorded at some Vinča culture sites. The most indicative situation is at the site Belovode where the settlement itself lies on top of charcoal deposits that are located rather shallow under the surface in the western part of the site. Many charcoal samples gathered from the layers of this settlement always mixed with small lumps of malachite suggest its exploitation and use.

Everything mentioned above indicates that area of the central Balkans offers today the most complete picture of primary and evolutionary phases of copper mining and metallurgy. From the complete archaeometallurgical opus of this culture we are going to discuss at this occasion just examples from the site Belovode in the area of the village Veliko Laole near Petrovac na Mlavi and Pločnik near Prokuplje. The more recent archaeological investigations of these Vinča culture settlements yielded many finds and situations that make possible unambiguous general reconstruction of the copper metallurgy.

The most numerous finds encountered within all layers of the Belovode settlement are large quantities of malachite and much smaller amount of azurite. Main characteristic of this material is altered structure of almost all samples due to the 'certain thermal treatment'! Structure of the all collected samples is porous and always mixed with ash and small lumps of charcoal. These characteristics unambiguously indicate that it was the result of thermal, we believe metallurgical process. Quantity of malachite obtained from few rather large areas in trench VII, approximately 2 x 2 meters in size, was around 800 grams (Fig. 1). Malachite was separated from small lumps of charcoal by flotation. Most of the obtained malachite are small grains mixed with sand (Fig. 2). These areas indicate the existence of certain metallurgical structures and in their vicinity were discarded these residues of smelting malachite or casting copper that later on got the present physical characteristics due to oxidation in the natural environment.

The most numerous finds at this site are beads but one pendant was also found (Fig. 3, 4). We discovered around twenty beads from 4 mm to 1.5 cm in diameter. Most of them are of symmetrical circular shape with rather sharp edges and that along with other physical characteristics suggests their metallic substance. Qualitative analysis using EDXRF spectrometry of two beads revealed that copper is their macro component. The deltoid pendant with perforation dates from the earliest phase and the time of settlement foundation. Production of such decorative objects required the knowledge about malachite

structure and careful working. The only and closest analogy so far is the similar object found in the Shanidar cave in Iraq (Knauth P., 1997, 25).



Fig. 1



Fig. 2

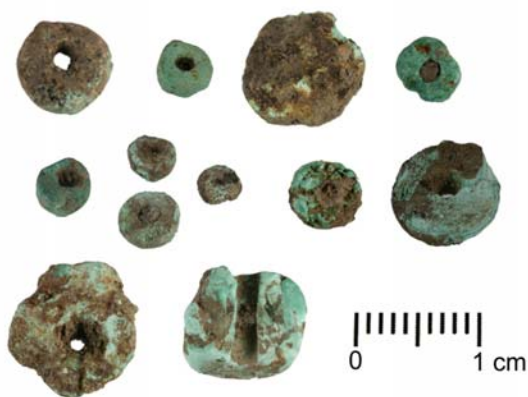


Fig. 3



Fig. 4

Interesting and rather numerous are distinct finds with traces of these minerals that were as the lumps of malachite also encountered in all layers of this settlement. Plenty of animal bones have intense and amorphous stains of green color. It is absolutely certain that they resulted from the contact with copper, which in the process of oxidation could cause such effects. This information also denies claims of some authors that this mineral was exclusively used for obtaining pigment as these are so far the only finds with traces of pigment from the numerous and heterogeneous repertoire of the Vinča culture at Belovode. Considerable number of fragments of pottery vessels of coarse manufacture reveals in its fabric small lumps of malachite. Even though these vessels are of rather small or medium size it is certain that these were the fragments of vessels being used in some way in the process of copper smelting. We assume that these tiny pieces of malachite, also of altered structure, resulted from oxidation of small drops of smelted copper remaining in the porous and coarse fabric of these vessels.

Layers of this settlement also yielded few small-sized pottery vessels, which according to the known analogies could be classified in a group of so-called ‘casting vessels’ (Fig. 5). Similar specimen was found with copper and stone artifacts in the fourth hoard from Pločnik (Stalio B., 1973, 157, T. 4).



Fig. 5



Fig. 6

Important finds from Belovode are pottery vessels of distinct character and infrequent in the Vinča culture ceramography (Fig. 6, 7). These objects have rims at both ends while handles were placed at one end. According to considerably later and functionally determined specimen from Agia Varvara in Cyprus (Early Bronze Age of the Aegean) it is certain that these objects from Belovode also were elements of metallurgical installations for copper smelting (Fasnacht W., 2002, 9 – 11). They could be described as chimneys installed over small ‘pits-ovens’ in order to improve air circulation and made possible maintaining the temperature necessary for smelting malachite and azurite or copper. Identical principle of maintaining the temperature, of course using structures made of modern materials – first of all metal, was used by few craftsmen in our territory almost as late as the middle of the 20th century.

In the meantime finds from Belovode were supplemented by new elements. Trenches X and XI excavated in 2003 yielded two rather small kilns, which could be the segment of metallurgical installations (Fig. 8). Both structures did not provide any archaeometallurgical finds. Identical kiln considering shape and size was found in Durankulak, Bulgaria with traces of malachite smelting and one pottery bellows on the rim (Dimitrov K., 2002, Abb.175). Pits – ovens identical to those from Belovode and even pottery vessels up to the 5 liters in capacity have been used in experiments and successful attempts to reconstruct the copper working in prehistory

(Happ J, 2002, 11 – 13, Fig. 2 – 7). Considering the finds from Durankulak, Agia Varvara and experiments of French technologists and archaeologists the finds from Belovode have all the elements for the reconstruction of one similar and simple metallurgical installation (Fig. 9). It is important to stress here the chronological priority of such technological achievement in comparison with the mentioned finds from Bulgaria and Cyprus. Such metallurgical features in the primary phase of metallurgy could provide small quantities of copper sufficient for production of rather small decorative objects and they certainly were the technological basis for the future development of metallurgy.



Fig. 7

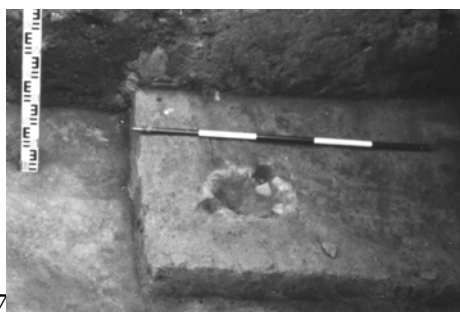


Fig. 8

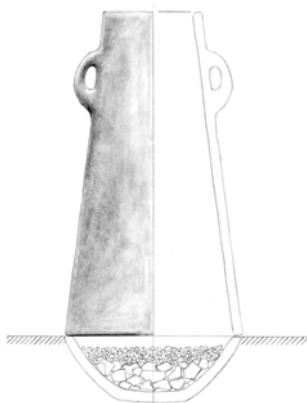


Fig 9



Fig. 10

Few individual finds complete the archaeometallurgical picture of this site. Oval stone mallet with groove along the middle have many analogies in the identical finds from Rudna Glava (Fig. 10). Half of pottery mold producing shapes identical to the massive copper chisels from the site Pločnik (Fig. 11). Two copper axes were also found in the close vicinity of the settlement at Belovode. Rather interesting is the specimen of functionally undistinguished shape. This awkward shape was made, as it seems, after stone axes of shoe-last type and perhaps it is the earliest form of

copper tools (Fig. 12). This specimen also suggests some other conclusions!. It could be assumed that it was semifinished article prepared for further metallurgical treatment and production of functionally defined tools or it was an ingot – of distinct value intended for exchange, i.e. trade (Čović B., 1999, 65, 70; Šljivar D., 1991, 36). This assumption is supported by preliminary physical and chemical analyses according to which both tools were made of copper with negligible amount of other metals and impurities!



Fig. 11



Fig. 12

Investigations at Rudna Glava revealed that volcanic – eruptive region of eastern Serbia that includes also the Homolje Mountains with Ridanj-Krepoljin metallogenetic zone is one of the areas where primary copper mining and metallurgy emerged in the Vinča culture (Jovanović B, 1982). Prospecting of the terrain in a wider surroundings of the Belovode settlement resulted in discovery of one such mining shaft near the village Ždrelo in the vicinity of the Reškovića River source (Fig. 13, 14).



Fig. 13

Wider area around Vukan, the dominant peak at the entrance of the Gornjak Gorge where the village Ždrelo is situated is abounding in ancient shaft. 'Over hundred' as states F. Hoffman, the quoted author, and seven heaps of slag were distinguished between them. The ore veins consist of pyrite, chalcopyrite, magnetite, galenite and sphalerite and they fill the cavities in the limestone or at the contacts of limestone and eruptive rocks (Jovanović D., 1991, 190). Reddish color of the surface geologic layers with typical 'iron hat' formation is conspicuous at this site. Very steep slopes are grooved by symmetrical vertical trenches starting from the bank of the Reškovića river and ascending to the very top of this hill. This situation reveals

the method of exploitation of the rich deposits of malachite and azurite. Surface works usually started from lowermost zone to avoid covering with muck. Halfway up the slope and to the right of one trench we discovered partially destroyed shaft. It means that malachite and azurite mineralizations had been followed on the surface and thus were discovered places where this ore erupted to the surface. The discovered shaft has been partially investigated. Its opening is around one meter in diameter. At the very beginning it was divided in two tracts. The right tract sinks almost vertically and it was investigated up to the depth of 1 meter. The left tract descends gradually and it was investigated up to the length of 5 meters. For the time being neither in the investigated area nor in the explored tracts of this shaft have been found any archaeological artifacts, which could help in chronological interpretation of this site. We registered only the traces of excavation of malachite on the walls of the shaft and they suggest the use of primitive implements and the most ancient mining technology confirmed by some finds from the Belovode settlement. We assume that future physical and chemical analyses of the samples of malachite from the mine and settlement will confirm chronological correlation of these sites.



Fig. 14

Such early mining and metallurgical activities required specific organization. Especially, as works at Rudna Glava revealed, when it concerns the transport of excavated ore to the settlement where further processing took place. Answer to this question is provided by the finds of zoomorphic figurines and paleozoological analyses of the material from Belovode. The most interesting detail on the realistically depicted figurines of bulls are perforations on the noses while analyses of animal bones confirmed the presence of two ancestors of domestic cattle: *Bos primigenius* and *Bos brachyceros* (Jovanović S. et al, 2004, 467 – 473).

The fact that there were two species of domesticated cattle is of exceptional importance for the archaeological interpretations of the Vinča culture. In the early phase of animal domestication we can exclude with great probability the knowledge about selection and crossbreeding of these animal species. It is more probable that cattle reached these areas by trade. *Bos primigenius* is the bovine from the steppe the so-called Podolian cattle of massive configuration and with span of horns up to 1.5 meters and much higher working abilities. The corresponding equivalent of value in

this commercial transactions was copper and finished artifacts of this metal. These elements make rather simple picture of economic and social relationships in the prehistory much more complex. Introduction of metal and development of this new technology resulted gradually in destruction of pastoral stockbreeding and agricultural communities. Metallurgy was the decisive impulse for further and rapid development of the prehistoric cultures because it caused the distinguishing of various special professions (miners, craftsmen, tradesmen and the like). From this very moment we encounter more rapid development of the European civilization based on new technologies and economic relations. Second cattle species *Bos brachyceros* (nowadays known as *buša* in Serbian) was an autochthonous animal. In favor of this statement speak not only stratigraphic situation in the trenches but also the finds of identical figurines at the other Vinča culture site Pločnik near Prokuplje.

Important elements depicted on three figurines of both racial and chronologically different groups are finely modeled perforations on the noses (Fig. 15). Modeling of this detail indicates also other characteristics of these animals even more so if we consider the cult purpose of these objects and ritual notion of their creators. This is the evident confirmation and proof of total domestication but also the exploitation of the cattle. It is certain that these bulls were lead using nose rings or in some other way and that man had complete control over such bridled animals. In such a way they had been used as working and pack animals for the transport of malachite and azurite ore (among other things) from the nearby mine to the settlement at Belovode. We should not exclude, even in this early stage, that they had been used for drafting certain primitive and improvised structures or materials as it was recorded in the ethnographic literature for the more recent past in this regions Šljivar D – Jacanović D, 2005)



Fig. 15

Another site is Pločnik near Prokuplje where important finds have been collected since the first investigations in 1927. Here, like at Belovode, was also encountered considerable amount of malachite within entire vertical stratigraphy. There were registered few zones with larger quantities of this material including samples of small granulation as well as more compact lumps of the weight indicating metallic core. Almost all samples have altered structure and are light, porous and mixed with small lumps of charcoal, soot and ash.

Still, in archaeometallurgical sense, here are most important and most interesting so-called 'hoards of copper tools' of the 'Pločnik' type, which is adopted in all typologies of copper finds in Europe. The hoards contain 4 hammer-axes, 25 chisels, 4 bracelets and one pin all of copper and their total weight is 16.034 kg (

Fig. 16, 17, 18, 19). This is a unique collection of copper artifacts from one settlement in the prehistory of southeastern Europe.



Fig. 16



Fig. 17



Fig. 18



Fig. 19

Interpretations of these finds were based so far on the term 'hoard' without attempts to define more precisely whether these are the 'founder's hoards, personal hoards or objects of cult character'! Also, such context did not allow more precise chronological determination of these finds so they were dated from the end of the Vinča culture to the Early Copper Age. The analysis of finding circumstances of these objects, stratigraphic positions and relevant accompanying material revealed that these copper tools were found in defined building horizons of this settlement. Such context changes the existing picture of this site and emphasizes entirely different metallurgical characteristics. First of all the advanced copper metallurgy with, for the time being, partially known elements of this technological process. Large number of finished tools and certain field observations ascertained in the course of excavations make probable certain assumptions. It is already quite certain that there was distinguished 'artisans' area' within the settlement with structures for smelting malachite and later also copper and with smithies for production of artifacts. In that regard the spatial distribution of all finds from Pločnik is indicative. Mapping of the finds distinguished western zone of this large settlement as an area where all copper artifacts have been found except small chisel found in 1978. Other elements recorded in the course of investigations conducted between 1996 and 2004 also speak in favor of the suggested assumption.

Stylistic and typological as well as cultural and chronological analyses of the relevant material require much more space and exceed the scope of this work. For the time being it is important to emphasize the following moments concerning the finds from Pločnik. Stratigraphic positions of all copper finds are uniform and they vary from 0.80 to 1.10 meters of relative depth. They have been found in the cultural

and building horizon characterized by specific pedologic structure and with portable archaeological material typical of the Gradac phase of this culture. This is the middle phase of the Vinča culture that is dated in the end of 6th and the beginning of the 5th millennium.

The Gradac phase of the Vinča culture was long time ago detected and identified by M. Garašanin and he explained it most comprehensively in one of his last works (Garašanin M, 1994 – 1995). Changes in the quality of pottery and stylistic modeling of the anthropomorphic figurines are basic characteristics of this epoch. The cause for these qualitative and aesthetic changes of the material culture of the Vinča population is the emergence and development of new types of economy and copper metallurgy is specified as main driving force of these changes. All archaeometallurgical finds recorded at many Vinča culture sites justify and confirm the accuracy of these conclusions of M. Garašanin. It concerns the first finds and observations of M. M. Vasić at the eponymous site at Vinča, the most recent discovery of mine and necropolis in Jarmovac near Priboj, the finds from Gornja Tuzla and Stapani, the Vinča culture graves at Gomolava and Divostin as well as the material from Pločnik and Belovode. These two sites offer at this moment most of elements necessary to understand and complete the basic outline of the emergence of new technology.

The investigations carried out so far at these sites could help greatly to reconstruct the archaeometallurgical basis of the Vinča culture. If the Gradac phase of the Vinča culture is characterized by advanced copper mining and metallurgy it is certain that primary and initial phases of this technology date from more distant past. This is the logical development and evolutionary course of every new technology. An indisputable basis for these statements is thoroughly investigated and well documented mining at Rudna Glava, absolutely certain in the mine in the village Ždrelo, series of individual finds and technological elements recorded at Belovode and large series of finished copper artifacts from Pločnik. At this moment is absolutely certain that Vinča culture was acquainted with copper technology from its very beginning and that as such it has priority in comparison with contemporary cultures of the southeastern Europe.

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