

UDC 930.85(4-12)

ISSN 0350-7653

SERBIAN ACADEMY OF SCIENCES AND ARTS  
INSTITUTE FOR BALKAN STUDIES

# BALCANICA

## XLVI

ANNUAL OF THE INSTITUTE FOR BALKAN STUDIES

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BELGRADE  
2015



## REVIEW ESSAYS

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### **Rudna Glava in the Foreground of Recent Overviews of the Beginnings of Copper Mining in Europe and of the Development of Archaeometallurgy**

The site of Rudna Glava was discovered in the 1960's and investigated by Dr Borislav Jovanović. The site yielded extensive and well-preserved evidence of early copper mine works that provided an important insight into the prehistoric mining activities in Europe. This brief commentary aims to call attention to the most recent recognition in the literature of the importance of the Rudna Glava mining site for understanding the beginnings of prehistoric copper extraction in Europe and worldwide, as well as the development of the study of early metallurgy.<sup>1</sup>

#### *Rudna Glava: discovery and finds*

In the mid-1960's modern opencast iron-mining activities in eastern Serbia cut across and exposed a series of prehistoric mineshafts and access platforms on Rudna Glava hill (also known under the old name "Okna", meaning "mineshafts") located some 20 km southeast of the town of Majdanpek (Fig. 1). The focus of mining around Rudna Glava at the time was the extraction of magnetite in which the area abounds. While following a

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<sup>1</sup> I sincerely thank Dr Borislav Jovanović for drawing my attention to the two recent accounts on the Rudna Glava mining site, for providing details on his work at Rudna Glava and for supplying the illustration in Fig. 2. I am very grateful to Dr Miljana Radivojević for making corrections to the text and suggesting relevant bibliographical references.

vein-like magnetite deposit, at about 12 m below the ground surface the miners found a small votive “altar” or “altar-lamp” made of clay and decorated with modelled deer heads. They took the find to the museum in the nearby town of Negotin, where it was put on display. The object soon attracted the attention of an archaeologist, Dr Borislav Jovanović, who had previously seen this kind of altars at Late Neolithic Vinča culture sites in the region. The find inspired him to survey the area where the altar was discovered. Together with Ilija Janković, director of the Museum of Mining and Metallurgy in Bor, he discovered the presence of a number of shafts and some surface finds of the Vinča culture type pottery on the slopes of Rudna Glava. In collaboration with the museum in Bor, Dr Jovanović initiated extensive archaeological excavation of the Rudna Glava site, which was carried out between 1968 and 1986, with the crucial help and advice provided by the staff of the modern Rudna Glava mine. Over this period some forty mineshafts (of which many completely intact) and five “hoards” containing pottery, and stone and antler tools were discovered and excavated. The fill material of the mineshafts contained numerous fragments of pottery and other artefacts (Fig. 2). Based on the pottery type and ornamentation, the use of the site could definitely be associated with the Vinča culture. Critically, by examining the morphology of the shafts and typology of the tools, the mining process could be reconstructed. The prehistoric miners of Rudna Glava followed oxidised copper ore veins, some of which were visible on the surface and distinguishable by the appealing green colour of secondary copper minerals (malachite and azurite). In order to fully expose the copper veins, they sometimes had to remove the top soil. Clearing up the surface soil resulted in the creation of funnel-shaped shafts, and platforms were built to allow access to the shafts and ore extraction from the underground. The ore was extracted by applying fire-setting: an alternating hot-cold treatment of the rock followed by breaking the rock with grooved stone picks made of large, hard river pebbles. Antler picks/mattocks were also used in this process. The shafts were up to 20 m deep and 1–2 m wide. Pieces of ore were brought to the surface in some kind of containers (perhaps textile or leather bags). Oxidised copper ore was extracted there, primarily malachite, but also azurite and cuprite. Radiocarbon dates show that the mine was in use throughout the late sixth and first half of the fifth millennium cal BC – during the regional Late Neolithic and spanning the entire duration of the Vinča culture. The mine seemed to have occasionally been in use in the Late Eneolithic, and quite certainly in Roman times (4th century AD). All these data point to Rudna Glava as the earliest documented mining site not only in Europe, but also globally (Jovanović 1971, 1978, 1982, 1986, 2009; Jovanović and Ottaway 1976; Borić 2009; Roberts et al. 2009).

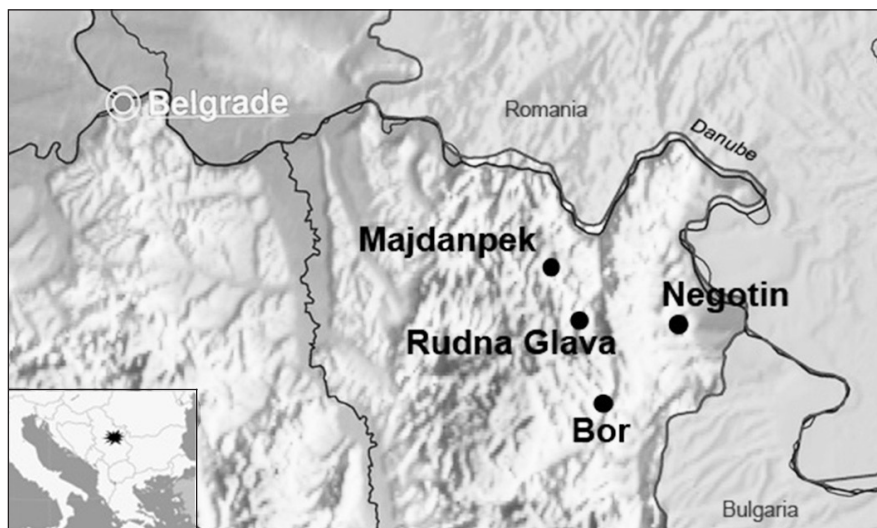


Fig. 1 Location of Rudna Glava in eastern Serbia

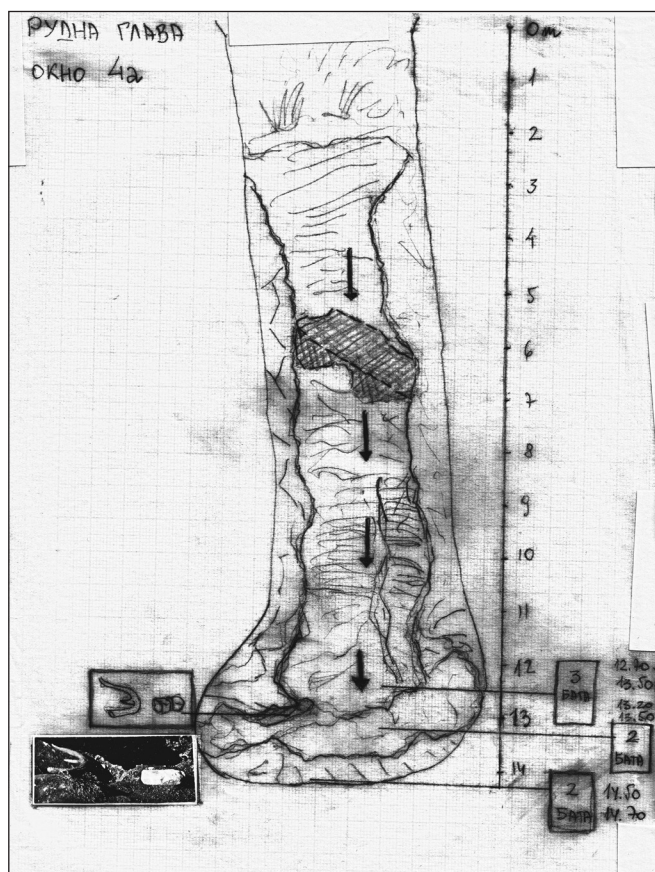


Fig. 2 Drawing of the cross-section of Shaft 4a at Rudna Glava with find-spots of some mining tools (courtesy of Dr Borislav Jovanović, original field records)

*Most recent recognition of the significance of Rudna Glava site in the international literature: O'Brien 2013 and Craddock 2013*

Discoveries at the site of Rudna Glava provided unique evidence for the beginnings of copper mining in Eurasian prehistory. Further, they indicated that copper extraction in the Balkans likely began independently of similar developments in the neighbouring areas (cf. Renfrew 1969) and, most significantly, in Anatolia, where evidence of early copper mining is remarkable (e.g. Lehner and Yener 2015). A number of prehistoric copper mines have since been detected in the central Balkans and, similarly to Rudna Glava, they all show connection with the Late Neolithic/Eneolithic Vinča culture (c. 5400–4500 cal BC) (e.g. Jovanović 1983; Derikonjić et al. 2011). Importantly, these records of early mining activities in the Balkans have recently been complemented with the world's earliest evidence for copper smelting, dated to c. 5000 BC, from the site of Belovode (Radivojević et al. 2010), but also from other Vinča culture sites (Radivojević 2015).

Extensively published by B. Jovanović, the findings from Rudna Glava have been referred to in the international literature on many occasions (most recently Kienlin 2014), further examined (e.g. Tylecote and Craddock 1982) and discussed in a broader geographic and chronological context (e.g. Pernicka 1993; Borić 2009). Two works published in the UK in 2013 are of interest here and their contribution to the recognition and presentation of the results of investigations of Rudna Glava is described below.<sup>2</sup>

*Prehistoric Copper Mining in Europe 5500–500 BC* by William O'Brien is a book recently published by Oxford University Press in which considerable attention is paid to the importance of the archaeological site of Rudna Glava, Serbia, for understanding the emergence and development of prehistoric copper mining in Europe on the one hand and, on the other, to the key role of the Rudna Glava fieldwork programme in laying the foundations for current research not only in the study of ancient copper mining but also of the prehistory of Europe in general. Although, as noted above, the relevant European literature contains a number of references to the evidence from Rudna Glava, the chapter that O'Brien devotes to this site (pp. 40–47) stands out as highly detailed and informative. In addition to the description of the archaeology of Rudna Glava, the chapter discusses the wider regional context of the mine, lists other contemporary sites in the area that yielded finds of copper, and refers to the newly available data on early copper metallurgy at the site of Belovode (Radivojević et al. 2010). Also, throughout the book, references are made to the discoveries at Rudna Glava wherever relevant. The text is enriched with illustrations and photo-

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<sup>2</sup> Opinions on the sections on Rudna Glava in the two publications expressed here are entirely mine.

graphs of the Rudna Glava site supplied by B. Jovanović. Particularly useful is the considerable attention paid to the description of the technology of mining reconstructed based on the spatial distribution and morphology of the mineshafts, the geological setting and the configuration of the ore veins (O'Brien 2013: 42–43). This is, perhaps, an even more scientifically important aspect of the prehistoric mine at Rudna Glava: not just that it currently is the oldest known mine in the world, but that its preserved features and artefactual evidence allow for a detailed reconstruction of the mining techniques, tools and process, and that they offer a rare glimpse of the social and symbolic meaning of (copper) mining in prehistory.

That the significance of Rudna Glava is manifold is further confirmed by Paul Craddock in his paper “Archaeometallurgy 1962–2013: The establishment of a discipline” published in the journal *Historical Metallurgy* 47. Craddock gives an overview of the key discoveries and achievements that marked the development of archaeometallurgy as a scientific discipline. In his selection of case studies, Rudna Glava figures as “the first European copper mine to be scientifically excavated...” (p. 2). This is a most direct acknowledgement of the great effort that Borislav Jovanović (in Craddock’s paper called ‘Boris’, which is how he has been referred to by his British colleagues) put into applying highest possible methodological standards and scientific approach at the time when experience with investigating prehistoric mining locations was, at least in the Balkans, lacking. The value of the research that B. Jovanović and his team carried out at Rudna Glava, and their discoveries, becomes even greater when considered against the general attitude of the archaeologists and historians working before and during the 1950s who ignored or even refused to accept the evidence of prehistoric ore extraction and metalworking (Craddock 2013: 1–2). Hence Craddock’s apt recognition of the importance of investigations at Rudna Glava for the establishment of archaeometallurgy.

It is worth noting that the publication of these two international accounts that place Rudna Glava in the foreground of the history of archaeometallurgical research comes at a contradictory time: on the one hand, thanks to the most recent discoveries, Serbia is in the focus of global archaeological attention as an area of the earliest mining and metallurgy in the world; on the other hand, the site of Rudna Glava, in theory protected as a cultural heritage site, is in reality being gradually swept away by soil erosion and landslides due to the absence of any protective structure over it. Decades ago, in 1984, B. Jovanović and the architect Čedomir Vasić submitted to the relevant Serbian authorities a thorough study of the geological and other natural processes at work at Rudna Glava, and proposed an excellent solution for the technical protection of the site that would also enable its conservation and public presentation (Vasić and Jovanović 1984). The

idea was subsequently elaborated (in 2001) and an action plan developed by Paun Es Durlić, a curator at the Museum in Majdanpek (<http://www.paundurlic.com/projekti/oplan.htm>). The project was supposed to be a collaborative undertaking of several relevant institutions in Serbia (local museums, Archaeological Institute in Belgrade, Department for the Protection of Cultural Monuments in Niš) and a partner-company from Germany. In 2001 an initial geodetic survey was carried out in preparation for further work; however, further work never took place because funding could not be secured either from Serbian state funding agencies or from private sources.

Several years ago, a large section of the unexcavated portion of the site collapsed due to a rockslide. It is quite possible that some of the prehistoric mineshafts got destroyed and are now lost, leaving behind only “scars” visible on the nearly vertical cliff at Rudna Glava into which prehistoric mining shafts were dug. This makes the completed archaeological work and discoveries at the site even more valuable and calls for urgent large-scale action towards public presentation of the finds from Rudna Glava, most of which are kept in the Museum of Mining and Metallurgy in Bor, and for the immediate protection of what has been left of this uniquely important archaeological site.

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This paper results from the project “Society, spiritual and material culture and communications in prehistory and early history of the Balkans” (no. 177012) of the Institute for Balkan Studies funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia.



