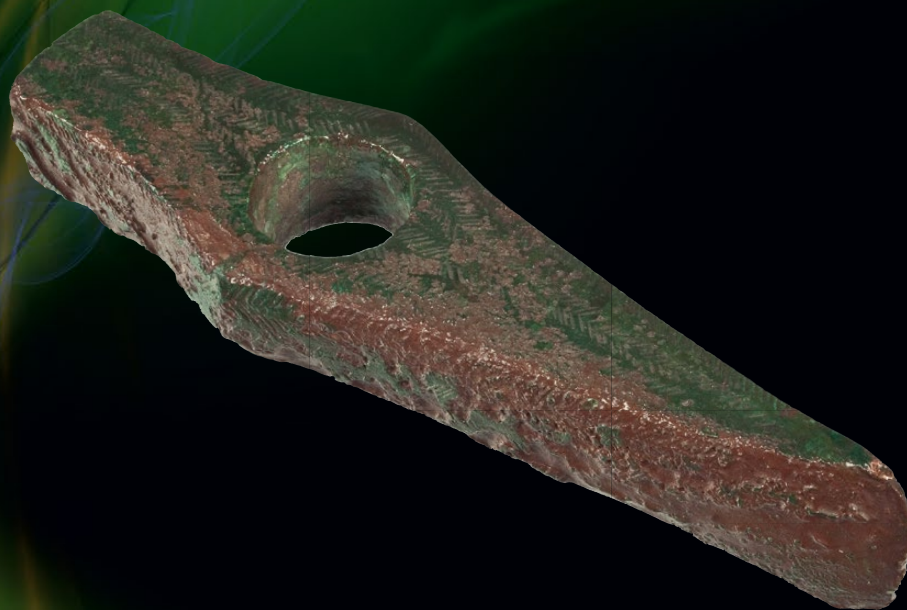




The Rise of Metallurgy in Eurasia

Evolution, Organisation and Consumption
of Early Metal in the Balkans



Edited by

Miljana Radivojević, Benjamin W. Roberts,
Miroslav Marić, Julka Kuzmanović Cvetković
and Thilo Rehren



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Inner back cover: Reconstruction of the world's earliest copper smelting. Green flames come from the
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To the memory of Borislav Jovanović, our colleague, friend and inspiration

(1930 - 2015)

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Chapter 16

Ground and abrasive stone tools from Belovode

Vidan Dimić and Dragana Antonović

Introduction

The analysis of ground and abrasive stone tools from Belovode encompassed an assemblage of 68 artefacts found in Trench 18, excavated in 2012 and 2013 and relatively dated to between the Vinča-Tordoš II (VinčaB1) and the Vinča-Pločnik I (Vinča C2) phases of the Vinča culture. The tools were categorised according to two criteria: the method of tool production and their functional-typological characteristics. 'Ground' and 'Abrasive' stone tools were further grouped into types and subtypes, according to their morphology and function.

The typological-functional analysis was conducted according to the morphological characteristics of the tools and traces of observable use. It was based on general observations and the correlation of the metric characteristics of certain tools and their position within a previously defined framework (Antonović 1992, 2003, 2014c), and was applied to all tools possessing the minimum preserved evidence necessary for analysis. The identification and definition of use-wear traces was conducted through comparison of data from the

same category of material at other sites (Semenov 1976; Olausson 1983a, 1990; Adams 1988; 1989; 2002; Adams *et al.* 2009; Pritchard-Parker and Torres 1998; Dubreuil 2001; Plisson and Lompre 2008; Pawlik 2007; Antonović 1992: 20–23; Dimić 2013a, 2015). Tool traces caused by the production process were also recorded to provide indications of the techniques used by Belovode craftspeople in the processing of different types of rock. All analyses were carried out at the Institute of Archaeology in Belgrade using magnifying glasses of up to 16× magnification and the Celestron® USB microscope-camera (with up to 100× magnification), with a connecting camera.

Raw materials

At Belovode, as at many localities in the Vinča culture, various types of rocks (as determined by the macroscopic observation of their petrographic features) were used for the manufacture of ground and abrasive stone tools. Most of the artefacts derive from only three groups of rocks, while other sources were represented only by single object (Figure 1).

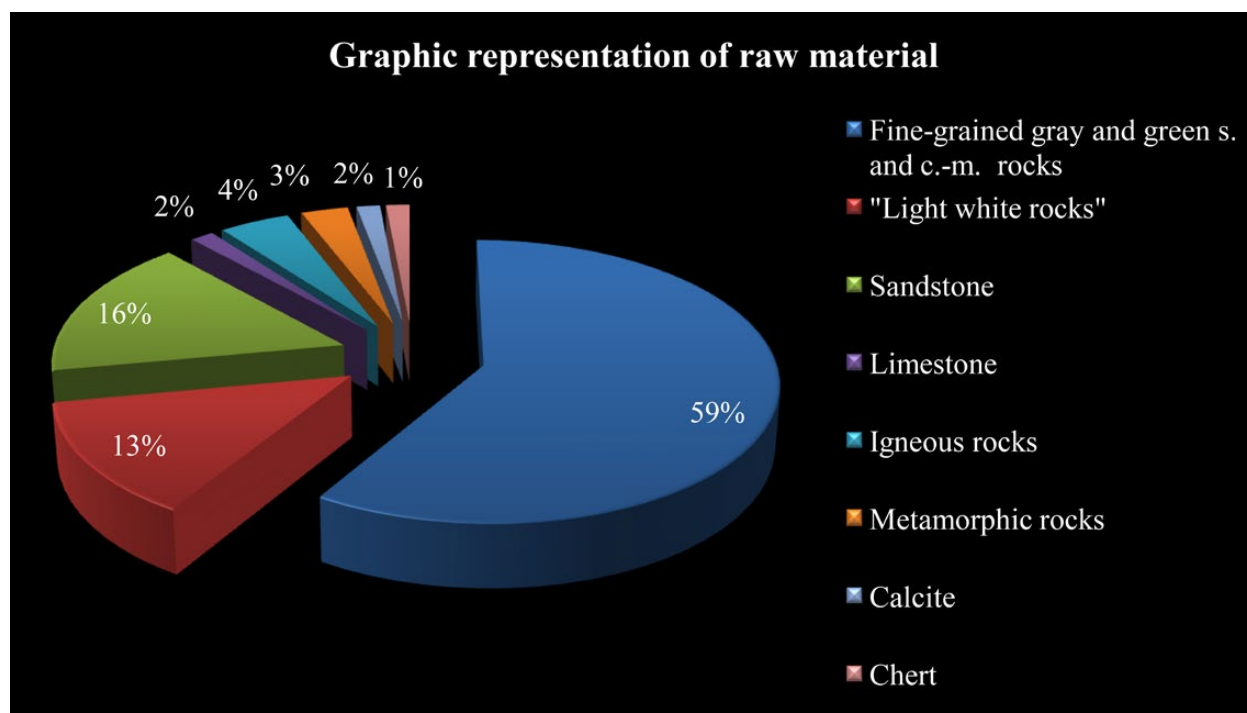


Figure 1. Graphic representation of raw material from Belovode, Trench 18.

Fine-grained, grey-green sedimentary and contact metamorphic rocks were used in the production of more than a half of all tools collected during the Belovode 2012 and 2013 excavation campaigns. Implements made from these sources, and having a cutting edge, occur in all phases of the settlement. These rocks have a variety of geological origins (e.g. crystalline schists, cornite, metasandstone and metaalevrolite), but the same technical-physical features: they are fine-grained, shades of grey-green, have a conchoidal fracture, and are very hard. This hardness ensured that tools such as axes, adzes, chisels, and hammers could be used for procedures which required frequent impacts.

Tools made of 'light white stone' were used in the later phases of the settlement, at the end of Vinča Tordoš II Phase (Vinča B1) and in the Gradac Phase (Vinča B2-C1). The term 'light white stone' refers to a distinctive group of macroscopically similar rocks whose main characteristics are that they are light in weight, porous, relatively soft, and occur in various shades of off-white and yellowish-white. According to the sparse analyses available, these rocks are variously defined as magnesite, chert, tuff, diatomite, and porcelanite (Antonović 1997; Antonović 2003: 45-47; Antonović and Šarić 2011: 68; Šarić 2002). Tools made of this raw material were mostly used in central Serbia and east and central Bosnia during later the phases of the Vinča and Butmir cultures and represent a definable characteristic of these phenomena. In central Serbia, 'light white stone' was the main raw material not only for ground stone tools, but also for the chipped stone industry. It was not intensively used outside the territory of the classic variant of the Vinča culture. This descriptive definition of the group of raw materials in Vinča and Butmir cultures was first recognised in late 19th century (Radimsky and Hoernes 1895: 29, 53-54) and has since been widely used in archaeological

literature (Antonović1997; 2003; 2011; Bogosavljević-Petrović 1992; Bogosavljević-Petrović *et al.* 2012; Dimić 2013a). In some assemblages, microscopic analyses revealed the 'light white stones' to be magnesite and chert (Antonović 2003: 45-46; Antonović and Šarić 2011: 68), which certainly cannot be termed 'light' due to their bulk mass but the porousness of the rock creates the false impression of lightness (see Antonović 1997; Šarić 2002). Partially silicified rocks with a hardness of c. 4.5 on the Mohs scale were the most commonly used raw material for production of the tools discovered in the earlier excavations at Belovode. Only rarely were raw materials with a lower hardness used, but since their characteristics were only macroscopically determined, the types of rock cannot be stated with total certainty.

Sandstone, a rock with abrasive properties, was a very common raw material at Belovode. Fine-grained, compact and well-silicified sandstones with high level of quartz were used to make all the abrasive tools. Other types of rocks were present in small amounts. One adze, one amulet, three abrasive tools, one fragment of perforated axe and two atypical fragments were made of diabase, aplite, gneiss, quartzite, chert, limestone, and calcite (Table 1).

The analysis of the stone raw materials used for tool production from Trench 18 at Belovode is completely compatible with earlier analyses of the stone tool assemblage from Trenches 1 to 6, which were excavated in the period 1994-1997 (Antonović 2000).

Typological-functional analyses

The 68 macrolithic artefacts from Trench 18 could be placed into two basic groups, the first characterised by mainly untreated tools with abrasive features and the second including tools shaped by grinding (Figure 2).

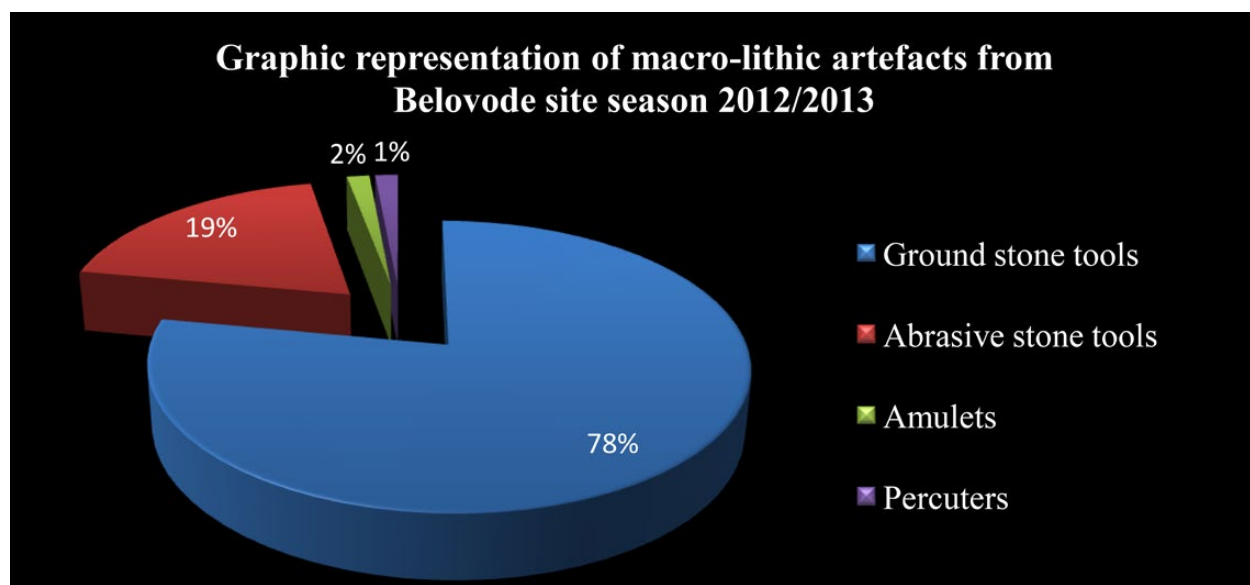


Figure 2. Graphic representation of macro-lithic artefacts from Belovode site, Trench 18.

Table 1. Types of ground and abrasive stone implements in Trench 18.

Type of tool	Number	Complete tool	Length in mm	Rock type
I/1b	3	0	64-90	Metamorphic sandstone, crystalline schist
I/3e	1	0	46	Crystalline schist
III/1a	5	1	65-90	Crystalline schist, metamorphic sandstone, metaalevrolite
III/1b	4	0	45-88	'Light white stone', crystalline schist, cornite
III/1c	1	0	66	'Light white stone'
III/1e	1	0	76	Crystalline schist
III/2a	2	0	65-96	Crystalline schist, metaalevrolite
III/3b	1	0	70	Crystalline schist
III/5a	1	0	52	Crystalline schist
III/5b	2	1	35-71	Crystalline schist
III/5d	2	1	47-113	Crystalline schist, limestone
V/1b	1	1	45	Crystalline schist
V/2b	4	2	47-50	Metaalevrolite, 'light white stone', crystalline schist
V/2e	1	1	73	Crystalline schist
V/4b	1	0	62	Crystalline schist
V/5b	3	0	37-91	Crystalline schist, cornite, metaalevrolite
V/6	2	1	46-47	Metamorphic sandstone, crystalline schist
XI/3a	1	1	123	Diabase
XI/3c	4	0	37-83	Coarse and fine-grained sandstone
XI/6a	1	0	74	Sandstone
XI/6b	2	0	90-147	Fine grained sandstone
XIII/3	1	0	109	Sandstone
Querns	2	1	250-290	Sandstone
Hammerstones	2	1	67-85	Aplite, crystalline schist
Amulets	1	1	30	Calcite
Preforms	3	2	62-118	'Light white stone', gneiss, crystalline schist
Pebble/pottery grinder	1	1	28	Quartzite
Chunks	3	0	37-42	'Light white stone', crystalline schist, metaalevrolite
Undetermined	12	0	34-102	'Light white stone', crystalline schist, diabase, metaalevrolite, sandstone, chert

Most (43) of the artefacts had serious damage, which had resulted in the tool being discarded. Somewhat smaller levels of damage were observed on 11 artefacts, while 15 were almost completely preserved. All tools, with even the slightest morphological evidence for typological determination, were included in the analysis (Table 1).

The abrasive tools from Belovode were less numerous than the ground stone artefacts. They encompassed

several smaller static grinders (eight objects), two querns, a handstone, a whetstone, and a pebble pottery-grinder (Figure 3), and a hammer-stone/percussion tool. The static grinders have mid-range dimensions, with traces of use-wear and one to two clearly defined working surfaces. They were made from fine-grained sandstones with abrasive characteristics. A grinder from Feature 14 (C-1859), made from fine-grained sandstone, with lateral edges partially processed by grinding, is especially notable. The technical-physical

features of the raw material made it suitable for fine-processing, most probably final-processing, of objects made from hard materials (e.g. rock, bone, horn, and pottery). It has two clearly defined working surfaces: after a large dent occurred on one side, the object was turned and the grinding was conducted on the other side until the stone became too thin, and fragmented (Figure 4). To produce querns, craftspeople used massive pieces of compact raw material with distinctive abrasive characteristics; they were partially modified by edge-pecking. Both querns from Belovode have visible burning traces on their lower, dorsal sides and clearly defined, smooth, concave working surfaces on their ventral sides. The traces of use-wear on the ventral side suggests that they were used through movement in various directions, but mostly longitudinally and transversely to the quern (Figure 5; see Dubreuil 2001: 73–87; Adams *et al.* 2009: 48–53).

Ground stone tools represent the majority of large stone tools at Belovode. Within this group, there are several types and subtypes including: axes (5),

adzes (22), chisels (12), and three pre-forms and nine fragments that could not be classified with any certainty due to severe damage (Figure 6). Two types of adzes are represented: I/1 – three objects, and I/3 – one object. One axe could not be typologically determined due to severe damage. Adzes are the largest category of tool with 22 objects. Type III/1, the most common type in the Vinča culture, is the most dominant with

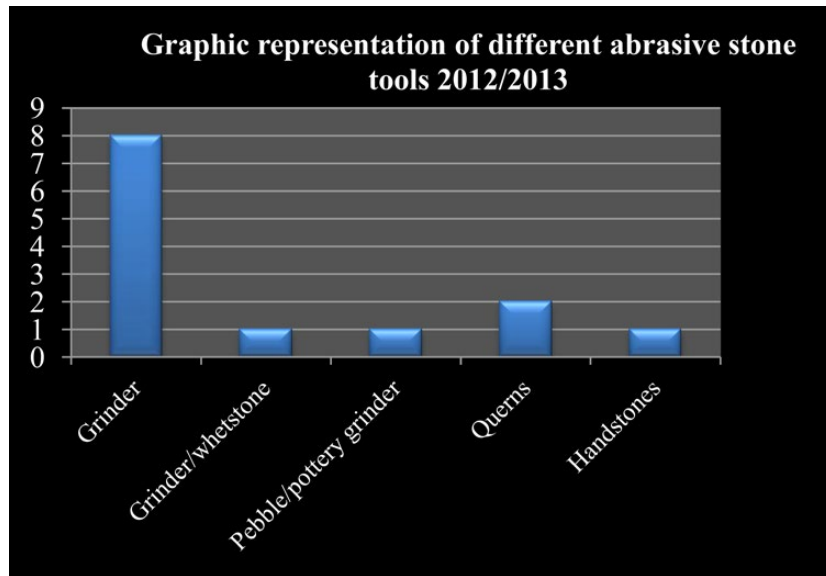


Figure 3. Graphic representation of different abrasive stone tools from Belovode, Trench 18.



Figure 4. Grindstone (C-1859); grey coarse-grained sandstone. Working surfaces on both sides, dorsal and ventral, are clearly distinctive.



Figure 5. Querns from Belovode (Finds 224/2 and 225 in the ground stone database).

11 objects; Type III/5 includes five objects, while Types III/2 and III/1 are represented by two and one object respectively (Figure 7). A tool with a perforation could not be typologically attributed due to a high level of fragmentation. An amulet with a groove, made from calcite by pecking and grinding, is the only find of a cult object or item for personal adornment (Figure 8).

All ground tools with a cutting edge were made from fine-grained, hard and compact grey and grey-green rocks (crystallised schists, cornite, metasandstone and

metaalevrolite), as well as from 'light white stones' of various hardness and silicification grades. The choice of raw material influenced the method of processing, i.e. the reduction technique used to create the desired size and shape. The traces observed on the ground tools indicate several stages of production (Antonović 2014b; Dimić 2015). The first of these was knapping. This was conducted mainly using the ventral side as the knapping platform, thus reducing the dorsal side and producing a recognisable semi-circular cross-section. This kind of knapping was usually practiced in the

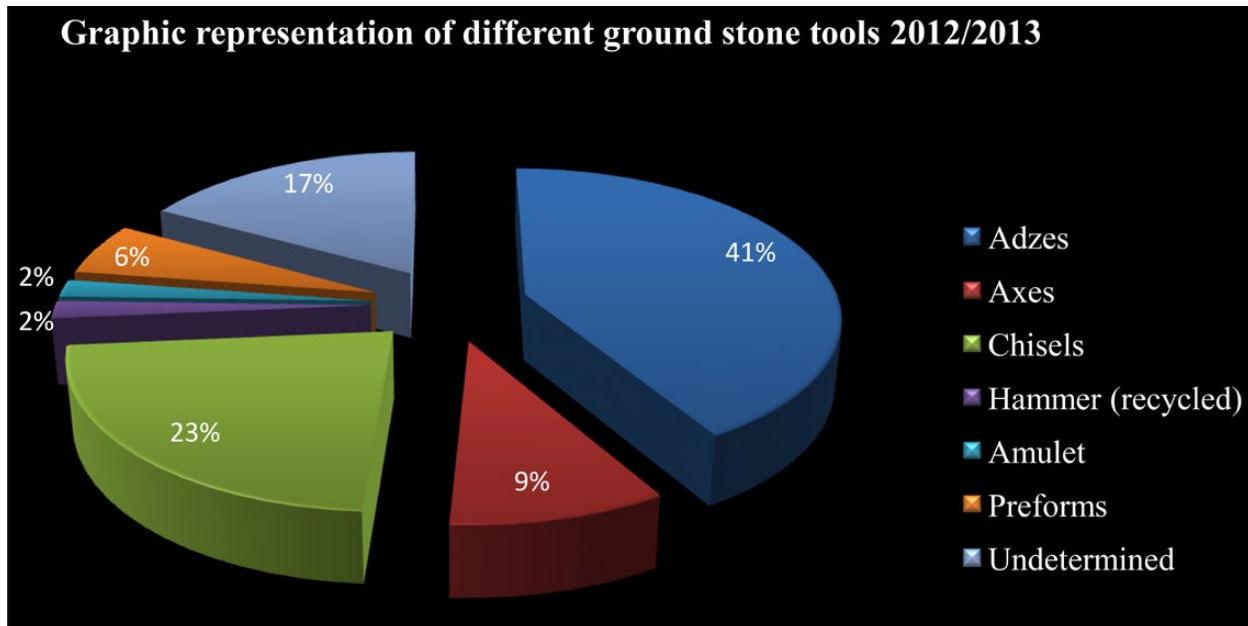


Figure 6. Graphic representation of different ground stone tools from Trench 18.

production of adzes and was a standard technique in the Vinča culture. By contrast, zig-zag knapping was used for producing axes, and can be observed on an example of a pre-form (Figure 9; Dimić 2013a). After knapping, the edges were retouched with a standard reduction of the butt, making it flat. The pre-form was finally processed by grinding on static grinders made from the fine-grained variety of sandstone. The grinding traces (rectilinear, parallel to the longitudinal axis of the object, and circular) indicate that this was conducted in several directions and that water was used. Particular attention was paid to processing the cutting edge.

When the use-wear traces of this tool category were investigated, different levels of destruction of edge and butt could be determined (Dimić 2015). Negatives of micro flakes, which occurred during intense use, can be observed on almost all cutting edges. Micro polish and rounded edges, produced by the pressure and friction that the tool head suffered from inside the haft, are visible on the butts (Figure 10). As previously mentioned, most of the tools suffered severe damage, although the position of the damage varied from the distal and proximal parts to the middle of the tool. After heavy damage, tools were rejected if they could not be recycled into a new object. Recycling was observed on three chisels, as well as on one larger tool. In this case, the tool (of unknown previous purpose) had suffered fragmentation of its distal part but had been transformed with minimal knapping into a hammer.

Conclusion

The analysis of the collection of ground and abrasive stone artefacts from the site of Belovode completely matches the results obtained through the examination

of the same category of tools from Trenches 1–8 excavated between 1994 and 1997 (Antonović 2000). The production of stone tools on this Neolithic settlement appears in its fully developed form from the earliest occupation activity (Vinča-Tordoš I Phase, or Vinča A) and did not significantly change until the very end. The craftspeople of Belovode had clear affinities towards macroscopically similar grey and grey-green raw material, which is generally also the case in other Vinča settlements (Antonović 1992, 2000, 2003, 2014b). Fine-grained sediment and contact metamorphic hard rocks with a conchoidal fracture (e.g. crystallised schists, cornite, metasandstone and metaalevrolite) were used to produce woodworking tools (axes, adzes and chisels) in the same manner as throughout the entire Vinča culture (Antonović 2014b).

Primary processing began with the knapping of a suitable piece of raw material and its reduction to a desired shape. A retouch was then used to achieve fine modifications, to shape edges and create a cutting edge, while the final form was obtained by grinding on static grinders, using water. Polishing, as a special technique, was recorded on several objects. All polished edge cutting implements were made of green and grey fine-grained, hard rocks.

The quality and intensity of grinding depended on the quality of raw material. The best ground artefacts were those made of compact and hard rocks, indicating that the stone craftspeople of Belovode were familiar with the petrographic features of rocks and invested the most effort in producing implements from material that could endure intense work. The greatest attention was given to the process of grinding the cutting edge, while the rest of the tool was only partially ground.



Figure 7. Ground stone cutting implements from Belovode, Trench 18: 1) adze type III/5b; 2) adze type III/1a; 3) adze type III/5d and segment of dorsal side surface with manufacture traces of grinding.

The resulting tools were used for a variety of activities connected to wood processing, from tree felling and splitting, to the production of architectural elements and pieces of house furnishings.

We could not identify a clear change in the choice of raw materials or in the production techniques in the ground stone industry throughout the horizons of occupation in Trench 18. From the very beginning, stone tools produced in the settlement are not conspicuous for their attractiveness or the uniqueness

of the manufacturing process, but for their consistency in the sizes, the types of tools, and the choices of raw material.

As in many other Vinča culture sites, Belovode populations also used objects made from 'light white stone', occurring from the Gradac Phase, although these are not as numerous as at some other sites (Antonović 1992, 2003, 2011:197, 2013: 26, 28; Bogosavljević-Petrović 2011: 215; Dimić 2013a). It seems that grey and grey-green rocks were abundant and available near the

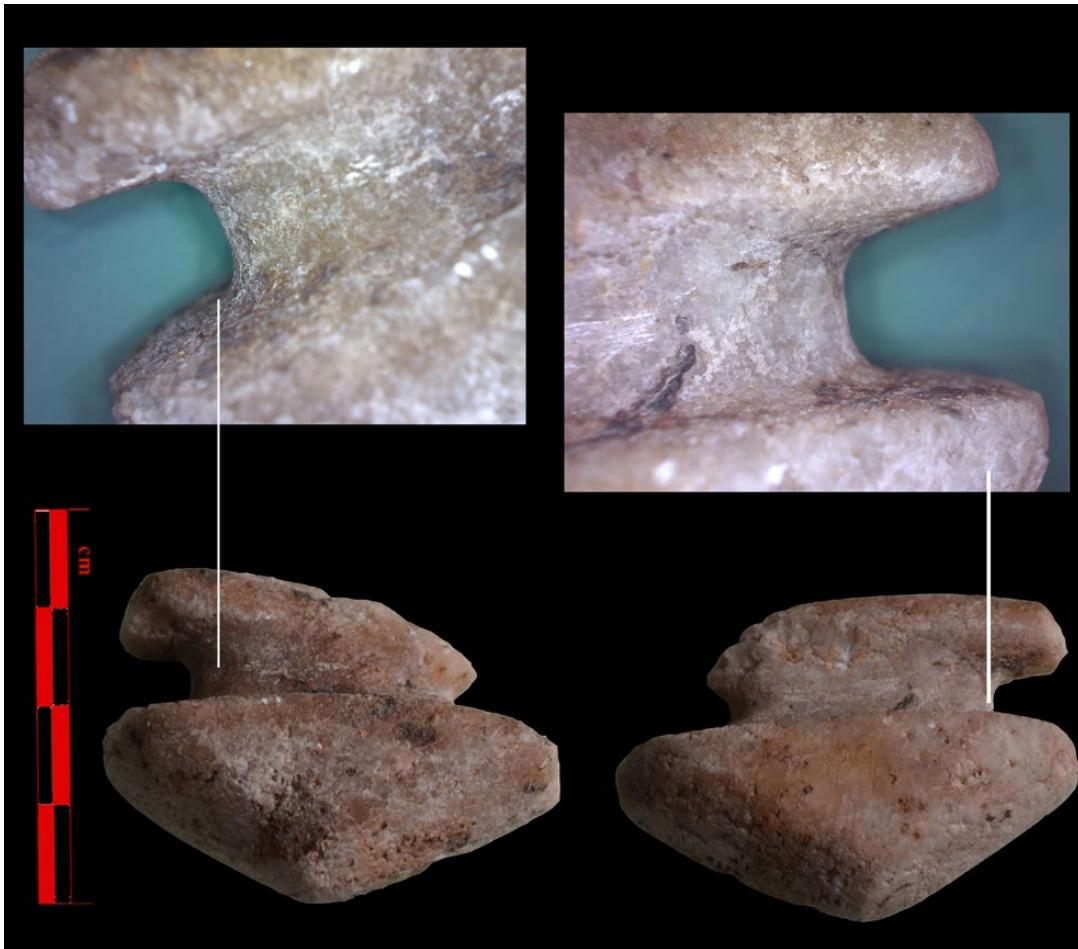


Figure 8. Ground stone amulet (C-1858) of calcite. Above: macro footage of groove and manufacture traces.



Figure 9. Preform of ground stone axe (Find 452); 'Light white stone'. Traces of knapping on both dorsal and ventral sides are clearly visible.

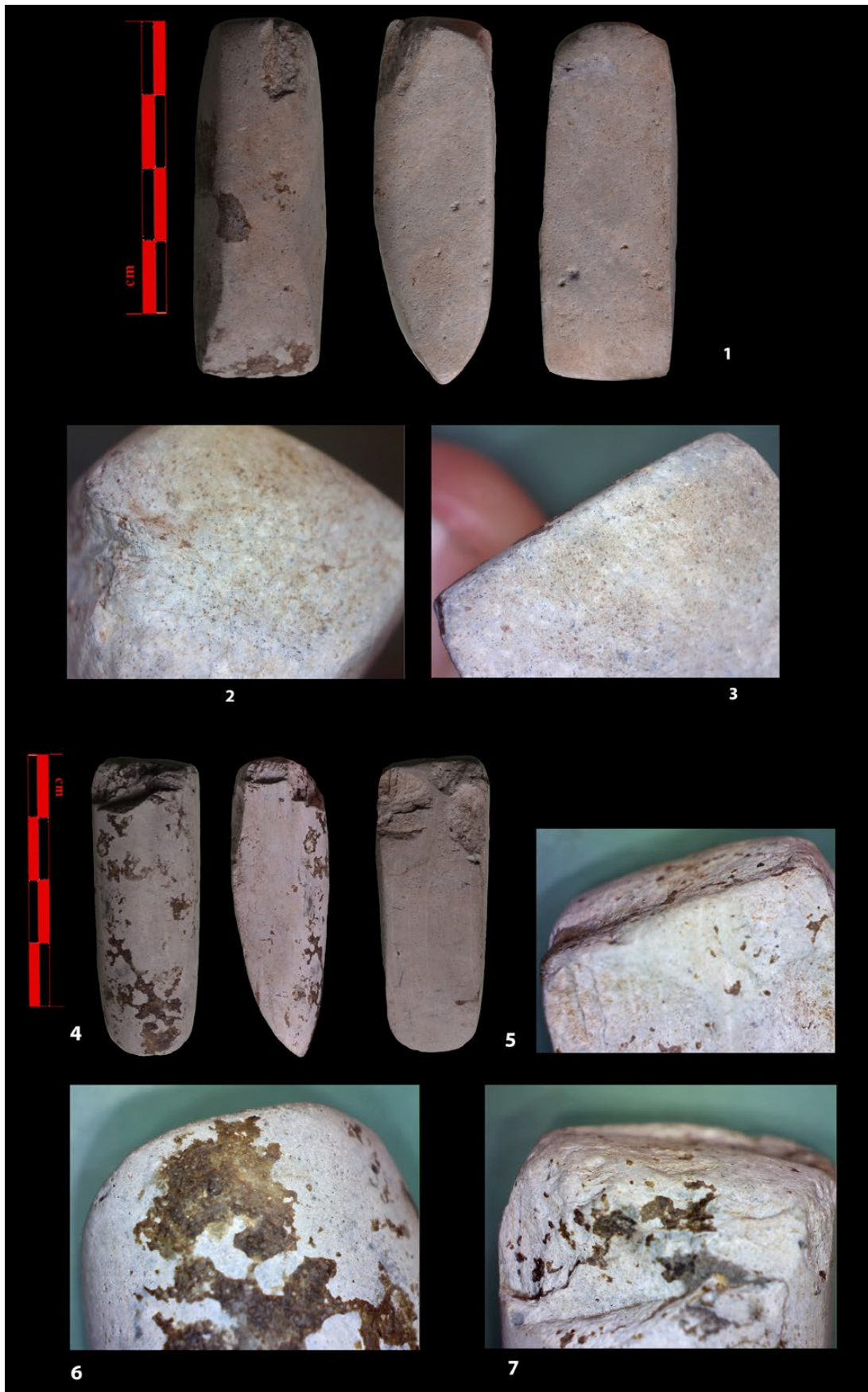


Figure 10. 1) Chisel (C-1817); 2) use-wear on butt 3); use-wear on cutting edge; 4) chisel (C-1823); 5) use-wear (rounded surfaces) on butt probably as an effect of hafting; 6) use-wear on the cutting edge is not very clear; 7) use-wear on butt.

settlement, so there was less necessity for ‘light white stone’ as elsewhere. Alternatively, it is possible that ‘light white stone’ deposits were limited in quantity at Belovode, perhaps occurring in smaller veins and interlayers, and not in whole geological layers as was the case with other areas in Serbia (Antonović 1997, 2003; Bogosavljević-Petrović *et al.* 2012; Dimić 2013a).¹

Thus far, there is not enough data to identify the exact locations from which Belovode craftspeople could exploit suitable stone. Nevertheless, based on the processing method and the shape of tools, it can be concluded that the rocks were exploited from both primary and secondary deposits. Secondary rock deposits were most probably in the form of alluvium

from nearby rivers and creeks; identification of primary deposits would require detailed geological prospection of the wider area around Belovode.

Stone tools from Belovode fit well within the framework of the ground and abrasive stone tool industry of the Vinča culture. They do not stand out for their production quality or attractiveness, but for their consistency over a long period with the production of tools of similar appearance, made from similar raw materials. Whether this was a result of defined production standards that completely fulfilled the needs of Belovode residents, or some other phenomena linked to the geological surroundings, or to social aspects remains to be explored in the future.

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¹ Geological analyses and prospection were not undertaken in the frame of the project. See Chapter 45, this volume for further details on stone raw materials from Belovode.

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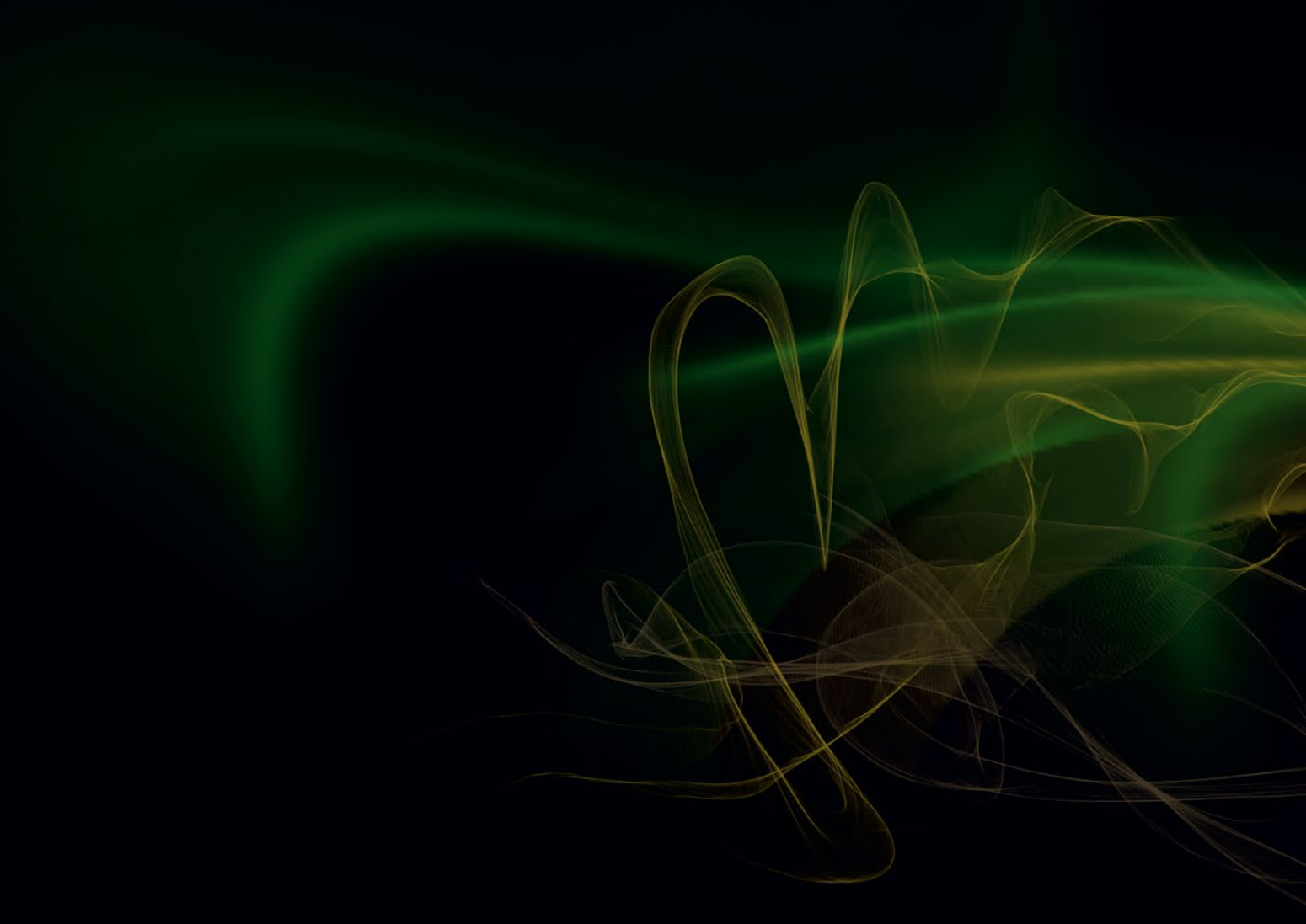
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The Rise of Metallurgy in Eurasia is a landmark study in the origins of metallurgy. The project aimed to trace the invention and innovation of metallurgy in the Balkans. It combined targeted excavations and surveys with extensive scientific analyses at two Neolithic-Chalcolithic copper production and consumption sites, Belovode and Pločnik, in Serbia. At Belovode, the project revealed chronologically and contextually secure evidence for copper smelting in the 49th century BC. This confirms the earlier interpretation of c. 7000-year-old metallurgy at the site, making it the earliest record of fully developed metallurgical activity in the world. However, far from being a rare and elite practice, metallurgy at both Belovode and Pločnik is demonstrated to have been a common and communal craft activity.

This monograph reviews the pre-existing scholarship on early metallurgy in the Balkans. It subsequently presents detailed results from the excavations, surveys and scientific analyses conducted at Belovode and Pločnik. These are followed by new and up-to-date regional syntheses by leading specialists on the Neolithic-Chalcolithic material culture, technologies, settlement and subsistence practices in the Central Balkans. Finally, the monograph places the project results in the context of major debates surrounding early metallurgy in Eurasia before proposing a new agenda for global early metallurgy studies.