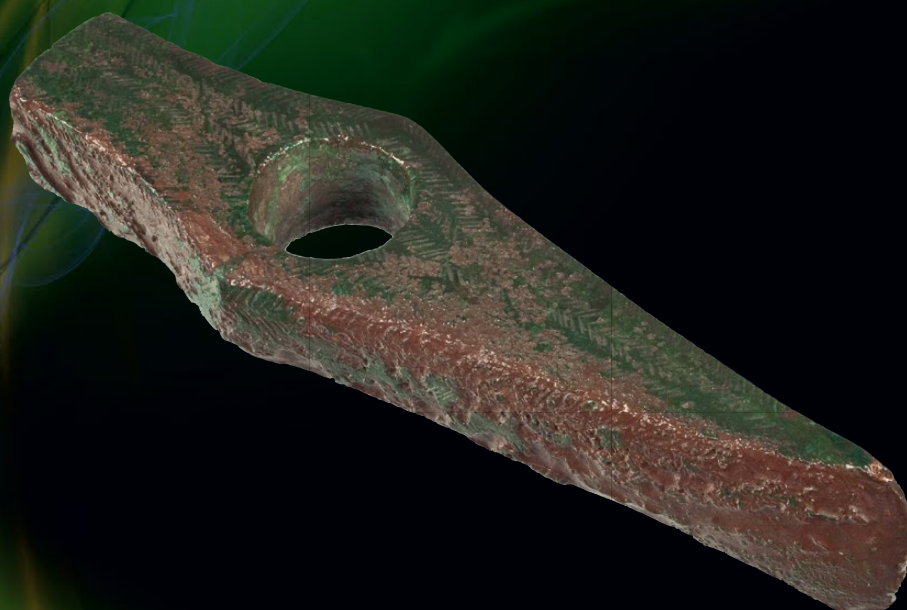


The Rise of Metallurgy in Eurasia

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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To the memory of Borislav Jovanović, our colleague, friend and inspiration

(1930 - 2015)

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Chapter 31

Ground and abrasive stone tools from Pločnik

Vidan Dimić and Dragana Antonović

Introduction

This analysis of ground and abrasive stone tools from Pločnik is based on the examination of assemblage of artefacts found during 2012 and 2013 in Trench 24. The assemblage is very characteristic of the Vinča culture and spans Vinča Tordoš I (Vinča A) to the Gradac Phase (Vinča B2–C1) when occupation at Pločnik terminated in a great destructive fire.

We analysed more than 100 artefacts but selected for detailed study only those finds with a clear context; 72 artefacts are discussed here. A large number (41) of large abrasive tools (static grindstones, grinders and querns made of various types of sandstone of local origin) were not included in this study because of their unclear context.

As with the Belovode assemblage, the ground and abrasive stone tools were classified according to the production method of the tools and their typological and functional features. The typological analysis was based on general observations and the correlation of metric characteristics of certain tools and their place within the methodological framework established by Antonović (1992, 2003, 2014c). Tool function was examined through the correlation of morphological characteristics and visible traceological markers for all tools with minimum preserved evidence (Semenov 1964; Olausson 1983a, 1990; Adams 1988; 1989; 2002; Adams *et al.* 2009; Pritchard-Parker and Torres 1998; Plisson and Lompre 2008; Pawlik 2007; Lunardi 2008; Antonović 1992: 20–23; Dimić 2013a, 2015). In addition to specific use-wear traces, other production marks were also recorded, providing indications of the

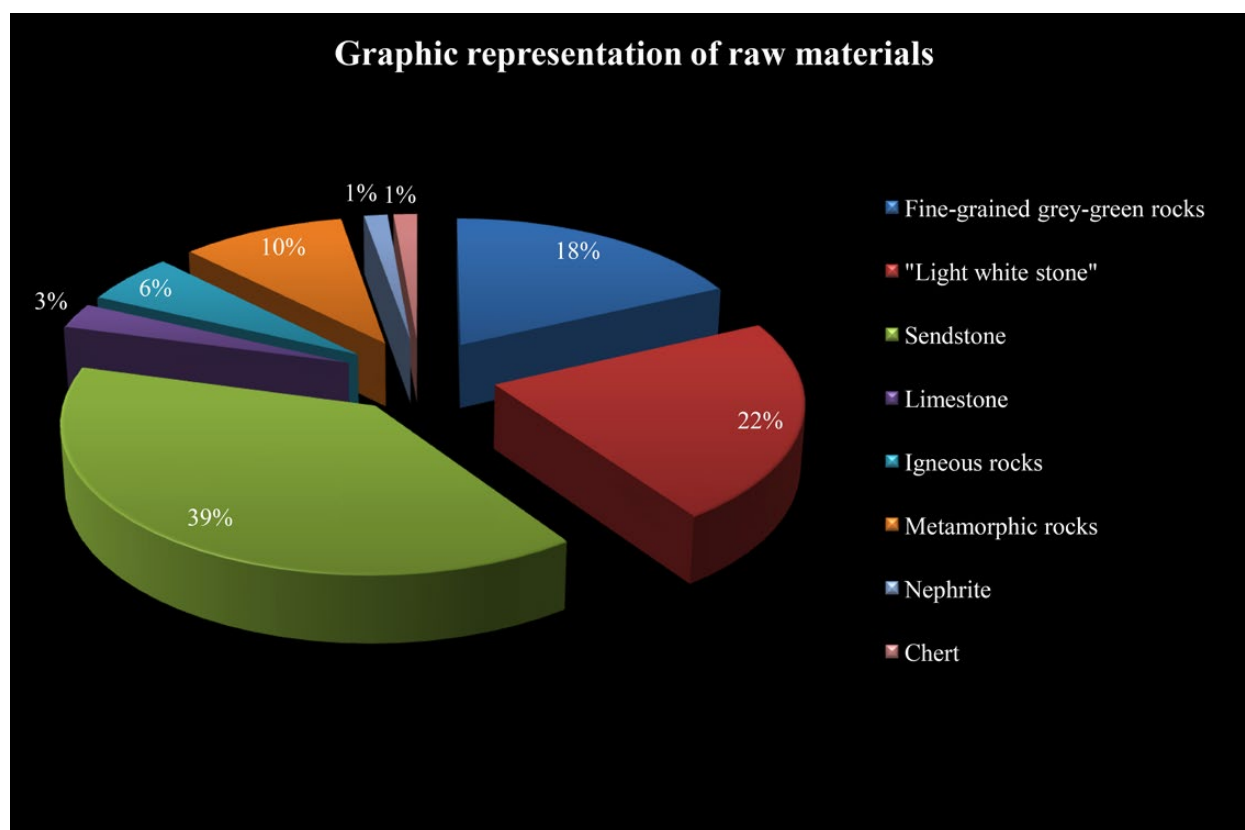


Figure 1. Graphic representation of raw materials from Pločnik.

methods and processing techniques used by Pločnik craftspeople for different types of rock. All analyses were carried out at the Institute of Archaeological in Belgrade using magnifying glasses with up to 16× magnification and a stereo microscope (Olympus®) with up to 100× magnification with a connecting camera.

Raw materials

The stone raw materials from the site of Pločnik are typical of the Vinča culture (Figure 1). Like all other Vinča culture sites, Pločnik had ground-edge implements (e.g. adzes and chisels) produced from fine-grained compact rocks of different geological origins (sedimentary and contact-metamorphic rocks) but with the same technical characteristics: they produce a distinct conchoidal fracture that enables processing by knapping, and a toughness to prevent them breaking during repeated impacts.

Two large groups of these rocks can be distinguished by colour: green-grey and white. Based on the macroscopic analysis, the group of green-grey rocks consisted of cornite, crystalline schist, and metaalevrolite. The white rocks could not be precisely defined by macroscopic analyses. These so-called 'light white stones' were the most popular stone raw material in later Vinča culture phases (Antonović 1997, 2003). In Pločnik, they were present in different degrees of silification from completely soft and powdery to those which were significantly harder, similar to chert (see Belovode report, Chapter 16, this volume). The abrasive tools at Pločnik were made from various types of sandstone. Fine-grained, very compact and hard quartz sandstones represent the main type of raw material. In addition, rocks and minerals such as silicified limestone, some igneous rocks (granite, andesite and aplite) and metamorphic rocks (marble, quartzite and chert) were also used. Nephrite was used to make one miniature adze. Most of the nephrite artefacts from the Neolithic and Chalcolithic cultures of the Balkans come from Bulgaria (Kostov 2013). Deposits of nephrite have not been found in Serbia, although areas geologically suitable for its occurrence do exist (Antonović 2003: 34–37, 139). Nephrite is found in Austria, Bulgaria, Italy, Poland, Russia, Ukraine, and Turkey (Kostov 2013). A study of the provenance of samples of this mineral found at Neolithic localities in Serbia might indicate trade relations with such remote areas.

Typological classification

During the excavation campaign of 2012–2013 at Pločnik, more than a hundred large stone tools were discovered, of which 72 were macro-lithic artefacts with detailed contextual information and therefore included in this analysis (Figure 2). Almost half (47.2%)

of these were fragmented or partially damaged, while 38 objects (52.8%) were completely preserved. The tools can be classified into two categories:

1. artefacts with abrasive features, which were not formed by intentional grinding in the process of production, but subsequently during their use; and
2. ground stone tools, which obtained their final form in the manufacturing process by grinding or polishing.

The abrasive stone tools included 28 complete and partially damaged artefacts (Figure 3). The most numerous are 15 whetstones, produced from fine-grained sandstones of different shades of grey and red. They are of various shapes and sizes, from flat ellipsoid to elongated, irregular rectangular in cross-section (Type XII/1: twelve examples, Type XII/2: three examples; types according Antonović 2003: 52–60). Pestles are also represented (four examples). These are made from hard, compact sandstone, as are two tools considered to be used for the thinning of metal objects (Freudenberg 2009: 343). Three hand grinders and three pebble grinders, possibly used for pottery polishing, were also present (Type XI/6: one example, Type XI/3: two examples). Five hammerstones of almost spherical shape were identified; few anvils and handstones were found.

Ground stone tools are present in slightly more significant numbers than the abrasive tools (Figure 2). Out of 34 artefacts with different degrees of preservation the following stand out: two decorative objects (pendants?); one fragment of a marble vessel; and one fragmented mace head (Type X/2). The remaining 30 objects belong to the group of edge-ground implements (Figure 4).

As at other Late Vinča sites in the Balkans, adzes from Pločnik are the most common ground stone tools. Twenty-three were found at the site, manufactured mostly from fine-grained rocks (e.g. crystalline schists, cornite, metaalevrolite) and 'light white stone' of different grades of hardness. The adzes have different degrees of preservation, from complete specimens (C-563, C-570, C-609, C-610, C-649, C-727, C-728, C-729, C-730, C-731, C-732, C-733, C-669) to fragments of the distal or proximal end. The dimensions of complete tools vary from 60–210 mm, most commonly being from 120–140 mm (Figure 5). The most dominant type are adzes have a wider distal end and a slightly convex edge (Type III/1: eleven examples). Next are elongated adzes with the slightly wider distal end (Type III/3: five examples), and other forms of adzes (Type III/2 with three specimens, Types III/4 and III/5 with two specimens and Type III/7 is represented by one artefact).

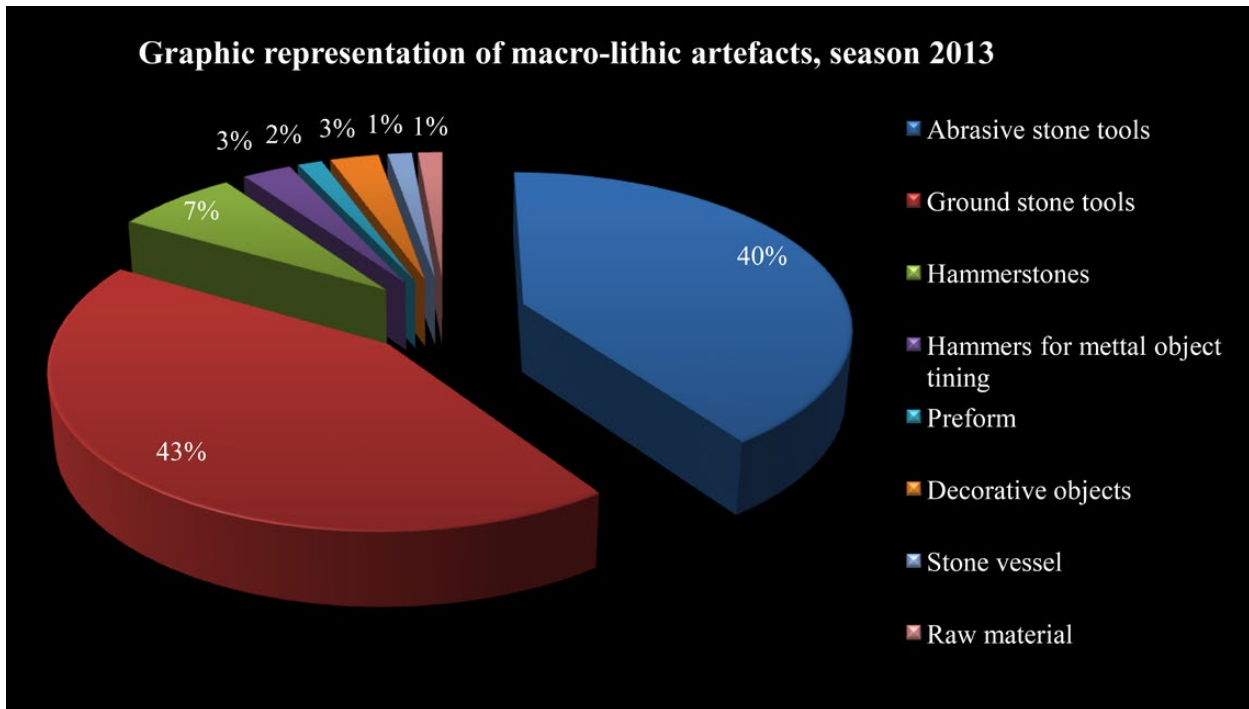


Figure 2. Graphic representation of macro-lithic artefacts from Pločnik.

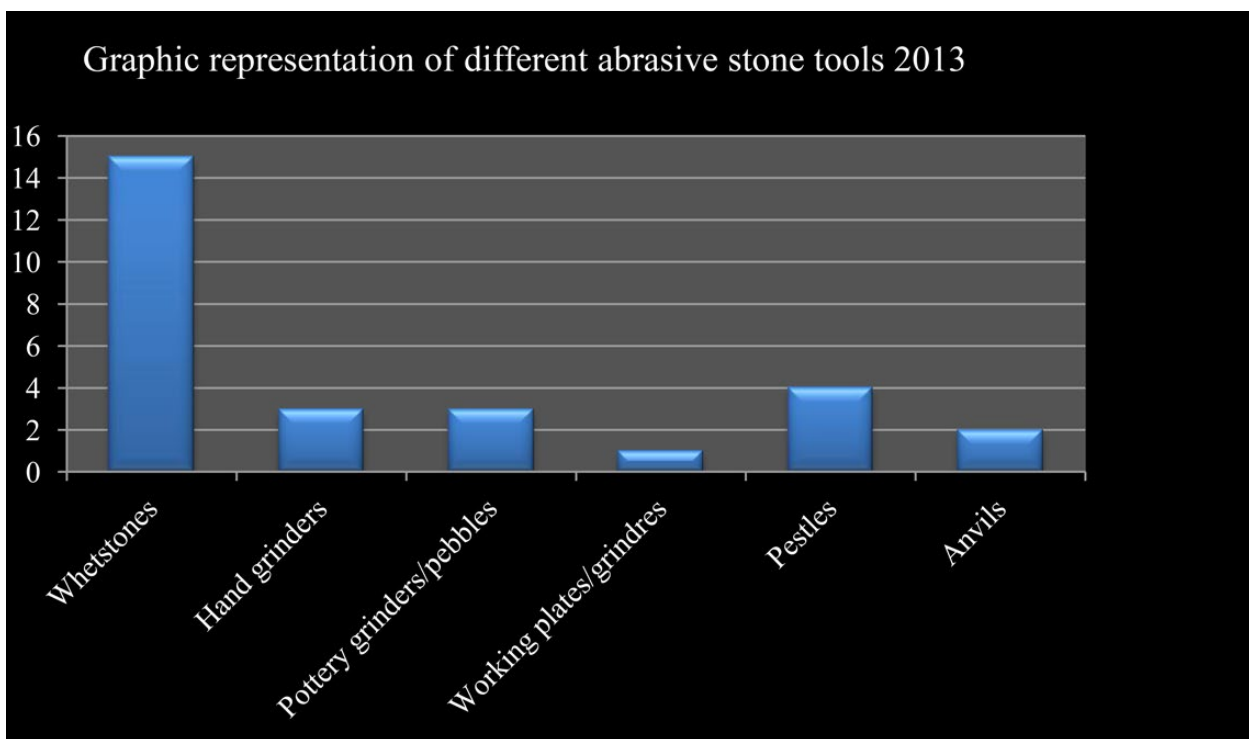


Figure 3. Graphic representation of different abrasive stone tools from Pločnik.

Particularly noteworthy is the hoard of eight adzes manufactured from the 'light white stone'. These belong mostly to the type of elongated adzes with a narrower proximal and slightly wider distal end with convex edge (Types III/1 and III/3). Microscopic examination has determined that four of the adzes carry distinctive

use-wear traces on their cutting edge and butt, which most likely occurred during their use in woodworking (see Figures 10 and 11).

Four chisels were also found, two of which were manufactured by the recycling of flakes produced

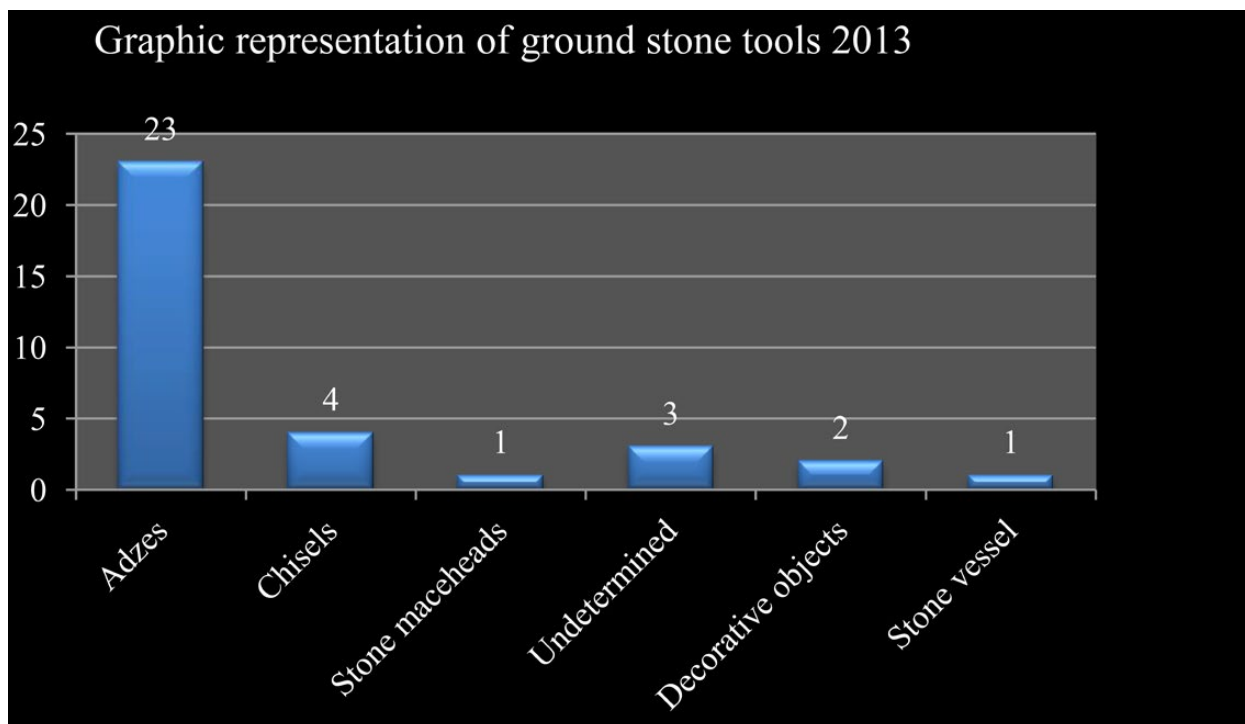


Figure 4. Graphic representation of ground stone tools from Pločnik.

Length of whole edge-cutting tools

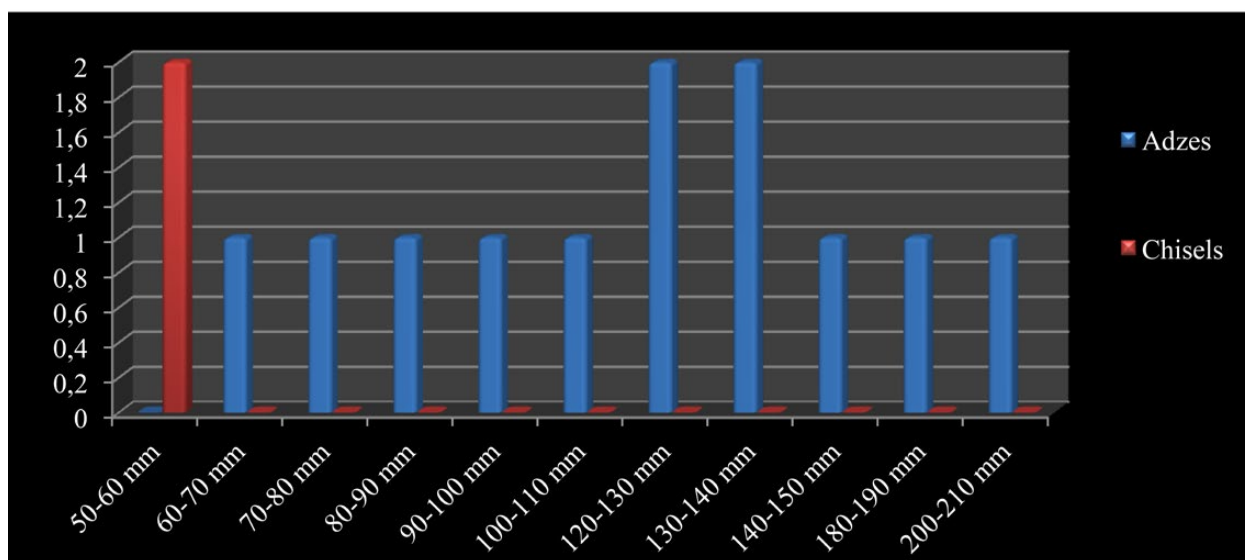


Figure 5: Length of complete tools with a cutting edge from Pločnik.

during the fragmentation of larger ground stone tools. The chisels and the adzes were produced from the raw materials of metaalevolite, cornites, and 'light white stone'. From a morphological perspective, three types are noted: chisels with parallel sides, and the convex edge which is not in the plane of symmetry of the tool (Type V/3 – two examples); chisels with a wider proximal end, and a convex edge that is not in the plane of symmetry of

the tool (Type V/2 – one example); chisels with a wider distal end, and a slightly convex edge that is not in the plane of symmetry of the tool (Type V/5 – one example).

Due to their high degree of fragmentation, three objects are classified as 'undetermined'. No examples of axes were found in the excavations at Pločnik between 2012 and 2013.



Figure 6. Pestle C-574 (left), pestle C-574e (right).



Figure 7. Pestle C-574c with clearly distinctive working surface. Traces of use are visible as parallel cylindrical furrows produced by circular working motion.

Traceology: production, function and use-wear traces

There is insufficient data to reconstruct the complete *chaîne opératoire* of ground and abrasive stone tools from Pločnik but examination of specific traces on the tools indicates some of the sequences. The traces relate to the techniques used, from the modification of a piece of stone to the fashioning of a complete tool, to the treatment of the tool during its use, fragmentation, re-sharpening, re-use, and deposition.

The abrasive stone tools are characterised by distinctive abrasive features related to the raw material from which they were made i.e. various types of sandstone of different hardness, granularity and colour. Most of these tools (whetstones and grinders) were not produced by the communities of Pločnik. Rather, they were used in their natural form as pebbles or slabs, found in rock deposits or in the gravel of the Toplica river and in nearby creeks.

One group of abrasive tools from Pločnik that were modified through primary treatment are the pestles. All have visible signs of pecking and subsequent grinding on the surface. Traces of pecking are noticeable in the form of small dents and notches that occurred as grains were removed from the rock mass in order to reduce the piece of stone to the desired shape. Grinding was then used to remove edges and make the object easier to grip. The pestles from Pločnik are of different shapes, from elongated to irregular spheres, and are characterised by a hemispherical protrusion on the distal end (e.g. C-574, C-574b, C-574c, C-574e). The protrusion was produced by pecking and served to provide better adherence to the concave surface of the mortar (see Figure 6).

Each of the use-wear traces on these tools comprises clearly visible concentric circles, extending from the top to the base of the hemispherical protrusions, produced by exerting pressure on the surface in circular movements (Figures 6 and 7). These tools were probably used for the pulverising and preparation of certain foods (e.g. cereals and other grains) but may also have been used for crushing pigments and copper ore such as malachite.

Two tools that resemble similar objects from Germany (Freudenberg 2009: 343) were supposedly used for the thinning and hammering of metal objects (Figure 8). One is a pebble of suitable dimensions and weight to be used in its natural form, and the other is a stone of roughly cylindrical shape that was modified by pecking and grinding (C-621). Both have clearly defined, highly smoothed working surfaces. Based on use-wear traces, the second object was used as a multifunctional tool.

For the other abrasive tools, traces of use vary depending on function. On whetstones and grindstones, very smooth and partially concave surfaces occurred as a result of extended use (Figure 9). As use of metal at Pločnik is unequivocally confirmed, it could be assumed that the whetstones, usually used in stone and bone tool processing, were probably also used for sharpening metal objects.

Very hard, sizeable, and compact pebbles of quartzite, sandstone or granite were often used as pounders. It can be presumed that these were collected from the alluvial deposits of the Toplica river. Traces of use appear on them in the form of shallow and concentrated dents, a consequence of pounding resulting in the loss of grains and micro flakes.

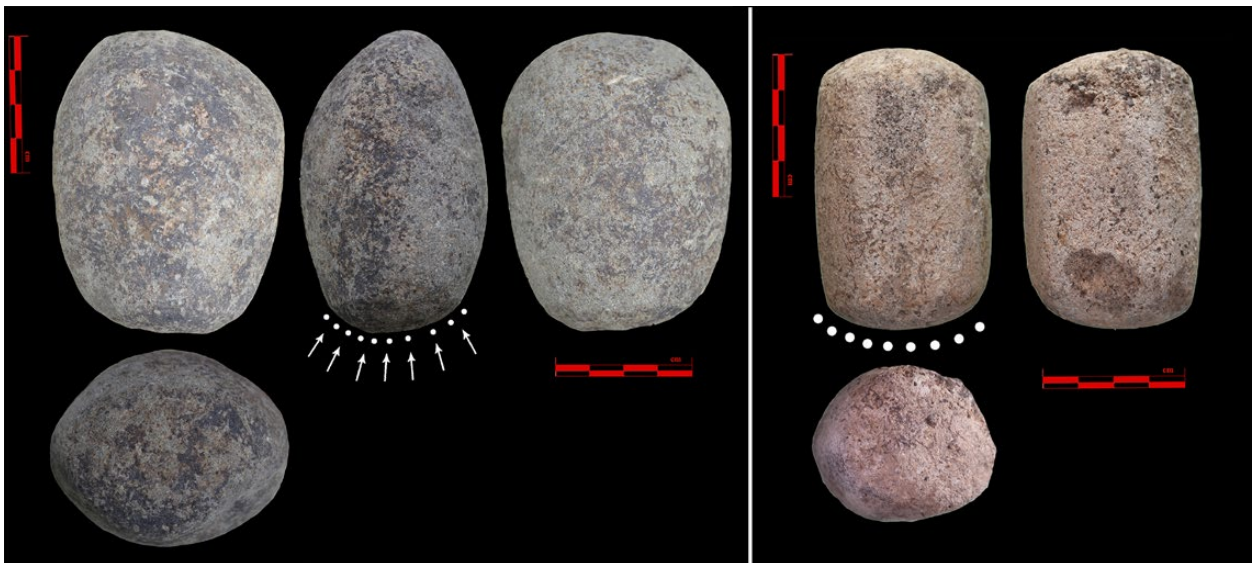


Figure 8. Tools which probably have been used for hammering and thinning metal objects. Traces of use are visible as rounded and smoothed surface on the distal end (left), and distal and proximal ends (right).

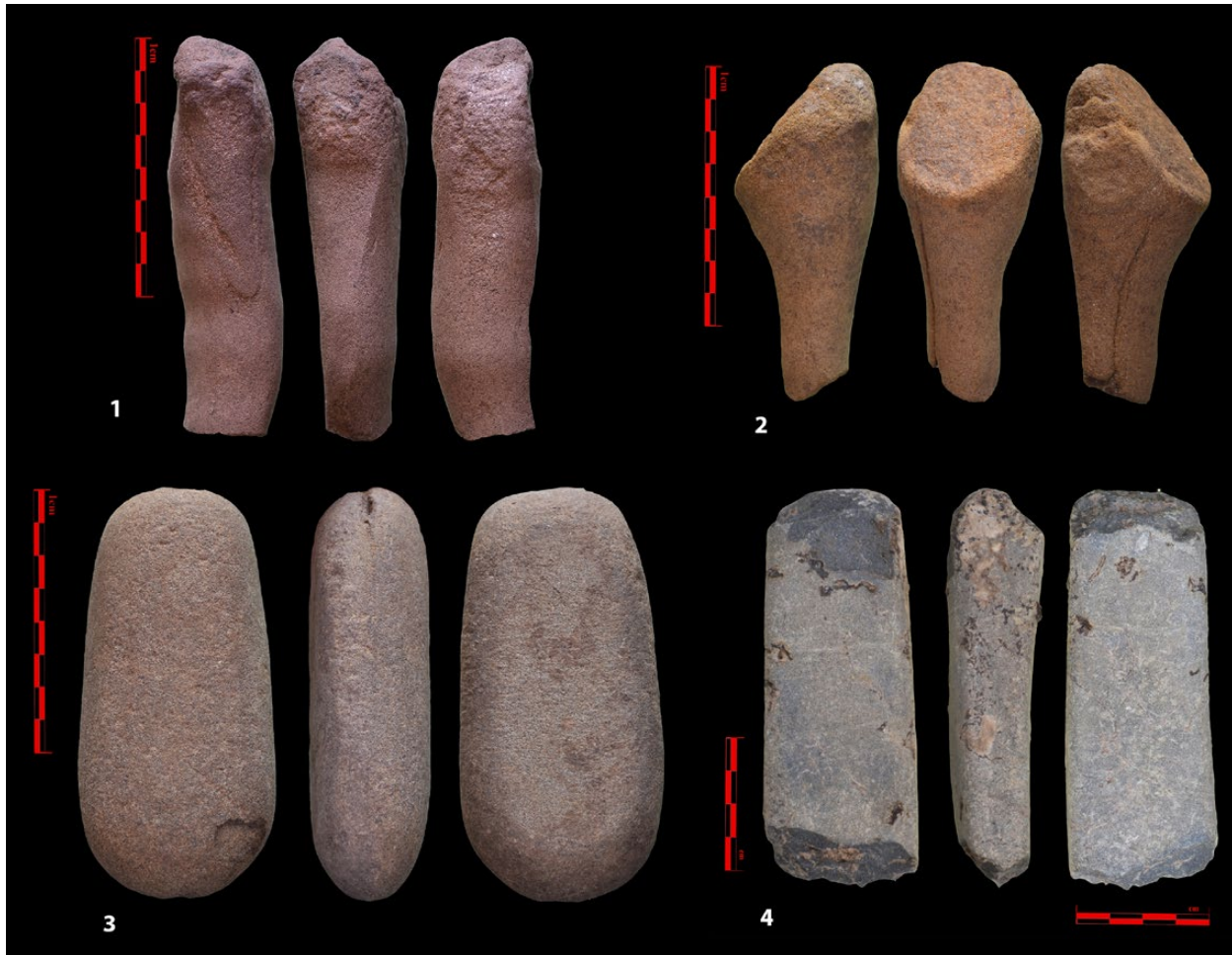


Figure 9. Whetstones from Pločnik.

Several production stages can be identified for the ground stone tools from Pločnik, depending upon the characteristics and quantity of available raw material. These include knapping, retouching, grinding, sharpening, retouching, and regrinding. The pecking technique was probably used to produce object C-566. The basic reduction technique was knapping, which left negative scars on almost all ground stone tools. The reduction of the dorsal side was often achieved by flaking, using a platform on the ventral side. The flaking technique was used on almost all ground tools, mainly due to the raw material used—fine-grained rocks with a distinct conchoidal fracture ('light white stones', crystalline schist, cornite, metaalevrolite).

Based on production traces, after flaking and retouching of tools, grinding was carried out on static grindstones made from fine-grained sandstone, with the use of water.¹ This was performed with both circular and rectilinear movements. Special attention was paid

¹ A 'skim' can be seen on the surface of certain tools due to thickening of the dust produced during grinding and water. Skim resembles a smear, with grinding marks macroscopically visible, e.g. on C-729 and C-730, produced from 'light white stone'.

to the cutting edge, while the rest of the object was, in most cases, only superficially ground. This kind of processing is characteristic of the end period of Vinča culture (Antonović 2003: 132–133). In most cases, tools were knapped and retouched, and only the edge was meticulously ground. The rest of the tool was only partially worked in order to reduce irregularities and ridges produced during knapping, that might cause the tool to break due to uneven spreading of the impact force. Some of the most representative objects of this approach are the 'deposit' of adzes made from 'light white stones' (Figure 10). These tools are made of more silicified and compact stone. Higher quality grinding was also noticed on one adze (C-649) made of metaalevrolite. Polishing, the finest processing technique, was partially applied only to the adze made of nephrite; there is no evidence of it on other ground stone tools from this assemblage.

The recycling of fragmented tools, which has been observed on three artefacts (C-573, Find-464, Find-488), was achieved by retouching and regrinding of flakes and chunks obtained following the fragmentation of larger ground tools.



Figure 10. Adzes from deposit of 'light white stone' adzes from Pločnik: 1) C-728; 2) C-732; 3) C-733; 4) C-731.

Ground stone tools with a cutting edge (adzes and chisels) could have been used for a wide spectrum of woodworking activities: felling of trees, adzing and gouging of trunks, stripping bark and adzing of branches, as well as for processing wood for house-building elements and house furniture. All these activities left recognisable use-wear traces on cutting edges and butts (Semenov 1976: 126; Lunardi 2008; Pawlik 2007; Dimić 2013a, 2015). Traces were defined on ten adzes, including four from the adze hoard (Figures 11 and 12; C-570, C-600, C-609, C-610, C-649, C-728, C-729, C-731, C-732). Artefact C-699 is classified as a miniature adze but was used as a chisel. Use-wear

traces could be observed on all other adzes that were microscopically examined.

Traces of use similar to those recorded on the adzes are also visible on one of the four chisels found at Pločnik. Micro-polished and rounded edges are clearly visible on the proximal end, while the cutting edge is slightly damaged by intense use, with furrows that occur perpendicular and inclined to the cutting edge. These are more intense on the dorsal side but can also be clearly distinguished on the ventral side. From traces on the butt it can be concluded that the chisel was hafted to a handle made of wood, bone, or horn.

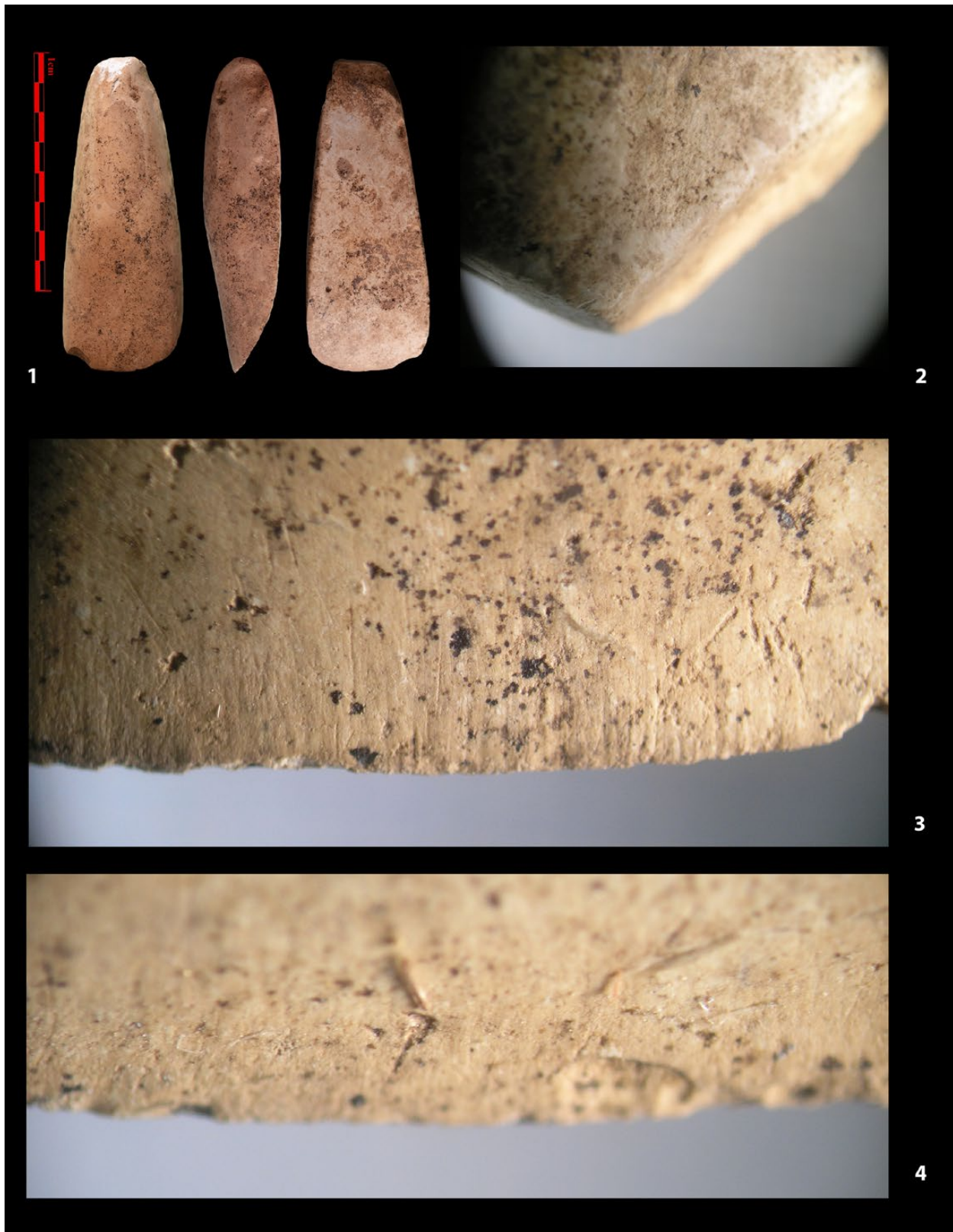


Figure 11. Use-wear traces on adze C-732.1) Adze C-732; 2) polished surface and rounding occurred on butt; 3) furrows/ striations on the edge (dorsal side) under magnification 32x; 4) edge (ventral side) at magnification 48x.

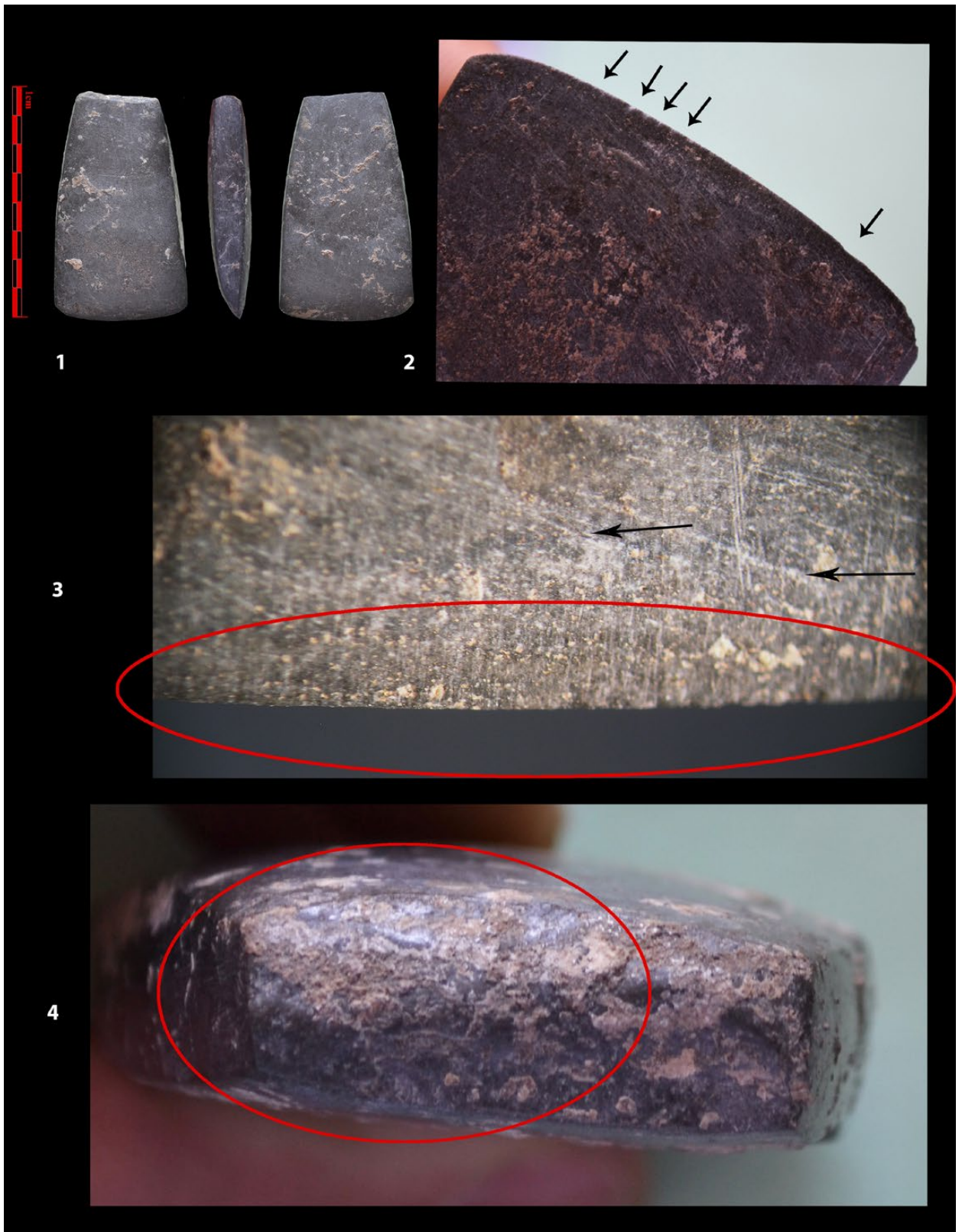


Figure 12: Use-wear traces on adze C-649. 1) Adze C-649; 2) edge (dorsal side) macro; 3) furrows/striations on edge (dorsal side) under magnification 40x; 4) polished surface, rounding and gloss on butt.

Conclusion

The ground and abrasive stone industry from the site of Pločnik is characterised by raw material selection and tool types typical of the Vinča culture. From the time of the earliest settlement in the Vinča Tordoš I Phase (Vinča A), the method of stone processing did not change significantly until the end of occupation at the site. Hard and compact, grey and green-grey rocks were used for manufacture of tools with a cutting edge. After reduction of the raw material by knapping, the whole tool surface was ground, with special attention paid to the cutting edge. Smaller abrasive tools were not (or only minimally) manufactured and were commonly left in their natural form. In the earlier layers of the settlement at Pločnik, maximal use of raw material through recycling and modification is evident, as well as the use of secondary (recycled) tools. Stone tools were valuable, and craftspeople from Pločnik were using them judiciously.

The first changes in the stone industry are visible from the end of Vinča Tordoš II (Vinča B) Horizon and the beginning of the Gradac Phase, when the so-called 'light white stones' came into use. The quality of tools with cutting edges decreased; raw materials were still primarily reduced by knapping but the whole tool surface was ground only on certain tools such as the hoard of adzes. Overall, the cutting edges were meticulously ground, while the remainder of the object only partially. This practice is also a mark of later phases of Vinča culture and most probably occurred as a consequence of the beginning of the use of copper (Antonović 2003: 132–133). Alternatively, it may have been due to demographic expansion and intensified building activities, with increased need for woodworking tools (e.g. axes, chisels, adzes), resulting in an emphasis on quantity rather than quality.

It should be noted that a large quantity of massive abrasive tools (41 objects) were not included in this analysis. The highest proportion are typologically connected to massive static grinders, with clearly defined working surfaces. Given their context, distribution and quantity in a small research area—Trench 24—the logical conclusion is that there was a workshop for the manufacture of stone tools in this part of the settlement.

There is currently insufficient data regarding possible locations from which Pločnik craftspeople may have obtained raw materials. It can be concluded with a high degree of certainty however, that the alluvial deposits of the Toplica river and/or the nearby streams provided one source. Sandstones could also have been gathered from river deposits, but it is more likely that they were exploited from primary deposits in the nearby hills. Based on the results of analysis from other Vinča sites, fine-grained, green-grey and 'light white stones' were certainly exploited from such sources (Antonović *et al.* 2005: 63; Šarić and Cvetković 2013: 42).

The ground stone industry at Pločnik fits entirely within established Vinča culture technological frameworks. Nevertheless, it has certain particularities including: the quantity and types of abrasive tools; the hoard of elongated ground adzes with a high degree of processing; and tools thought to be used in the hammering and thinning of metal objects. Based on the number of stone tool finds and the quality of their production, it is no exaggeration to state that Pločnik was a large economic centre in the Vinča culture, where the production of unique, massive copper tools probably derived from earlier, well-developed stone tool production practices.

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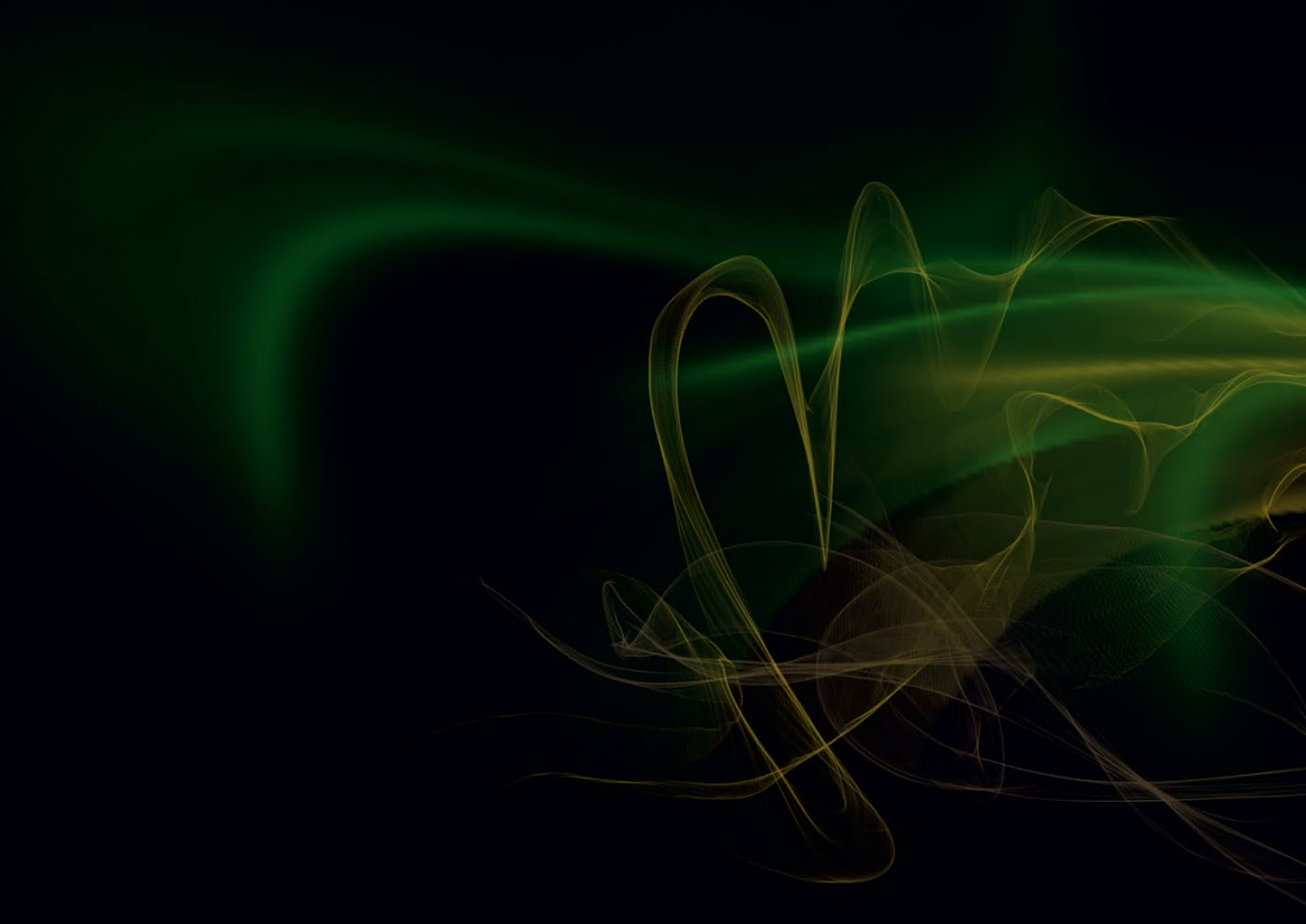
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The Rise of Metallurgy in Eurasia is a landmark study in the origins of metallurgy. The project aimed to trace the invention and innovation of metallurgy in the Balkans. It combined targeted excavations and surveys with extensive scientific analyses 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.