

## PETROLOGIC, MORPHOLOGIC AND FUNCTIONAL ANALYSES OF GROUND AND ABRASIVE STONE TOOLS FROM RUG BAIR, OVČE POLE VALLEY

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**A b s t r a c t:** This paper represents the results of the ground and abrasive stone tools analyses based on the finds collected during the excavation of Rug Bair undertaken in 1970s, and today stored in the Museum and Institute for Protection of Štip. The studies were made possible with the help from the Faculty of Natural and Technical Sciences, Štip, Republic of Macedonia. Through the stone material, an attempt was made a more comprehensive picture of the raw material, petrologic, technical and typological characteristics of the Neolithic stone industry at this site to be gained as well as its relationship with related simultaneously industries.

**Key words:** Neolithic; Rug Bair; Amzabegovo–Vršnik; Macedonia; raw materials; ground; polished; abrasive; tools

### LOCATION, EXCAVATION AND DATING OF RUG BAIR

The archaeological site of Rug Bair is located about 2 km south from the village of Gorobinci (Fig. 1), in the Saint Nicholas region, within the Ovče Pole valley. The location where the site is placed is a big naturally flatten terrace, in the middle a little concave recession, elongated in the direction east–west and with the dimension of 220 × 80 m (Археолошка карта, 1996).



**Fig. 1.** Map of the Republic of Macedonia showing the location of Rug Bair

Natural conditions of the Ovče Pole valley, which is among the largest basins in the Republic of Macedonia, the geological structure of the environment, fertile land and river valleys of the Vardar and Pčinja are the topographic characteristics of this region that have contributed to the well-known Amzabegovo–Vršnik cultural group to develop a flat-type of settlements such as Rug Bair, morphologically different from Neolithic settlements such as "tumba", which can be found in the region of Pelagonia (Симоска, Санев, 1975). Today, except for one small spring, there are no water resources around the Rug Bair and the nearest river is located at a distance of 2 km. But during the Neolithic time, geomorphologic features were quite different. In a supporting of this paleoreconstruction, during the excavation in block G were detected river deposits suggesting that in the Neolithic period when the settlement lived, through one part of the site the river was flowing (Санев, 1975).

Unlike previous prospecting and excavation which has not been published (Šaržoski, 1961), in the 1970s the City Museum of Štip undertook new excavation with a team from the Smithsonian Institute (Los Angeles, California) as part of a bilat-

eral research project for exploring and studying of the Neolithic in eastern Macedonia. This excavation confirmed a multi-layer cultural settlement with a layer thickness of 1.40 m, in which the material remains were three times inhabited.

Rug Bair is a middle Neolithic settlement which belongs to the complex of Amzabegovo–Vršnik cultural group. The artifacts, especially ceramics founded in a large amount, according to the typology of forms, ornaments and the techniques used, as well as visual and other characteristics, are on the whole identical with the ceramics from middle Neolithic layers (II-IV) of the Barutnica site (in the literature known as Amzabegovo), but also with other settlements within Amzabegovo–Vršnik cultural group.

This archaeological excavation, followed later by zooarchaeological, archaeobotanical and palynological data in the frames of this region, showed a population which lived in warm and humid climatic conditions. Economic development was based on agriculture, cattle breeding and harvesting of wild plant species, some of them now cultivated in the territory of Macedonia. Fertile land allowed intensive farming, which was confirmed

by a range of cereal grains found in archaeological excavations in this region. Nearby the site were mountain pastures dominated by low grasses and in the wider surroundings of the settlement there were mountains with extended forest that have enabled hunting and collecting of wood necessary for construction and fire. The vast amount and variety of ornamented pottery suggests that the craft was well-developed and technically accomplished. Ornamental imprints, found at the bottom of some vessel, indicate the existence of weaving crafts (Schwartz, 1976; Beug, 1976; Renfrew, 1976; Санев, 1975; Gruger, 1976; Димитровска, 2011).

The results obtained by processing the material from previous excavations at Rug Bair, were published in a sublimated article, originating exclusively from the trenches that were conducted by the ‘Yugoslav’ archaeologists (Санев, 1975).

For the purposes of this paper it is very important to emphasize that processed stone material derived from trench II and the squares F and H from trench III, which means that the material has not been published by now.

#### PETROLOGIC DETERMINATION OF THE RAW MATERIAL

Macroscopic determination of the raw material by a petrologist was performed for all artefacts from the site Rug Bair. Determination comprised the following categories: the type of the raw material, colour, structure, texture, varieties, mineral composition (examined macroscopically) and origin.

At the site of Rug Bair can be defined several types of rocks which are the base for the ground and abrasive stone tools made of: a group of metamorphic rocks types such as serpentinite, a group of volcanic rocks types such as andesite, a group of volcanic rocks types such as basalt, a

group of sedimentary rocks types such as sandstones – in which the two subgroups differ (fine-grained and coarse-grained sandstones) and a group of residues of different origin (Fig. 2). The last group comprises a small piece of stone of different geological origin predominantly rich in silica, and there are also fragments of metamorphic rocks. Each artifact is made of a stone (rock or mineral) that has certain petrographic and technological attributes. Petrographic analysis of the raw materials used for making ground and abrasive tools from the Rug Bair was performed macroscopically and microscopically.

Raw material	Color	Structure	Texture	Varieties	Origin
Serpentinite	dark green	porphyritic	massive	fine-grained	local
Andesite	gray to dark gray	porphyritic	massive	coarse-grained	
Basalt	light gray to dark gray	porphyritic	massive amygdaloidal	coarse-grained	local
Sandstone	light gray to dark gray	psammite	massive	coarse-grained fine-grained	local
Miscellaneous	different	different		minerals (opal), metamorphic rocks	Local

Figure 2. Raw materials for ground and abrasive stone tools from Rug Bair

### *Serpentinite*

Only one specimen of the dark green serpentinite was found. Macroscopically, the rock shows hardness, scratch and colour resemble nephrite. Because the artefacts made from nephrite are not yet confirmed on the prehistoric sites in the territory of Macedonia, for the purpose to define this raw material, a microscope preparation from the sample was made. The results showed that this is not a mineral, but artefact made of serpentinite, a specifically rock that belongs to the metamorphic rocks consisting mainly of serpentine minerals, which subsequently have been heavily modified. Serpentinite is a rock composed of one or more serpentinite group minerals, pyroxene and accessory minerals. In the alteration process pyroxene is transformed in chlorite group of minerals. The structure of the rocks is porphyroblastic. The base of the rock is fine-grained with the transformation of serpentine minerals in clay minerals. The team who processed the prospecting about the searching of 'Local resources of stone tools in Amzabegovo–Vršnik' was consisting of: Vasilka Dimitrovska (archaeologist), Biljana Garevska (paleontologist) and Stevče Donevski (local guide). During the prospecting, it was confirmed the local origin of serpentinite around the nearest area of Rug Bair, where exists deposits of this raw material by the banks of the Bregalnica river and its influents. The material is located on the surface in the form of small blocks.

### *Andesite*

All specimens of andesite used in the manufacture of ground stone tools are gray to dark gray color. The structure is porphyritic, the texture is massive, and the varieties are coarse-grained. The ground mass is hypocristalline and fenocrystals are represented by biotite, hornblende, and sanidine, but this interpretation needs more detailed microscopic examination of rocks. Hardness is not particularly emphasized. The origin is local in the vicinity of Rug Bair, where there are deposits of

these rocks in the so called the Kratovo–Zletovo area.

### *Basalt*

The samples of the basalts are of various colors, from light gray to dark gray shades. The structure is porphyritic, the texture is massive and amygdaloidal and the varieties are mostly coarse-grained. The samples that are amygdaloidal are also suitable for use because they have a hardness of basalt, which is a replacement for quartz sandstones in some regions (e.g. in Serbia) where they were used as an abrasive tools. The origin is local, from the vicinity of St. Nicholas, where there is a major occurrence of basalt 7–8 million years old.

### *Sandstone*

The sandstones are of different colors, from light gray to dark grey. Despite the presence of quartz, the sandstones doesn't have high hardness, and their composition is generally consists of quartz, feldspar with a certain amount of mica. On the basis of macroscopic examination it is easy to determine whether the samples main mass is made of carbonate cement or silica. For that purpose, some specimens were treated with HCl acid to determine the presence of carbonate cement in the primary mass. The origin is local, and this type of sandstone is dominates in the flysch of the Vardar Zone.

Sandstones on the Rug Bair are categorized based on grain size, and thus recognize two groups: fine-grained sandstone (0.25 to 0.05 mm) and coarse-grained sandstones (2 to 0.5 mm). Since the Rug Bair is a site where it was first officially confirmed this type of raw materials through the petrologic analysis, the classification is made in order to follow the appearance of different varieties of sandstone in Neolithic sites in the territory of the Republic of Macedonia. This would determine whether there is some regularity in their use and make a connection and comparison of the materials.

## A GROUP OF STONES WITH DIFFERENT GEOLOGICAL ORIGIN

In the collection there are several specimens determined in the category of miscellaneous. It is about a small pieces of stone with different geo-

logical origin predominantly rich in silica (one specimen can be included in opals), and there are also fragments of metamorphic rocks.

## DISCUSSION ABOUT THE PROVENANCE OF THE RAW MATERIAL AT RUG BAIR

For all the artifacts of polished and abrasive stone, the petrologic determination of raw materials through the macroscopic examination was made. According to the results of the analysis, they revealed the presence of different types of raw materials.

Andesite is a volcanic rock and its presence in the territory of Macedonia is from the Tertiary age, including the samples from this assemblage. It belongs to a group of intermediate volcanic rocks that have relatively excess  $\text{SiO}_2$  content (52–66%). It could successfully be used for tools of ground stone industry, but in our case the used for making abrasive tools is primarily due to its abrasive properties, which comes from the high content of quartz, as the prehistoric inhabitants of Rug Bair noted.

Basalt belongs to the group of basic igneous rocks, which have relatively low contents of  $\text{SiO}_2$  (45–50%). Basalts are usually black in colour, depending on whether more or less the surface is altered with the climate impact. In the Ovče Pole region there are other phenomena of basalt that are significantly suitable for making tools because of finer (fine-grained) structure, as opposite to coarse-grained specimens suitable for abrasive tools found on the Rug Bair. Residents of Rug Bair chose specific basalt for this type of artefacts. For the reason which is still unknown, this Neolithic community has been using resources of basalt that were located further away from the site. This indicates that local resources may have been occupied by some other community or community that settled Rug Bair moved and may have acquired the habit to procure the raw material from resources that have been previously used, i.e. maybe they have not met the local resources of this raw material. The choice of this so called 'poor quality' variety of basalt maybe was conditioned, because this type of basalt has more abrasive ability of 'better' varieties of basalt that can be found around the site, and may have been deliberately chosen for manufacturing of abrasive tool. More specifically, it is a very high quality stone for abrasive tools (primarily the querns), and more compact basalts are not suitable for processing through the polishing because of its hardness. In relation to andesite, basalts have higher hardness and can be used as an abrasive, and a ground tools too. A large percentage of basalt in the collection indicates that the rock was

one of the most frequent raw materials for abrasive tools of Rug Bair.

The sandstones are sedimentary rocks with a distinctive clastic structure, and polyvalent mineral composition. Rocks of this group represented a small number of tools at Rug Bair, and are mainly used for obtaining an abrasive type of tools such as the grindstones and whetstones, because of its highly abrasive properties.

In contrast to the basalt, which has been used exclusively for querns, both varieties of sandstone (fine-grained and coarse-grained) were the main raw material for grindstones and whetstones. However, it can be noticed that the grindstones are made of both varieties of sandstone, while for the whetstones was selected exclusively fine-grained sandstone, because purposes of these artefacts was their use mostly in processing and finishing primarily the artefacts from the bone.

The only archaeological site within Amzabegovo–Vršnik cultural group where the analysis of the raw material for making stone tools was processed very carefully is Barutnica (Fig. 3), the eponymous site of this culture. In the first excavation, definition of the origin of some raw materials for stone tools such as the hard materials – serpentinite and diorite, was made (Корошец, Корошец, 1973). Comment which can be attributed to the authors, who published this information without consulting a petrologist, is that serpentinite can be a tough material, unless it is not silicified. Later, when the trenches of the excavation extended, the publication (Gimbutas, 1976) revealed that the raw material used for the most of the ground stone industry consists of andesite (31%) and fine-grained to medium-grained sandstone (50%), and a small percent of basalt, quartz, metamorphic undefined rocks, limestone and quartzite. It was also pointed out that sources of these raw materials – sandstone and volcanic rocks – should be searched northwest of Saint Nicholas (in the vicinity of the site Rug Bair), since the prospecting did not gain any results about the sources of these rocks in the vicinity of Amzabegovo (Waide, 1976).

Most of the artifacts from the ground stone industry at Amzabegovo were made of the so-called green stone, which can be found north of the site in the slopes of Mt. Bogoslovec. Therefore the researchers concluded that the raw material for the typologically defined ground stone tools is of local



origin. Color of the samples varies from light green to white and vice versa, to dark grey and black, with shades and transitions. The author of the article states that few tools are made of "real jade" (Smoor, 1976). The author by the term greenstone described the rocks which comprise few minerals in their composition, and the largest percentage belongs to the serpentinite and jadeite, with intrusions of asbestos. We must emphasize that the author of the article about the ground stone industry from Amzabegovo made a mistake in the determi-

nation of this green stone that apparently could be a green serpentinite or green shists (Smoor, 1976). Namely, serpentinite is a rock and jadeite is a mineral. Rocks such as serpentinites are also composed of several minerals, and one of them is the serpentine. An abundant source of these rocks ('green stone') is located 15 km south of the site Amzabegovo, where the population gathered on the northern and eastern slopes of the Mt. Bogoslovec. It is also stated by the same author that at that particular location can be found small nodules of jadeite.

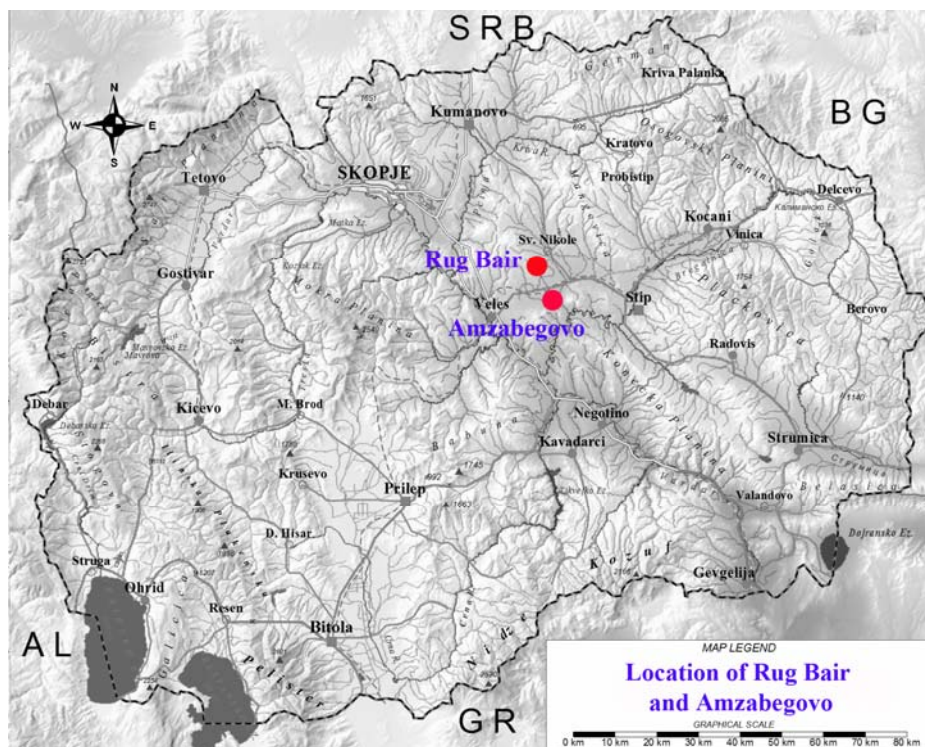


Fig. 3. Location of the archaeological site Amzabegovo, Republic of Macedonia

According to researchers, the ground and abrasive stone tools found at Rug Bair (axes, adzes, chisels, querns and mortars) are made of rocks with a Tertiary origin and of green sandy stone (Санев, 1975). Considering the lack of petrographic analysis of previously published material of ground stone industry, and the presence of only one tool (adze from serpentinite) in this collection, it is difficult to compare results in terms of whether they had used the same or similar raw materials. It also remains a mystery what the researchers meant by the term 'green stones' at Rug Bair and at Amzabegovo. Rug Bair is a village located 16 km north of Amzabegovo. In the assemblage was found an artifact of serpentinite, with the deposits of this raw material in the vicinity, while nephrite has not been confirmed in prehistoric

Neolithic collections from the archaeological sites in the Republic of Macedonia. We can conclude that what was determined at the Rug Bair and Amzabegovo as a greenstone is not nephrite, but possibly serpentinite or green schist, although it is not disputed that some samples from Amzabegovo may have been made of nephrite that came through the import, trade or exchange of goods. There is also a possibility that nephrite could be from the local origin, which is a presumption that should be proved by further fieldwork.

According to papers from the congress held in Bratislava in 1999, it was established that the most frequent raw materials used in the Neolithic period on the territory of Europe for obtaining ground stone tools were: green schist, amphibolite, basalt,

and to a lesser amount jadeite, eclogite, serpentinite, and others. (Težak-Gregl, 2001). Nephrite in the Neolithic Balkans was used as a decorative stone for luxury items (Antonović, Stojanović 2009, 183-191), and can be found in few places in Serbia, and much more in Bulgaria at the Neolithic sites by the river of Struma, with an attempt by the researchers to define the so-called nephrite culture of the Balkans (Kostov, 2005).

Existence of primary source for raw materials confirms that most of the artifacts on the Rug Bair are made of raw material with a local provenance that the population was able to gather around or near the site. A common feature of Rug Bair and Amzabegovo is the presence of serpentinite, volcanic rocks of andesite and basalt, and sandstones that creates the largest percentage of ground and abrasive stone industry at both sites. It is possible that the use of local resources was the same for these two Neolithic communities, because of their vicinity. The sources were accessible on the surface and this was the main reason why they came to the same place to collect the raw materials for their stone tools.

The geological material from which stone artifacts at Rug Bair were made is very diverse, but it is conditioned and limited to the amount of material originating from a single trench. In this regard there are analogies and parallels to Neolithic sites in Macedonia, where there is greater diversity in the raw materials used for ground and abrasive tools (like Tumba Madžari or Govrlevo), but unfortunately the material is not published yet.

#### *Typological and technological analysis of the industry at Rug Bair*

The main criteria for the classification of ground stone industry and abrasive tools were the morphology of artifacts and raw materials from which they were made of. However, we should pay attention to the definition of the terms "ground" and "abrasive." When we classify ground stone tools, then this primarily refers to a technique that was used for obtaining of these tools, while the term abrasive tools primarily refers to the raw material from which the artifacts were made of. All tools from Rug Bair were divided into two main groups: ground industry (polished stones) and abrasive tools (grinding industry).

This Neolithic collection have provided conditions to distinguish the manufacturing techniques of making objects from ground and abrasive stone,

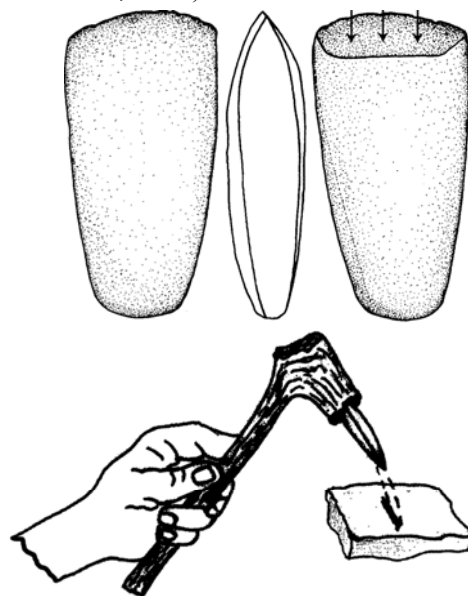
which generally includes: chipping and retouching, pecking and grinding (Антоновић, 1992).

#### *Typological and technological analysis of the stone ground stone industry at Rug Bair*

In order to reconstruct the technology of the tools, the analysis of ground stone included: the platform on which the tool was formed, the degree of preservation/fragmentation of artifact, morphometric characteristics, the processing stage (semi-finished / final product), processing technique, the morphology of the dorsal side, chemical/thermal damage (eg burning) and changes in materials, the presence of cortex and traces of use on the basis of the microscopic identification. During the processing of this type of tools, modified and adapted formulary was used (Антоновић, 1991).

#### *Adze*

Adzes are artifacts that belong to the group of ground stone industry, with the edge on the distal part of the tool (Fig. 4). The edge is not in the plane of symmetry, giving the tool an asymmetrical profile and thus morphologically in its typology is different from axes. The function of chiseling and trimming wood, used in making various wooden objects, is characterized by the use wear in the form of fine lines parallel with the longitudinal section of the tool (Антоновић, 1992; Antonović, 2003; Semenov, 1976).



**Fig. 4.** Morphology of the adze and its movement while working (after Анастасова, 2008, 95, Fig. 1-2)

Only one fragmented adze from serpentinite (No. SII D13C) with preserved distal part was found at the site of Rug Bair. It is a final product that was obtained by polishing of the tool (T I/2). The specimen has defined edge in the distal part which is also broken. The analyses of the use wear traces on the surface of the artifact confirmed that the morphology of this type of tools such as adzes fits with its function (Fig. 5).



Fig. 5. Traces of use on the surface of the adze made of serpentinite  $\times 40$  magnifying (photo by authors)

#### *Typological-technological analysis of the abrasive tools at Rug Bair*

Abrasive tools are included in the archaeological finds, because they undoubtedly played an important role in the life of Neolithic people. Some types of artifacts in this group were used for millennia and remained morphologically unchanged to this day; resembling the form they had in prehistoric times. Abrasive tools include: grindstones, whetstones, pounders, querns and mortars (Антоновић, 2008).

Tools with abrasive characteristics from Rug Bair are represented with a small number of pieces. Their typology and function is given in summary, because this makes it easier to follow the analysis of this type of finds. The main basic feature of abrasive tools is the choice of raw materials which

depends on the functions of the artifacts, while the shape of the tools is of secondary importance.

In the analysis of stone artifacts with the abrasive characteristics, analysis included: the dimensions of artifacts, the degree of preservation/fragmentation, physic-chemical and thermal damage as well as the changes in materials, the presence of cortex and traces of use on the basis of the microscopic identification.

The Rug Bair abrasive stone assemblage consists of 40 artifacts in total, which have been attributed to 4 main categories: grindstones, whetstones, pounders and querns.

#### *Grindstones*

The grindstones are artifacts belonging to the group of abrasive tools that were used for working and shaping of other solid materials (stone, bone, horn, ceramic, wood) by whetting and grinding. Depending on the work surface, the shape of the tools, and traces of use, different types (with subtypes) of grindstones can be distinguished, and according to the morphometric characteristics they can be classified into: manual (movable) and static grindstones, sometimes with large dimensions, with one or more work surfaces (Antonović, 2003; Антоновић, 2008).

Several types of grindstones can be found in the Rug Bair material. Except for one piece, the rest of the assemblage is fragmented. The grindstones from Rug Bair are classified into the following categories:

**1. Manual grindstones.** In total, 5 hand grindstones are found in the collection. Two pieces are small and were made of pebbles of coarse-grained sandstone (No. C2 SII; No. SII D2-1), partially fragmented, and with all sides polished (T II 2). The other two specimens from coarse-grained sandstone are fragmented, rectangular in cross section, with slightly convex work surfaces (No. FH3-1), and one (No. SIII F1-1) piece bearing also fragmented groove for modeling awls and needles (T I, 1). One manual grindstone of fine-grained sandstone was part of a larger tool, according to a depression located on the inside of the tool (No. SII E5). The artifact is polished on all sides and at the same time this is the only complete tool in the entire collection of ground and abrasive stones from Rug Bair (Fig. 6). The length of grindstone is between 40 mm and 69 mm, width ranges from 34 mm to 56 mm, and thickness is from 22 mm to 36 mm.





**Fig. 6.** Manual grindstone – the only complete tool in the assemblage (No. SII E5) (photo by authors)

**2. Static grindstones.** In the collection there are 2 fragmented pieces of static grindstones from fine-grained sandstone bearing at least one working surface. The preserved piece of the slightly flat and polished working surface in both cases indicates larger size grindstones.



a) No. SII C2-1

b) No. SII C2-2

**Fig. 7.** Static grindstones at Rug Bair (Photo by authors)

The first piece of static grindstone (No. SII C2-1) is a small triangular fragment with rectangular cross-section (83×63×20 mm). It looks like a plate with parallel sides and it can be recognized by one working surface which is polished by use, while the other parallel side to the surface is rough and without any traces of use (Fig. 7a).

The second piece of static grindstone (No. SII C2-2) is a massive four-side fragment with rectangular cross-section (102×82×51 mm) with preserved at least one work surface that is slightly polished and gradual. Fragmentation of the tool indicates that this sample comes from the grindstone of larger size and it is possible that had more than one working surface (Fig. 7b).

**3. Double grindstones.** This group includes the grindstones with two working surfaces. There are three fragmented examples of this type in the collection, made of fine-grained and coarse-grained sandstone. Two pieces are with parallel polished

sides (No. SII F16; No. SIII FFH25-2) (T II, 3), and one is a fragment of a large static double grindstone (No. SII D7) which has a nice polished concave work surface (T II, 1).

### *Whetstones*

Whetstones are included in the group of abrasive tools like the grindstones, but the difference is the small size and the type of raw material from which the products were made of. Whetstones are used for fine finishing of bone, bone needles and awls (Antonović, 2003; Антоновић, 2008).

Whetstones are artifacts made of material which could be used as a working surface from all sides of the tool (Fig. 8). The choice of materials for whetstone and their working surfaces are not related. Opposite of the grindstones made of rough materials and used for the grinding, whetstones were used on the way that would allow polishing all around the surface of the tool. They are classified primarily on the basis of rectangular shape in the form of small tablets with thin-section and a flat work surface.

Grinders are represented in the collection with four examples of fine-grained sandstone (No. SIII F40-1, No. SIII F40-2; No. SIII F42-1; No. SIII F42-2). The length of these artifacts is in the range from 31 mm to 70 mm, width of 22 mm to 59 mm, and a thickness of 6 mm to 13 mm (T I, 4, 5).



**Fig. 8.** The surface of whetstone from Rug Bair (No. SIII F40-1) – T XVIII No. 4 ×40 magnifying (photo by authors)

### *Querns*

The quern as an abrasive tool is mostly characterized by massive specimens that have a flat or slightly concave working surface that was used for milling grains, pigments, ceramics... It consists of two parts, the lower (stationary) part of the quern



and the upper (movable) part so called pounder. Querns could be used as universal tool for shaping the objects made from a hard material and it is sometimes difficult to distinguish the quern from the grindstone. The only way is according to traces of use wear of the working surface (Antonović, 2003; Антоновић, 2008).

The querns can have at least one, and sometimes more working surfaces. Since it was a multi-purpose tool, when it is fragmented like some pieces from the Rug Bair (Fig. 9), then it is difficult to define how many working surfaces had this type of artifacts.



Fig. 9. Fragmented querns from Rug Bair  
(Photo by authors)

The Rug Bair querns, according to the shape, number and use wear of the work surface, are divided into:

1. Regular querns from basalt (No. SII C2-3; No. SII D2-2; No. SII F1; No. SII EA2-1; No. SII EA2-2; No. SII EA2-3; No. SIII F1-3; No. SIII F27; No. SIII F33-1; No. SIII F33-2; No. SIII H7; No. SIII FFH16-1; No. SIII FFH16-2; No. SIII FFH25-3) and andesite (No. SII H3; No. SIII H-5), fairly fragmented, where traces of use can be distinguished at least on one work surface.

2. Querns with two work surface – only one fragmented specimen from this type was found (No. SII D13-2) with recognizable two work surfaces.

3. Undefined fragments of grindstones – Due to the undefined shape, a fragmented piece of basalt (No. SIII F1-2) could be placed into two groups, as well as the grindstone without a work surface or as part of a quern. It is possible that this artifact belongs to the group of querns because it is made from basalt, opposite of grindstones which are usually made of sandstone.

Considering the fact that the quern was composed of two parts, all fragmented specimens belong to the lower or static part of the tool, while the upper, or movable parts of this tool on this site are represented in the form of pebbles. Based on the use wear traces of work surface that is more rough than polished, and the type of the raw material, we can conclude that these are the querns. The small fragments of these querns are preserved and only parts of at least one work surface, which is not enough for definition of their form. Work surfaces are mostly flat, sometimes concave from the use with a visible signs of previous treatment.

#### *Pounder*

The pounder is the last artifact included in abrasive tools, because it got its shape mostly by using. This group may include pebbles or rocks with a suitable shape without their moulding, and comfortable for holding in the hand. According to the use wear traces, the pounder was a multifunctional tool that was used as a retoucher, hammer, anvil, for crushing and grinding fruits, grains, pigments and others. This type of tool is a common artifact on the Neolithic sites often founded by the querns during the excavations (Antonović, 2003; Антоновић, 2008).

The Rug Bair collection comprises two fragmented pieces made of andesite (No. SII C1; No. SIII FH5) that were used in the function of pounders. Both implements are formed on pebbles suitable for comfortable holding in the hand. They

were used on all sides, making the rough work surface (Fig. 10). The traces of intense burning can be recognized on one specimen with an ellipsoidal shape (T I, 3).



**Fig. 10.** The surface of a poulder (No. SII C1) ×40 magnifying (photo by authors)

Analysis of the ground stone industry and abrasive tools found at Rug Bair confirmed the existence of the whole range of implements (Fig.11) which was established with the previous excavations of the site (Санев, 1975). The collection consists of 1 ground stone tool made from one raw material, 34 abrasive tools made from 4 raw materials, and 6 miscellaneous pieces without specific morphology and different geological origin.

Figure 11

*The representation of types and tools of ground and abrasive tools from Rug Bair*

Type of tool	Specimens	%	Complete tool	Raw material	Origin
Adze	1	2.4	/	Serpentinite	Local
Grindstone	11	26.9	1	Sandstone	Local
Whetstone	4	9.7		Sandstone	Local
Quern	15 2	41.5	/	Basalt Andesite	Local
Pounder	2	4.8	/	Andesite	Local
Miscellaneous	6	14.6	/	Raw material with SiO <sub>2</sub> Opal Metamorphic rocks	Local
Summary	41	99.9	1		

The Neolithic community at Rug Bair could collect the raw material used for obtaining the tool in the vicinity of the site. The selection of raw ma-

### Miscellaneous

This category includes specimens which could not be defined on the basis of their morphological characteristics. These include the waste of the raw materials rich in SiO<sub>2</sub> and a piece of opal. One specimen (No. F13 SIII) is a partly fragmented river pebble with elongated shape, made of quartz-feldspar metamorphic rock. Its interesting and nice shape resembles the retoucher, but on the surface there are no traces of use, so the purpose for its use by the local Neolithic community remains unknown. Perhaps it was a piece of raw material that was rejected, because it was not suitable for the the abrasive tools, nor for adzes or axes.

### CONCLUSION

terials was determined due to their further usage. For grindstones and whetstones were used sandstones, for pounders – andesite, and for querns – basalt. Because of its abrasive properties and types of materials from which they were made of, the abrasive tools at Rug Bair are largely fragmented, except for one piece of the complete tool. We may assume that the abrasive tools are fragmented because the excavation included the garbage dump, e.g. a part of the site where the fragmented and unusable tools were thrown.

The ground stone industry at Rug Bair is represented with only one tool in the form of an adze from serpentinite, which can be found in many Neolithic sites in the Balkans and in Europe. The tool has fragmented distal part, obtaining of the implement was with chipping and retouching, and the final trimming wash with polishing which visually gave the adze shape of the tool (No. SII D13c).

The largest percentage of material from Rug Bair consists from tools with abrasive properties. This type of artifacts very rarely has an intentionally manufactured surface, because its shape is mostly obtained through usage, without the application of some of the techniques for making stone tools. Considering the fragmentation of the artifacts, it is difficult to determine specifically what technology has been used at the site for their obtaining.

According to the findings at the Rug Bair from other trenches that were published previously, ground and abrasive tools compared with

the chipped stone assemblage are in a big amount and very heterogeneous (Санев, 1975), which is quite opposite case with the findings from this trench which is the subject of this paper. According to the researchers, they distinguished: axes, adzes, chisels, querns and mortars (Fig. 12, 13, 14, 15).

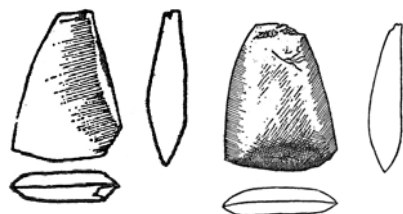


Fig. 12. Axes from Rug Bair (after Санев, 1975, T I, 1–2).  
No scale provided for the drawings.

Axes were not found in the processed material from Rug Bair. Based on the drawings and their description in a previous publication, there were more types and subtypes of axes with different longitudinal and transverse sections (Fig. 12). They were divided into axes with edges that are flat obtained with equal treatment of the bottom and top (Санев, 1975), i.e. with the parallel polishing of the dorsal and ventral side in the distal part of the tool.

Adzes were the most often found implements in the field. According to the reports of the excavators, they were divided on the basis of their form and section into several types and subtypes, and mainly described very descriptively (Fig. 13). Determination was made on the basis of the round edge grinded only from the bottom side (Санев, 1975). The latest research of Rug Bair found a piece of fragmented adze with the preserved distal part with an edge, and traces of use were confirmed the matching of the morphology of the tool with its function (Fig. 5; T I,2).

Chisels are a third category of edge tools at Rug Bair. In the observed assemblage, the chisels are lacking, and considering the fact that only one tool has been found in all trenches from previous excavation (Fig. 14), it is not possible to calculate the percentage of this type of tools in the settlement. The chisel has been described as an elongated tool whose upper side is rounded, while the edge is sharp, partly flat and oblique at one side (Санев, 1975). According to the typology, a chisel is a tool with an edge in the distal part, but the edge can be at both ends simultaneously. They are separated into a special category of tools due to the

small size and the length of the edge that does not exceed 25 mm (Antonović, 2003). They can be recognized by the elongated form that is approximately equal to half the width (Anastasova, Pavuk, 2001; Anastasova, in press).

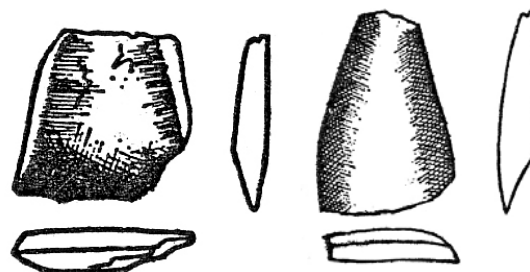


Fig. 13. Adzes from Rug Bair (after Санев, 1975, T I, 7–9).  
No scale provided for the drawings.

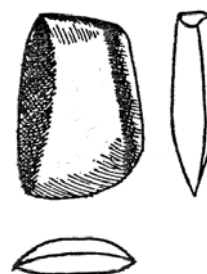


Fig. 14. The chisel from Rug Bair (after Санев, 1975, T I, 10).  
No scale provided for the drawing.

It should be noted that classical typology determines the types of tools by their morphology, and functional analysis determines the types according to their function. Ground tools with an edge in the distal part of the artefact, on the basis of the longitudinal section are divided into axes (with symmetrical) and adzes (asymmetrical) cross-section. Considering the fact that published drawings are without any scale provided, what was previously identified as an axe could easily be a chisel, and vice versa, what is typologically defined as adze, after the use wear traces can be an

axe. This is important because in the previously published material from Rug Bair some adzes have been classified as axes, and that which is determined by its morphology as a chisel could be also an ax, which depends on the use-wear traces on the surface of the tools whose analysis is not carried out by researchers.

Contrary to the previous publication which states the entire range of ground-edge tools, such as axes, adzes and chisels (САНЕВ, 1975), it must be emphasized that in this assemblage from the site Rug Bair was found only one ground-edge tool, an adze. Axes, adzes and chisels are the tools that are related to woodworking (and possibly breaking bones) and can be found in the forested areas. The natural environment of the Neolithic community which settled the Rug Bair were the mountain pastures and mountains with forests and conditions for collecting the wood necessary for construction and fire. The absence of other ground-edge tools in this collection can be explained by the limited access to the material, which comes only from a single trench.

Typological and functional analysis of the processes assemblage indicates that the largest percentage of abrasive tools from Rug Bair belongs to the querns, and then to static and manual grindstones. Use wear traces, abrasion of the work surface and the type of raw material determine the type of tool. The special case is with fragmented querns and fragmented big massive static grindstones, which the researchers mostly classified all of them as a querns. Therefore, the static grindstones are not mentioned in the previously published collection of the Rug Bair that was processed in the 1970's, and within the group of the querns only complete specimens are described (Fig. 15). Also, it is stated that nearby the complete querns were found pebbles classified into pounders (САНЕВ, 1975). Pounders, which were moving parts of the statically grindstones, are confirmed in this work too. Because pebbles were mainly used as a pounders, researchers often do not make much distinction between pounders and hand grindstone, which differ in form and traces of use.

Abrasive tools were used to process solid materials, as well as to carry out the preparation of food within the household. A large percentage of abrasive tools in the collection indicate that the inhabitants of this settlement carefully selected the raw material for implements of this type which had played a big role in the daily life of the population at Rug Bair.

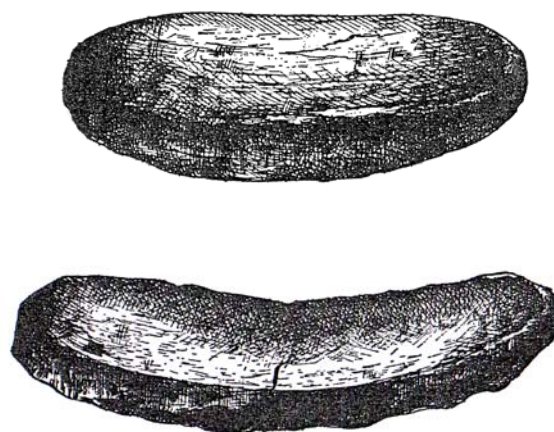


Fig. 15. Down (static) part of the quern from Rug Bair (after САНЕВ, 1975, Т II, 1–2). No scale provided for the drawings.

The ground-stone and abrasive tools from Rug Bair belong to the Middle Neolithic in the Republic of Macedonia. Although these artefacts are poorly indicative in terms of chronology, analysis of these industries within one archaeological site or in one region can show us the level of technology used while processing the stone, how these technologies developed during the time, and eventually lead us to remote but common Mesolithic roots, as tradition that is kept in some type of products.

Beside analogy with the contemporary Neolithic sites in Macedonia, these industries from Rug Bair can find its parallel in the published literature about Neolithic sites in the territory of the Balkans, primarily in Serbia such as Vinča (Антоновић, 1992), Donja Branjevina (Антоновић, 2002), Пича Brdo (Антоновић, 1997), then Galabnik (Anastassova, Pavuk, 2001), Provadija (Anastassova, 2008a) and Dobroslavci (Anastassova, 2008b) in Bulgaria, or Makriyalos in Greece (Tsoraki, 2007).

The ground-stone and abrasive tools from Neolithic sites in the Republic of Macedonia have not been thoroughly analyzed in terms of raw materials. The absence of this analysis complicates the identification of the raw materials that were used by the Neolithic inhabitants within one culture or region, including their provenance and the geographical distribution area in which the residents were moving. They could point out to the ways the raw material was collected, whether it was imported or came via trade in the Neolithic communities whose lives depended on stone as primary material in their economics.



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Резиме

**ПЕТРОЛОШКИ, МОРФОЛОШКИ И ФУНКЦИОНАЛНИ АНАЛИЗИ НА ЗЕМЈЕНИ И АЛАТКИ  
ОД АБРАЗИВНИ КАРПИ ОД РУГ БАИР, ОВЧЕ ПОЛЕ**

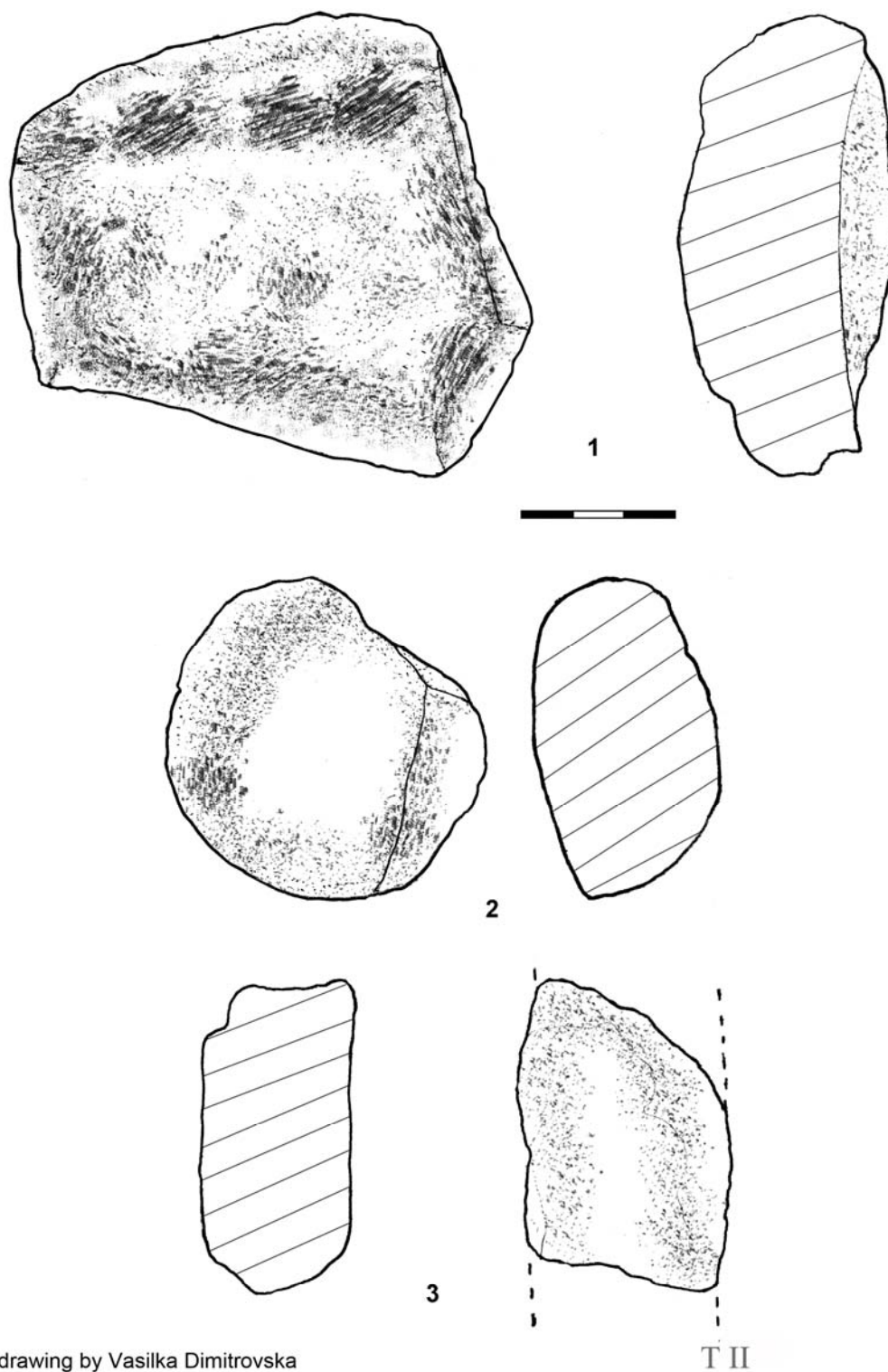
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**Клучни зборови:** неолитски; Руг Баир; Амзабегово-Вршник; Македонија; суров материјал; земјени; полирани; абразивни; алати

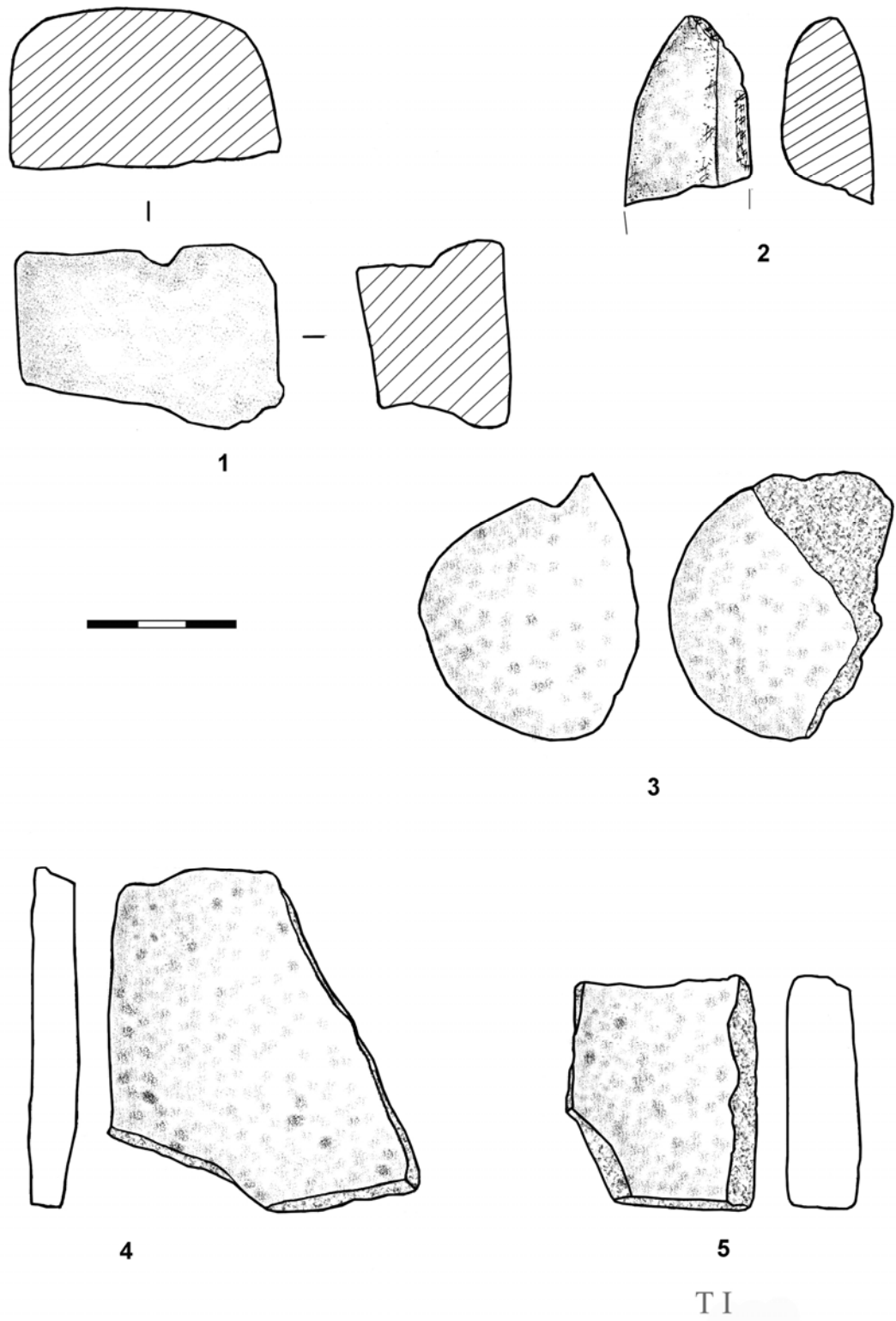
Во овој труд се презентирани резултатите од анализите на земјени и алатки од абразивни карпи базирани на наодите собрани за време на ископувањата на Руг Баир во 1970-тите, а денес складирани во Музејот и Институтот за заштита во Штип. Проучувањата биле овозможени со помош на Факултетот за природни и технички науки во

Штип, Република Македонија. Преку карпест материјал, направен е обид за добивање сеопфатна слика на суровиот материјал, петролошките, техничките и типолошките карактеристики на неолитската продукција од камен од овој локалитет, како и воспоставување на врската со паралелно поврзаните индустрии.



drawing by Vasilka Dimitrovska

### Appendix 1



drawing by Vasilka Dimitrovska

### Appendix 2