

CHIPPED AND GROUND STONE IMPLEMENTS FROM THE MIDDLE NEOLITHIC SITE OF POLGÁR 31 (NORTH-EAST HUNGARY)

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Abstract. The site of Polgár 31 (Ferenci-hát) is situated on the left bank of the Upper Tisza, within the so-called “Polgár Island”. The site consists of single features dated at the Alföld Linear Pottery Culture (ALP) I-III, while the majority of features belong to the youngest phase (ALP IV) attached to the Bükk Culture.

Our analysis focuses on both the chipped stone and the ground stone implements. The most important raw material used for the chipped stone industry of ALP IV phase was obsidian, followed by limno-hydroquartzites. Extra local raw materials played a minor role. Both in the case of obsidian as well as limno-hydroquartzites on-site production was limited, while most artefacts were produced off-site. The structure of retouched tools shows that end-scrapers dominate slightly over marginally retouched blades.

The most commonly exploited raw material in the ground stone industry were various types of rhyolites deriving from the areas 40 to 50 km north of the site. Among tools predominate implements related to food preparation such as a variety of grinding stones, pestles, grinders etc. As part of rituals these tools were destroyed. Sometimes the fragments were used for crushing mineral dyes. Both: fragments of ground stone as well as chipped stone tools occur also in the graves.

Key words: Neolithic, ALP, Tisza Basin, Bükk Culture, obsidian, chipped stone, ground stone, traceology

1. INTRODUCTION

The Polgár complex of Neolithic sites is situated on the left bank of the Tisza river, in the Upper Tisza region. The complex is formed by 34 sites. Polgár 31 (Ferenci-hát) site covers an area of 5–10 ha, of which 3.6 ha have been excavated. From ALP Phase IV, corresponding to the Bükk Culture, dated at 5294–5075 cal BC (RACZKY, ANDERS 2009) a central unit has been discovered, which was surrounded by a round ditch. Inside the enclosure concentrated burnt houses and storage pits. The unit



provided, besides , graves of which two are noteworthy as they were furnished with exceptionally large obsidian cores.

In addition to the ceramics typical for ALP Phase IV, Polgár 31 contained pottery with the decorations typical for Tiszadob, Esztár, Vinča and Szakálhát styles (RACZKY, ANDERS 2009). Moreover, a face decorated vessels and anthropomorphic figurines were also found (RACZKY, ANDERS 2003). Such a range of ceramics is the evidence of broad contacts of the inhabitants of the settlement.

2. CHIPPED STONE INDUSTRY

2.1. Raw materials

The chipped stone industry from the ALP IV Culture features at Polgár 31 numbered about 455 artefacts. The majority of specimens (Table 1) are made from obsidian (316 – 69.5%), probably originating from the region of Tokaj in Hungary (Carpathian obsidian 2a and 2b – TAKÁCS-BÍRÓ 1986; WILLIAMS-THORPE et al. 1987), and from the Zemplín Plateau in Slovakia (Carpathian obsidian 1 – KAMINSKÁ 2001). According to the classical definition of C. Renfrew (RENFREW et al. 1966) obsidian is here a raw material whose source areas were close to the restricted supply zone and frequently were visited by inhabitants of the settlement in search of the obsidian nodules.

Limnoquartzites/hydroquartzites are second in importance (125 – 27.5%) viz. “Avas” type from Pergola and Tűzköves from Miskolc, “Boldogkővár-alja” type, best quality yellow variant of the Korlát – Arka limnoquartzite from the Tokaj Mts.

Other raw materials are represented in trace amounts of less than 1% each. These are:

- radiolarites from, probably, north-eastern Slovakia (4 specimens),
- opal or jasper from the region of the Mátra Mts. (1 specimen),
- black quartzite of unknown origin (1 specimen),
- menilithic hornstone probably of Carpathian origin (1 specimen),
- flints probably from southern Poland: Jurassic flint from the Kraków-Częstochowa

Table 1. Raw material structure in major technological groups

Major group	Obsidian		Limnoquartzites		Others	
	Number	%	Number	%	Number	%
Cores	22	4.84	16	3.52		
Flakes and fragm	71	15.60	38	8.35	5	1.09
Blades and fragm	119	26.16	20	4.39	2	0.43
Chips	47	10.33	4	0.88		
Retouched tools	57	12.53	47	10.33	7	1.53
Total	316	69.46	125	27.47	14	3.05

Plateau or “chocolate” flint from the region north of the Holy Cross Mts., and erratic flint from Upper Silesian moraines) represented by 3 specimens.

- yellowish, white spotted flint, probably from Banat (1 specimen),
- grey flint of unknown origin, burnt (1 specimen).

Single, fine flakes from andezite and limestone may come from pestles or from preliminary treatment of polished stone tools.

The exceptionally homogenous raw materials structure of the chipped stone industry is striking. In fact, it is restricted to only two types of raw materials: obsidian and limnoquartzites/hydroquartzites. They come from the areas to the north (obsidian), north-east and north-west (limnoquartzites/hydroquartzites) of Polgár. The distance of the deposits from the site does not exceed 50–100 km.

Extralocal raw materials occur only in minute quantities. Three artifacts (including end-scraper on a retouched blade) from southern Polish flint brought from the distance of 350–400 km. are probably Upper Palaeolithic additions. Yellowish, white spotted flint – represented by one flake – is the only raw material of south-eastern provenance on the site. Its outcrops occur in the territory of northern Balkans.

2.2. Major technological groups

The relation between the major technological groups, expresses well the absence of early phases of processing on the site. Cores – 38 specimens (8.4%) are numerous in comparison to flakes (114 specimens – 25.1%) and chips (51 specimens – 11.2%);

Table 2. Structure of major technological groups

Major group	Number	%
Cores	38	8.35
Flakes and fragments	114	25.05
Blades and fragments	141	30.98
Chips	51	11.21
Retouched tools	111	24.39
Total	455	99.98

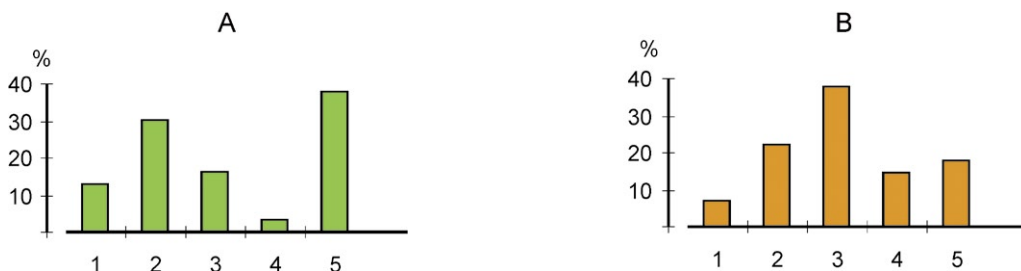


Fig. 1. Polgár 31. ALP IV (Bükk) assemblages A – limnoquartzites/hydroquartzites, B – obsidian; 1 – cores, 2 – flakes, 3 – blades, 4 – chips, 5 – retouched tools

the proportion of unretouched blades (141 – 30.9%) and retouched tools (111 – 24.4%) is also exceptionally high (Table 2).

Unretouched blades are the most frequent group of obsidian artifacts (119 – 37.6%) (Fig. 1). This shows that only a part of blades were detached from prepared cores transferred to the site and, then, exploited on-site until the advanced phase of core reduction was reached. Other blades was brought to the site as completed forms.

The structure of main technological groups of limnoquartzite/hydroquartzite artifacts is different (Fig. 1). The most numerous categories are flakes (38 – 30.4%) and retouched tools (47 – 37.6%), but the ratio of cores (16 – 12.8%) is also relatively high. The high ratio of cores and flakes points to the local production of flake blanks; the exceptionally high frequency of retouched tools documents the preference for limnoquartzite for tool shaping and the import of finished tools on the site (Fig. 2). The same tendency to prefer one raw material for tool shaping has been observed in Bandkeramik Culture (LBK) sites in Western Slovakia (KACZANOWSKA 1985).

2.3. Reduction sequences and attribute analysis of debitage products from obsidian

2.3.1. Reduction sequences of obsidian cores

Because early phases of core reduction are absent, it is difficult to reconstruct complete *chaines opératoires*. Only one, flat obsidian lump occurred which, except for one scar at one end, was unworked (Fig. 3). The surface of the obsidian lump shows numerous traces of red mineral dye (hematite), which suggests that the specimen was transported together with the dye in – for example – a vessel or another container. With the exception of the above-mentioned obsidian lump no other traces of early stage of

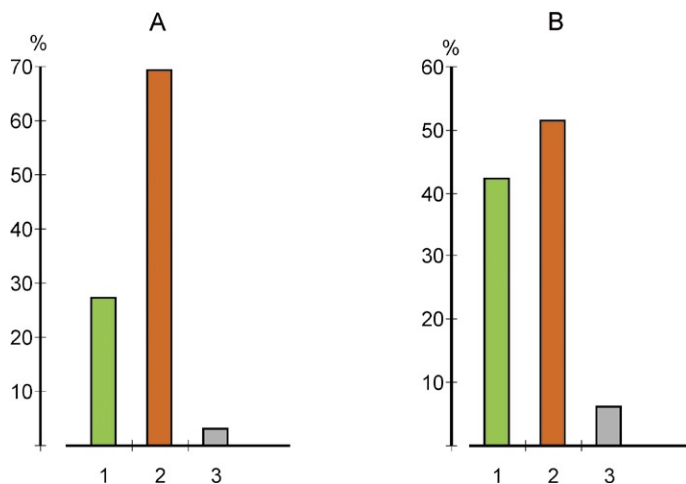


Fig. 2. Polgár 31. Raw material frequency in: A – total assemblage, B – only retouched tools. 1 – limnoquartzite/hydroquartzite; 2 – obsidian; 3 – other raw materials

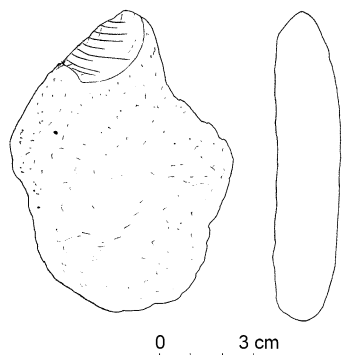


Fig. 3. Polgár 31, feature 241.
Obsidian nodule with one scar

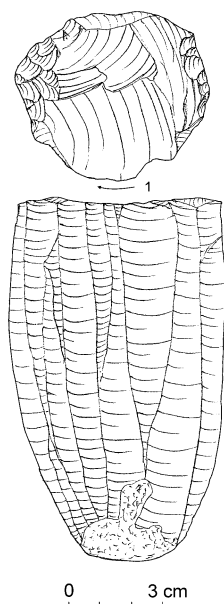


Fig. 4. Polgár 31, grave 697.
Obsidian core

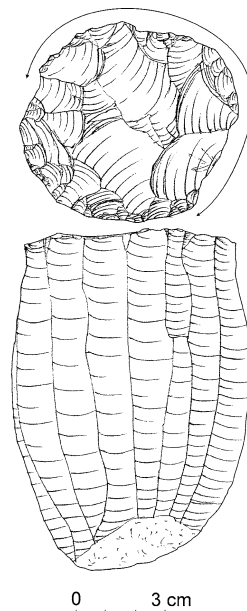


Fig. 5. Polgár 31, grave 867.
Obsidian core

processing of obsidian nodules was registered on the large area of the site that has been excavated. Same wholly cortical flakes have been recorded, and the number of partially cortical flakes is very small.

Obsidian cores must have been, therefore, transferred to the site in prepared forms and further reduction was continued on-site until the advanced phase of reduction. Except for the two cores from burials (features 697 – Fig. 4 and 867 – Fig. 5), no discards of obsidian cores that would, still, be suited for further reduction or that would enable detachments of blanks of the standard set by the Bükk culture industry were recorded.

The two, very large cores (from graves 697 – Fig. 4 and 867 – Fig. 5) are single-platform, sub-conical, with flaking surfaces round the whole circumference, and scars from regular blades with parallel or convergent lateral sides. Their platforms are very carefully prepared by centripetal removals after the last series of blade removals. This may indicate that the cores were deposited in the grave after the final series of blade detachments had been accomplished, and after the platforms were rejuvenated again so that the cores could be used by the dead in his/her after life. The sequences of blade detachments on the two cores differed: on one core reduction was executed from one spot on the core's circumference from two opposite directions, on the second core blade detachments were random, in various directions around the core's circumference. To maintain the ideal shape of the cores the knapper had to be highly skilled – although blade detachments were not made by pressure technique but by means of a soft hammer or a punch.

Only three other obsidian cores for blades do not represent the final phase of reduction. But their dimensions are much smaller – only 3.0–4.5 cm long – than those

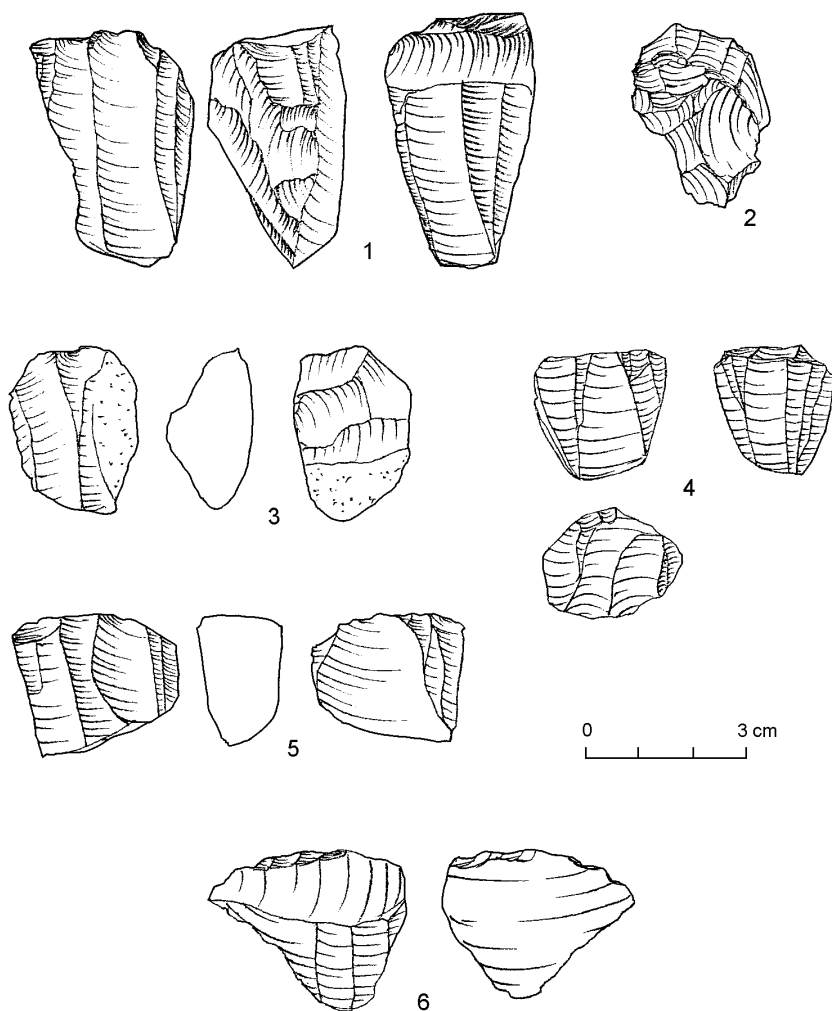


Fig. 6. Polgár 31. 1 – obsidian core (feature 276); 2 – obsidian tablet refitted with no 1 (feature 298); 3 – obsidian core (feature 219); 4 – obsidian core (feature 785); 5 – obsidian core (feature 819); 6 – obsidian tablet (feature 576)

of two above mentioned cores in the full stage of reduction which were 9.0–9.5 cm long. Two of these cores are with the flaking surfaces on only half of their circumference (Fig. 7: 2). Two cores show traces of postero-lateral preparation (Fig. 6: 3). All the three specimens have prepared platforms, and in one case a tablet, which makes up a refit with one of the cores, was detached. This core was discovered in feature 276 (Fig. 6: 1), whereas the tablet in pit 298 (Fig. 6: 2). The refit shows that the core reduction led to the flaking surface extension using the *semi-tournant* system and to a distinct shortening of cores by means of platform rejuvenation.

In view of the facts described above we can assume that the remaining cores (7) which are microlithic (less than 2.5 cm high) represent the final phases of reduction

of bigger cores, and that they were not intentionally shaped to obtain microlithic blanks. Only some of them have regular conical shape, the other cores are flat, sometimes with a cortical back and, occasionally, with the second striking platform parallel to the first one (Fig. 6: 4). We can, thus, assume that besides the reduction sequence that led to the rounding of the flaking face, reduction sequences were also used that maintained only slight convexity of the flaking face. One of the flat, microlithic residual cores shows a 90° change of orientation while the bladelet scars are maintained. One such core is multidirectional.

The core reduction resulting in considerable shortening of cores did not always enable to keep the blade proportions of the detached blanks. Five specimens are microlithic flake cores, low, single-platform (Fig. 6: 5). Only in one case the final phase of reduction resulted in a multiplatform flake core. In two cases single-platform flat flake

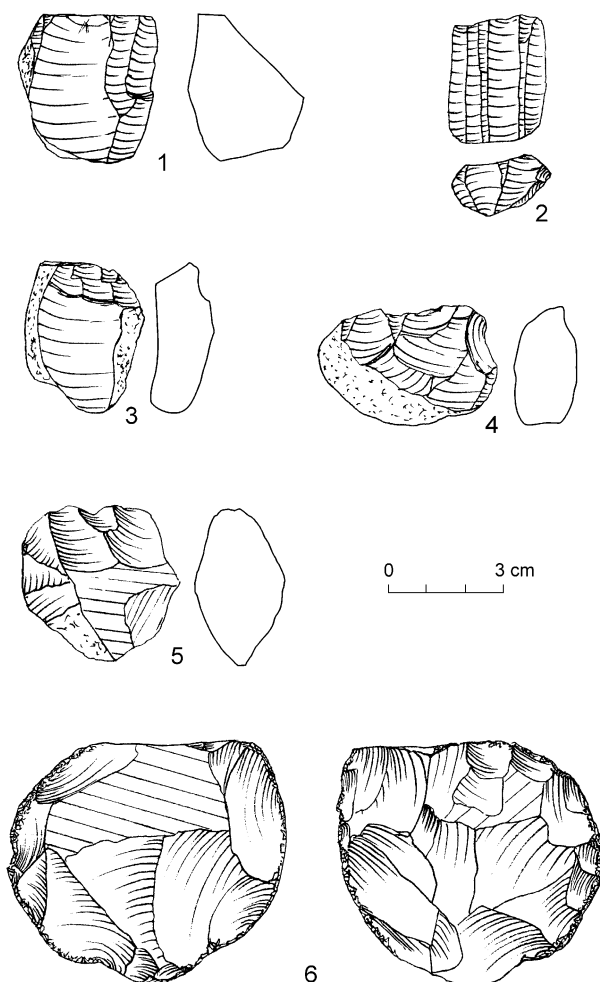


Fig. 7. Polgár 31. 1–6 – cores (1 – flint; 2–4 – obsidian; 5, 6 – limnoquartzite). 1 – feature 624; 2, 3 – feature 812; 4 – feature 819; 5 – feature 276; 6 – feature 566

cores (Fig. 7: 3, 4) were the result of final phase of the reduction of unprepared (except platform) cores; in early phase from these cores blade blanks have been detached.

When we attempt to reconstruct *chaines opératoires* in the production of obsidian blanks we can point to the following stages (Fig. 8):

1. The early stage when the platform was prepared and in the case of some cores flaking faces were prepared from central crests or postero-lateral crests. This stage is poorly represented on the site.

2. The exploitation stage – detachment of blade blanks. Two systems were used: either blades were detached from slightly convex flaking faces or the striking platform was rounded until a conical or cylindrical form was obtained. In order to maintain the correct coring angle in the course of reduction the platform was repeatedly rejuvenated by centripetal removal of flakes or tablets (Fig. 6: 6). Debitage products from platform rejuvenation constitute a large proportion of the total of obsidian flakes (26 out of 71).

3. The final stage of reduction when short but fairly broad bladelets or flakes were detached, and an attempt was made to retain the same axis of the core (“*cintrage*”). In this phase orientation was rarely changed.

Such a reduction system evidences thrifty use of obsidian. The exploitation of obsidian nodules for blank production was maximized even when blanks did not always meet the required standards of size and proportion.

2.3.2. Attribute analysis of obsidian flakes

The total number of flakes (including flake fragments, blade-like flakes, flakes from hammerstones and splinters) is 114 i.e. fewer than unretouched blades. Obsidian flakes (including fragments and splinters) are 71. Only 39 pieces are sufficiently complete to enable attribute analysis. In addition, there were 47 chips (<1.5 cm) that may come both from tool retouching as well from platform edges rejuvenation (on flaking faces or the platform).

The majority are pieces entirely cleared of cortex (30 – 76.9%), or with <33% cortex (5 – 12.8%). Cortical flakes are not very numerous: only one flake represents the group with 33 – 66% cortex (2.6%), and only one flake has more than 66% cortex (2.6%); two are wholly cortical (5.1%). Such proportions confirm that obsidian concretions were decorticated away from the site. Thus, most flakes were detached either during core rejuvenation alternating with reduction, or – possibly – in the final phase of blade cores exploitation. However, it seems most likely that obsidian flakes come from core rejuvenation (platform rejuvenation by tablet detachment [3 pieces – 7.6%], platform edges preparation, lateral crests rejuvenation), to a lesser extent from the change of orientation on cores (only two cores show change-of-orientation in the final phase of reduction).

Analysis of the dorsal pattern of flakes showed, mainly, three directions: parallel to flake detachment (15 – 38.4%), or perpendicular (8 – 20.5%) and centripetal (7 – 17.9%). Only three flakes show opposite dorsal pattern (7.6%). Moreover, 3 tablets occurred that indicate rejuvenation of the whole platform, not only of platform edges. Dorsal pattern analysis confirms that the most common technical operation carried out on site was rejuvenation of platform edges.

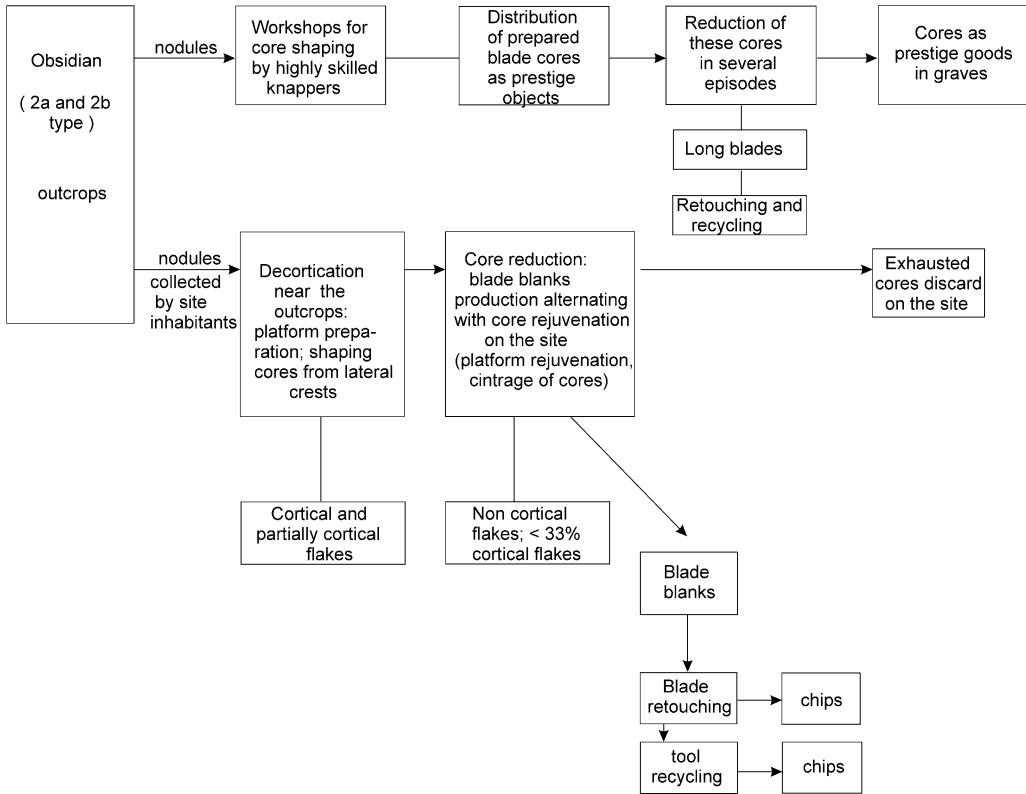


Fig. 8. Obsidian reduction sequences

The structure of flake butts is consistent with repeated rejuvenation of core platforms. Flakes with single-blow butts are most frequent (10 – 25.6%), followed by punctiform and linear butts (10 – 20.6% together) and faceted (5 – 12.8%). It should be noted that as many as 5 flakes are with cortical butts (12.8%); they may come from the expansion of the core platform when detachments removed the remains of cortical surfaces on core sides.

Flakes butts are predominantly straight (18 – 46.1%), less often concave (3) convex (2), and asymmetrical (4).

Butt edges of flakes (on the flaking surface side) are mostly untreated (17 – 43.6%), sometimes made straight by splintering (14 – 35.9%). Abrasion was recorded on only two pieces.

Flake bulbs are well-marked (11 – 28.2%), often with flaws (13 – 33.3%) or with percussion cones (4 – 10.2%), even double cones (2 – 5.1%). Two pieces are with flat, weakly distinguished bulbs (2 – 5.1%). The presence of marked bulbs and cones indicates the use of a hard hammer for core preparation, although a soft hammer could have been used for platform edges rejuvenation.

The majority of flakes are irregular in shape (25 – 64.1%), less often sub-rectangular (4 – 10.2%), with divergent (7 – 17.9%), or convergent edges (2 – 5.1%).

Flakes are small: only one flake was 56 mm long, and only two pieces were more than 35 mm long; the remaining flakes are from 17 to 34 mm. Flake width is from 35–40 mm in two cases, the width of other flakes is from 11–33 mm. In three cases thickness is from 10 to 17 mm; the remaining specimens are from 4–9 mm thick.

Small dimensions and irregular shapes of flakes confirm that – together with some chips – they are waste, first of all from the process of core rejuvenation.

2.3.3. Attribute analysis of obsidian blades

Out of 119 obsidian blades and fragments only 58 specimens were selected for attribute analysis of which 31 were intact and 27 were fragments large enough to enable full analysis. As expected from the core analysis only 9 blades out of 58 (15.5%) have dorsal cortex (4 blades <33% cortex, 4 blades between 33 – 66% cortical surface, and only one blade has more than 66% cortex). Cortex is mainly distal (these are, first of all, the four blades with <33% cortex) or lateral (the remaining 5 specimens). Such a small number of cortical blades confirms the supposition that cores were decorticated away from the site; only small cortical patches remained that were removed as the flaking surface expanded, and when blade removals became longer taking away the cortex from distal part. Although, recently, doubts have been voiced as to the unquestionable value of cortical blanks proportions as indicators of core reduction and transport (DIBBLE et al. 2005) in the case of Polgár 31 the raw material is homogeneous with similar nodules geometry.

On 56 blades the dorsal pattern is unidirectional (Fig. 12: 1, 3–5) which is consistent with the single-platform core reduction system; only one blade has a dorsal scar from the opposed platform which could be the effect of change-of-orientation occasionally registered on the site. Only one specimen is a crested blade; this type of blade is not frequent, evidencing core preparation with lateral or postero-lateral crests, too, was carried out away from the site.

Blade butts are more varied. The predominance of faceted butts shows that on site blades were detached from cores with carefully prepared striking platforms by means of small removals that were repeated with advancing core reduction. There are 17 blades with faceted butts i.e. 29.3% of all the pieces with preserved butts. Other butt types are rare, such as: single-blow butts (8), linear and punctiform (7), dihedral (2) and cortical (2). The shaping of core striking platforms, therefore, must have been done by detaching one large flake only in the early phase of core preparation, subsequently by small removals on the platform edge.

In shape butts are mainly straight (24 pieces – 41.3%), rarely concave (4 – 6.8%), convex (2 – 5.8%) and asymmetrical (1 – 1.7%). The straight, symmetrical shape of the butt was obtained by a method of blade detachment wherein the point of percussion was located at the intersection of the interscar ridge and the platform edge. The straight, symmetrical butt shape correlates with marked percussion points (30 spec. – 51.7%) and fairly well distinguished bulbs (14 spec. – 24.2%); percussion cones (6 spec.) and bulbar scars also occurred. Experimental research (PELEGRIN 2000) shows that this kind of attribute correlation (straight, symmetrical butt, the

presence of bulbar scars, distinguished percussion point) is the effect of the use of soft hammer, probably made from organic material (bone, antler) rather than from soft stone (e.g. from sandstone). The use of a sandstone hammer has a tendency to give – as a result – linear butts.

However, it is likely that in some cases pressure technique was used which is corroborated by the presence of curved lines emphasizing the bulb, recorded on six pieces. Lines like this were experimentally obtained by means of pressure technique, well correlating with straight, symmetrical, fairly narrow butts.

Butt edges are, as a rule, unprepared (23 – 39.6%), less often made straight by small removals that cut off interscar ridges on flaking surfaces (*esquillements*: 10 spec. – 17.2%), possibly abraded before blade detachment (6 spec. – 10.4%). Blades are usually rectangular, with parallel sides (39 spec. – 67.2%). There are 8 blades with convergent sides, 4 pieces with divergent sides, and 7 blades with irregular sides. Blade profiles are predominantly straight (31 – 53.4%), but a fair number have convex profiles (24 spec. – 43.2%). Such profiles are consistent with detachment of blades from subconical – cylindrical cores with weak convexity of core profiles.

Blades cross-sections are trapezoidal (22 spec. – 37.9%) and triangular (19 spec. – 32.7%). At the same time blades with two interscar ridges are most frequent (26 spec. – 44.8%), and percentages of blades with one (14 spec. – 24.1%) or more than two ridges (15 spec. – 25.8%) are more or less equal. This indicates that convexity of core flaking surfaces varied and, consequently, both triangular and trapezoidal cross-sections of blades were obtained.

Blade length is in the interval from 12 to 64 mm, the maximum frequency is in the interval from 29 to 45 mm. Blade width is from 4 to 24 mm, the maximum frequency is from 10 to 22 mm. Thickness is in the interval of 1–11 mm, with the maximum frequency from 2 to 4 mm.

2.4. Reduction sequences and attribute analysis of debitage products from limnoquartzites/hydroquartzites

2.4.1. Reduction sequences of limnoquartzite/hydroquartzite cores

16 cores made from these rocks exhibit considerable differentiation of macroscopic characteristics of raw materials which must have come from different deposits. This means that only a small part of the blades discovered on the site was produced on-site. For example, the blades made from “Boldogköváraja” type limnoquartzite are fairly frequent (8 out of 20 specimens), whereas there is only one core from this raw material. The random selection of raw materials is in agreement with the predominance of cores for flakes made from limnoquartzites/hydroquartzites. In fact only one core – which functioned as a hammer in the advanced phase of reduction – was used to produce regular blades (Fig. 9). The core has a slightly convex, weakly rounded flaking face, 6.5 cm high; with careful bilateral preparation on the back. In all likelihood macro- and mediolithic blades from limnoquartzite/hydroquartzite, that are fairly frequent on the site (Fig. 11: 1–3), were detached from cores like this.

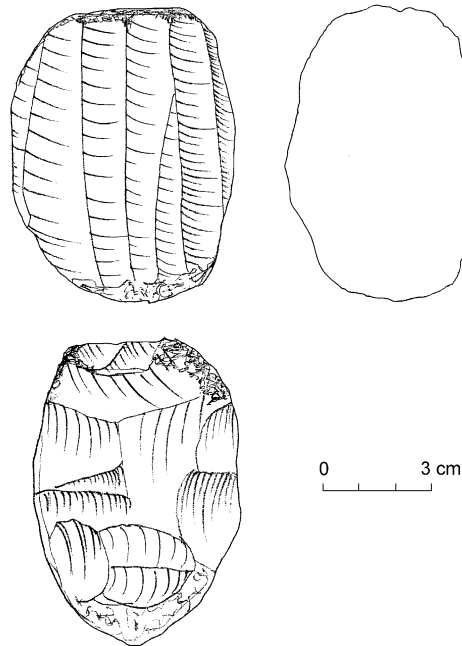


Fig. 9. Polgár 31, feature 837. Limnoquartzite core

The question arises whether the fact that discards of cores of this type do not occur on the site means that they were prepared elsewhere, or that they were transformed during the process of reduction, just like obsidian cores. The former hypothesis seems more plausible, because the majority of limno- and hydroquartzite cores were *a priori* intended to be flake cores. These are: double-platform flake cores (3 – Fig. 10: 4; Fig. 11: 4), a single-platform specimen with “para-Levallois” preparation (1), discoidal (Fig. 10: 3) and subdiscoidal cores (4 – including two cores transformed into a hammerstones – Fig. 7: 5, 6; 10: 2). Only in the case of low, single-platform cores (2 – including a subcarenotid specimen – Fig. 10: 1) can we assume that they represent the final phase of reduction of single-platform blade cores. The state of preservation of one of these cores suggests that this could be a Palaeolithic core found by the Neolithic inhabitants of the settlement.

The above observations allow us so formulate the following conclusions (Fig. 13):

1. the majority of blades from limnoquartzite/hydroquartzites (20 specimens) and blade tools from these raw materials were brought to the site in a completed form. It should be added that in this group of artefacts the limnoquartzites of the highest quality i.e. Boldogkövávalja type and white limnoquartzites resembling opals, are best represented. The metrical attributes of the high quality blanks are exceptional: some of the blades are as much as 8.0–9.5 cm long and 1.2–2.2 cm broad.

2. The most important blanks produced from these raw materials on-site were flakes. They were obtained in two basic reduction sequences: from opposed platform cores and from discoidal cores.

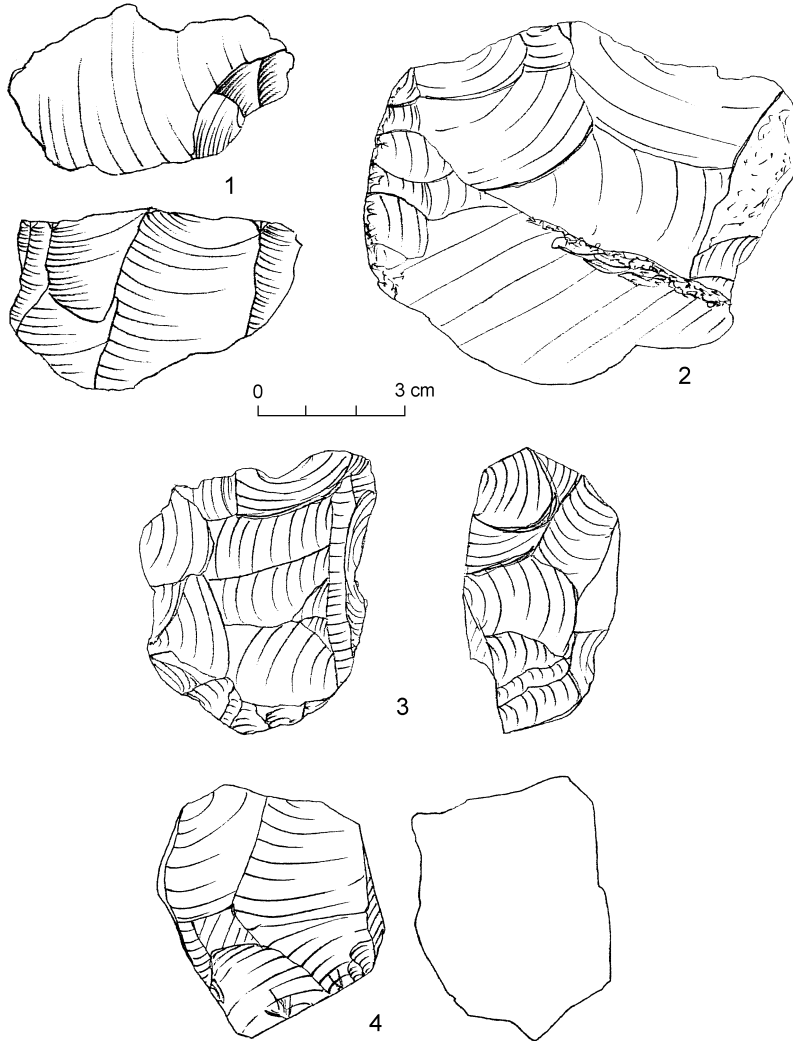


Fig. 10. Polgár 31. 1–4 – limnoquartzite cores (features: 1 – 502; 2 – 812; 3 – 169; 4 – 367)

3. The two core reduction sequences led to the residual phase and – just like in the case of obsidian – evidence economic raw materials exploitation. Sometimes, after the advanced phase of reduction has been accomplished, cores were used as hammerstones (Fig. 9).

4. The *chaîne opératoire* starting from well-prepared single-platform blade cores and leading to low microlithic cores – better documented by the obsidian cores – is confirmed by one specimen representing the advanced phase of reduction, and, possibly, by one (or two) specimens in the final phase of reduction. The small number of flakes from limno- and hydroquartzites, that come from platform rejuvenation (5 out of 38) is smaller than in the case of obsidian specimens (26 out of 71).

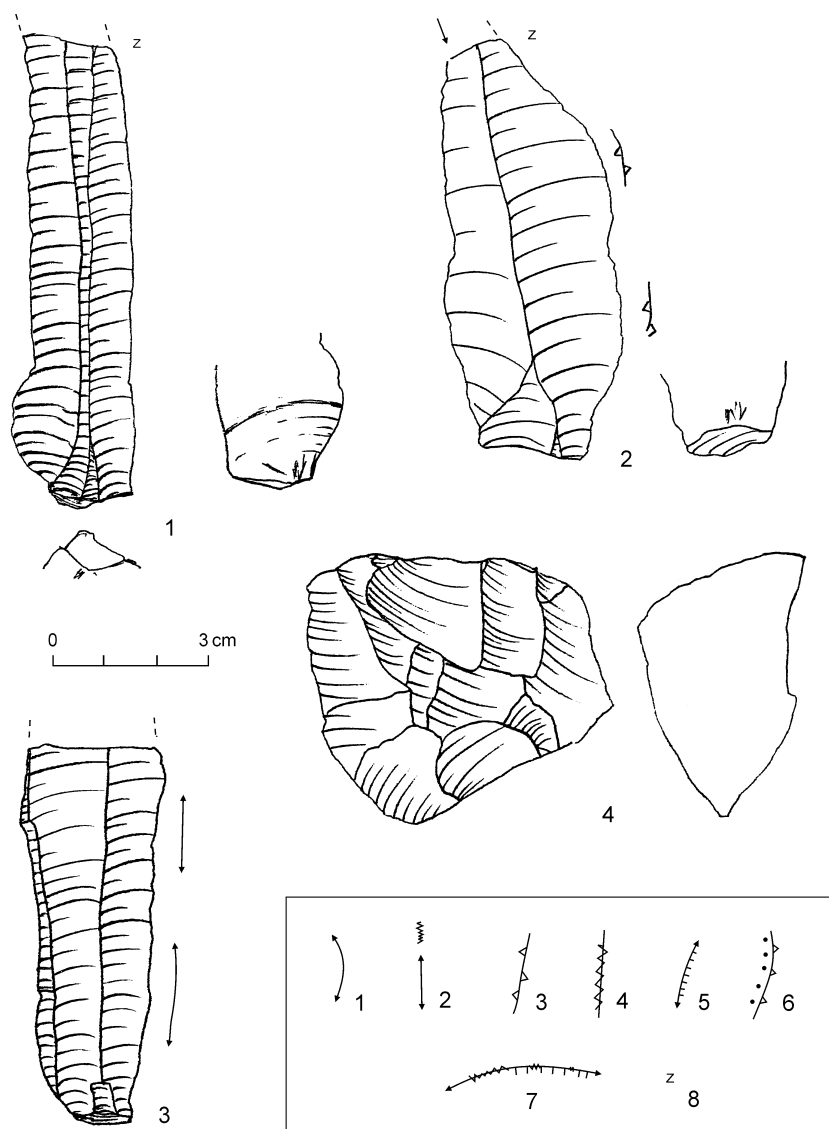


Fig. 11. Polgár 31. 1-3 – limnoquartzite blades (features: 1 – 38; 2 – 167; 3 – 625); 4 – limnoquartzite core (feature 367).

Key for use-wears: 1 – rounding of the edge; 2 – rounding and nibbling of the edge; 3 – microscars; 4 – crushing of the edge; 5 – striations; 6 – micropolis and nibbling; 7 – nibbling, crushing and striations; 8 – broking

2.4.2. Attribute analysis of limnoquartzite flakes

Limnoquartzite flakes (38) are more numerous than unretouched blades from this raw material (19). However, only 12 flakes could be fully analysed (including two blade-like flakes); the remaining pieces are flake fragments. There were only four limnoquartzite chips.

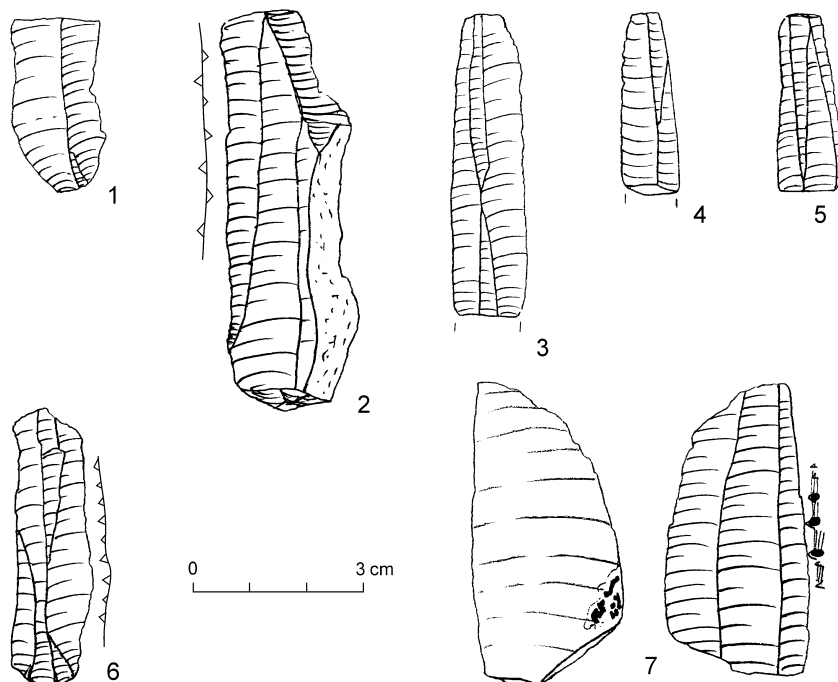


Fig. 12. Polgár 31. Obsidian (1, 3–7) and limnoquartzite (2) blades. 1 – feature 241; 2 – feature 624; 3–5 – feature 819; 6 – feature 554; 7 – feature 576

Out of 12 analysed pieces only two have small cortical areas (less than 33%); one of the blade-like flakes is almost entirely cortical; the other specimens are without cortex. Such proportions of cortex confirm that decorticated cores were brought to the site.

The structure of dorsal pattern shows predominance of perpendicular pattern of scars (4). Unidirectional dorsal patterns (4) are equal in number to opposite and centripetal scar patterns (2 each). One trimming flake was also present. The flakes and the cores on the site evidence that flake blanks production from limnoquartzite employed specific reduction sequences utilising double-platform and discoidal cores. We can assume that some completed limnoquartzite blanks and – even – some retouched tools were brought to the site.

In contrast to obsidian flakes among flakes from limnoquartzite single-blow butts occur most often (9); dihedral (2) and linear (1) butts are less frequent. Butts are usually straight (7) followed by convex (3) and asymmetrical (2). Percussion points can be distinguished (6) or undistinguished (6). Bulbs are visible (5) weakly marked, flat (4), occasionally percussion cones occur (2). These bulb and butt types evidence the use of hard hammer technique in the production of limnoquartzite flakes.

Flakes are predominantly irregular (5), less often sub-rectangular (4), exceptionally sub-triangular (1).

Only two limnoquartzite flakes are between 35 and 48 mm long. The other flakes are in the interval from 18 to 30 mm. Flake width is between 36 and 44 mm, mainly

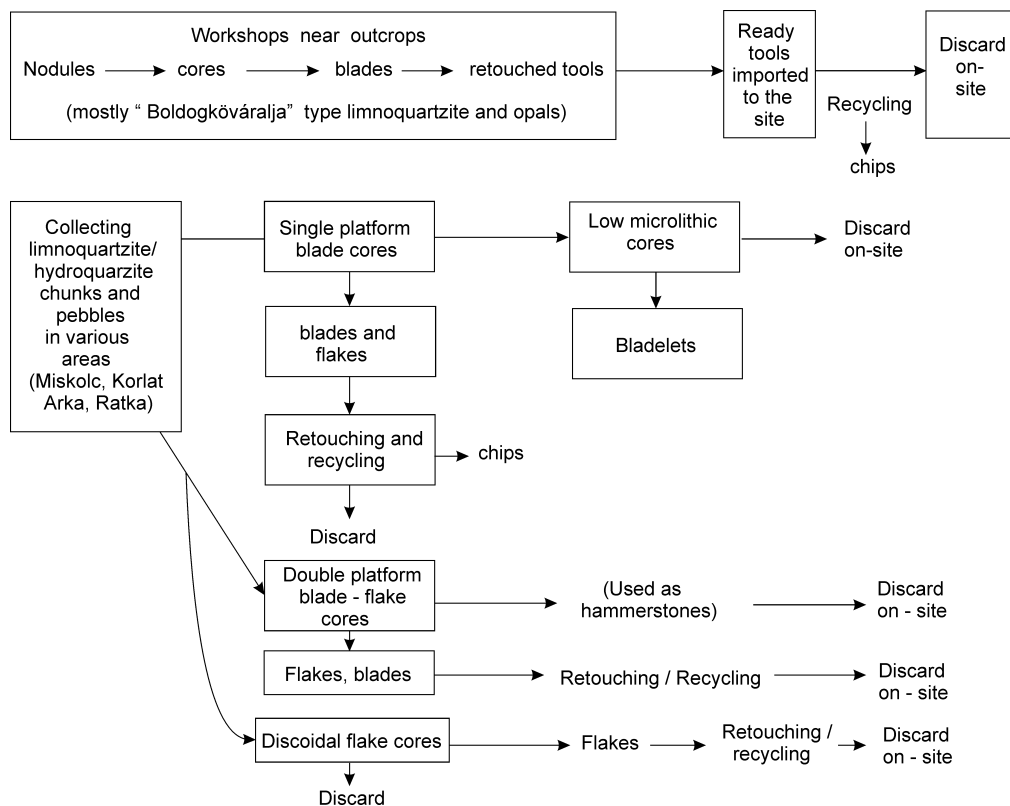


Fig. 13. Limnoquartzite reduction sequences

between 22 and 31 mm. Two flakes measure 16 mm in thickness, the others are in the interval from 5 to 11 mm.

2.4.3. Attribute analysis of limnoquartzite blades

While the number of blades made from limnoquartzite (19) that lend themselves to attribute analysis is small, it is still larger than the number of indeterminate blade fragments (3) from this raw material. Limnoquartzite blades were accidentally broken or destroyed to a lesser extent than were, more friable, obsidian blades.

Only one limnoquartzite blade was cortical; the remaining pieces have no dorsal cortex. Just as obsidian blades, limnoquartzite specimens were detached from single-platform cores (Fig. 11: 1). Two blades were detached from opposed platform cores which were registered in the investigated assemblage (Fig. 12: 2). The use of lateral preparation is confirmed by one blade detached after the crested blade. The most numerous are single-blow butts (7) and faceted butts come next (5); butt preparation by small removals was less common than in the case of obsidian cores. Only one blade has a dihedral butt. Morphologically, blades with concave (5) butts are more numerous than those with straight (3), convex (2) or asymmetrical butts (1). Usually, butt edges are unprepared (10). Specimens with abrasion (2) or splintering (2) of the platform edge are rare. Points of percussion are,

as a rule, well marked; bulbs are visible (5) or with bulbar scars (4). Bulbs show bulbar scars or radial ridges. These attributes point to the use of hard hammer direct percussion while in the case of obsidian blades production soft organic hammer was applied.

Limnoquartzite blades are predominantly with parallel, straight (11) or irregular edges (5); only one blade is with convergent edges, whereas divergent edges are absent. Blade cross-sections are most often trapezoidal (9) or triangular (7), sometimes irregular (2). The profiles are straight (11), or convex (7). There are specimens with one (6) or with two interscar ridges (8) that are usually parallel (6).

Morphologically limnoquartzite blades do not essentially differ from obsidian blades except that in the former group pieces with more than two interscar ridges are absent. In the case of obsidian cores the number of interscar ridges is determined by the greater rounding of flaking surfaces.

Limnoquartzite blades are longer than obsidian pieces, some are between 65 to 88 mm long, blades shorter than 40 to 48 mm are less numerous. Only one blade is 20 mm long. Width of limnoquartzite blades is from 17 to 33 mm, with the majority in the interval from 20 to 30 mm. These values are bigger than for obsidian blades. Similarly, thickness of limnoquartzite blades is larger than that of obsidian pieces (3–8 mm).

The use of hard hammer for detachment of limnoquartzite blades caused that these blades do not taper towards the butt as strongly as obsidian blades. The width of butts of limnoquartzite blades approximates the maximum width of blades.

All in all we can say that limnoquartzite blades are bigger than obsidian specimens and that in their production the method of direct percussion with a hard hammer was used. However, this conclusion must be treated with caution because experimental production of limnoquartzite blades by a variety of different techniques has not been carried out.

2.5. Other raw material treatment

Other raw materials that occurred only sporadically should be approached individually; their small quantity shows that they did not arrive at the site as part of the whole system of raw materials provision. Moreover we should bear in mind that some of the artefacts made from less frequent raw materials may not correspond, in terms of chronology to the Linear Pottery settlement, but e.g. may come from the Palaeolithic (patinated specimens from Southern Polish flints) or can be attributed to the Szatmár Group settlement (flint from northern Balkans; Fig. 7: 1).

2.6. Morphology of retouched tools

Among 111 retouched tools end-scrapers (25 – 22.5%) and blades with marginal retouch (23 – 20.7%) have a decided ascendancy. Retouched truncations (11 – 9.9%), perforators (5 – 4.5%), retouched flakes (6 – 5.4%), macro-tools (heavy duty tools – 6 – 6.3%), burins (5 – 4.5%) and notched tools (7 – 6.3%) are less numerous.

Other types of retouched tools occur as single specimens. These are: geometric microliths (2), microtruncations (2), tanged pieces (4), a shouldered piece (1) and denticulated tools (2).

Because splintered pieces (9) were not exploited as cores but rather used as chisel-like tools, they, too, can be assigned to tools *sensu lato*.

A specific tool category – identified on the basis of macroscopic use-wears – are sickle-inserts. A total of 11 such sickle-inserts included only three retouched tools (an end scraper and two truncations); the remaining specimens were unretouched blades with sickle gloss.

There are 3 limnoquartzite/hydroquartzite hammerstones with traces of use on the whole surfaces.

End-scrapers (25)

In this group of tools there are 11 blade scrapers (including one on a trimming blade), 10 flake scrapers, 2 end-scrapers made on retouched blades and two double end-scrapers. A majority of end-scrapers are made of limnoquartzite/hydroquartzite (20); sporadically on obsidian (3), radiolarite (1) and Jurassic flint (1) (see: Table 3). The end-scraper made on Jurassic flint is, in all likelihood, an Upper Palaeolithic addition: it was made on a bilateral retouched blade (Fig. 14: 6). Among finds from Polgár 31 there are no blank types or types of retouch that would correspond to this end-scraper.

Only three blade end-scrapers were not shortened during use. One of them is made on a limnoquartzite trimming blade; its proportions indicate that it had not been shortened during use; the front is fairly high, shaped by lamellar retouch, damaged (Fig. 14: 4). The proximal parts of the two other end-scrapers were broken off. One of these end-scrapers has a weakly concave, steeply retouched front (Fig. 15: 8) and use-wears on the lateral edge. The other has a narrow, asymmetrical, weakly convex front, shaped by retouch at an angle of about 50 degrees.

Table 3. Raw material structure in major tool categories

Retouched tools	Obsidian	Limnoquarzites	Other	Total
End-scrapers	3	20	2	25
Retouched blades	18	4	1	23
Truncations	5	6		11
Perforators	2	1	2	5
Retouched flakes	5	1		6
Macro-tools	2	4	1	7
Burins	3	2		5
Notched implements	1	6		7
Microliths	4			4
Tanged and shouldered pieces	4		1	5
Denticulates tools	1	1		2
Splintered pieces	8			8
Hammerstones		3		3
Total	56	48	7	111

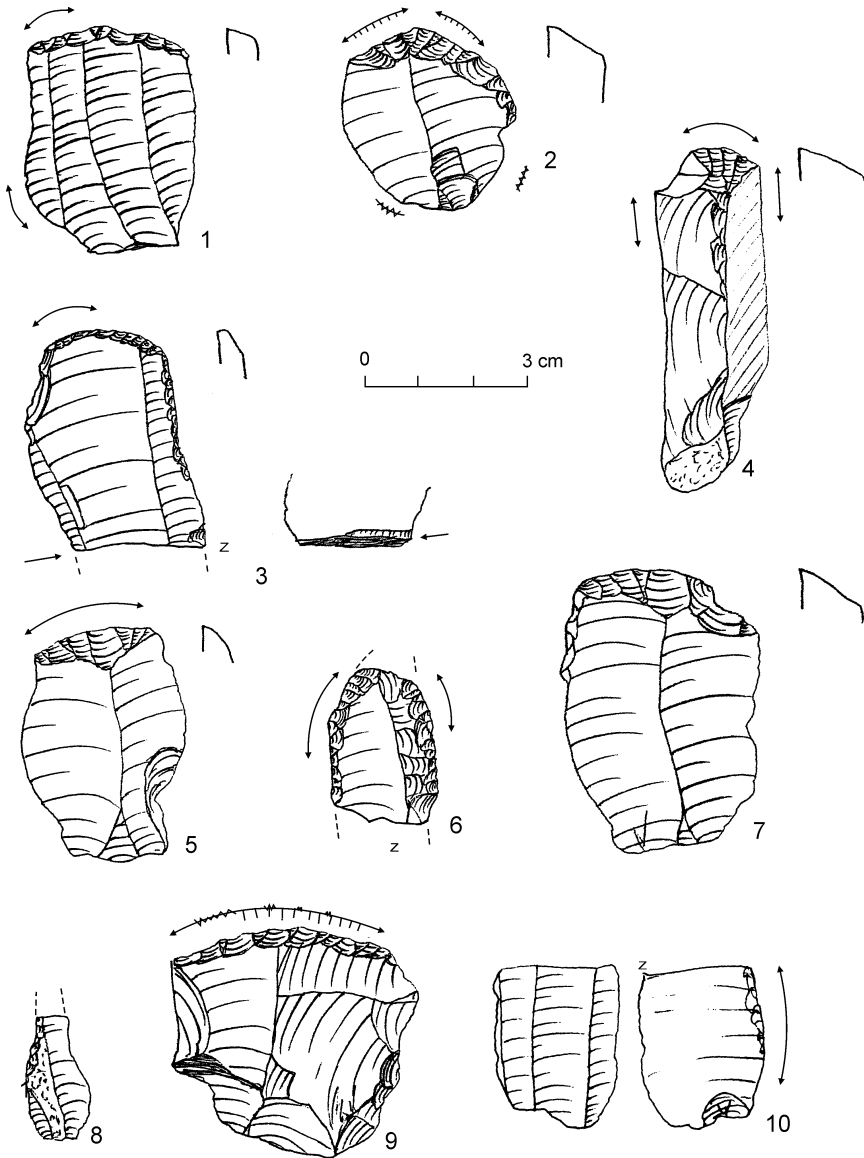


Fig. 14. Polgár 31. 1–7, 9 – end-scrapers (1–5, 7 – limnoquartzite; 6 – Jurassic flint (?); 9 – obsidian); 8 – microtruncation (obsidian); 10 – retouched blade (obsidian). 1 – feature 130; 2 – 265; 3 – 274; 4 – 993; 5–7, 8 – 819; 9 – 322; 10 – 541

The front of another blade end-scraper has been initially shaped on the transversal break.

The proportions of other end-scrapers indicate that they were shortened during use or that the blade was segmented. Specimens like this are shown in Fig. 14: 1, 5, 7; 15: 3, 4. The fronts are slightly convex shaped by retouch at an angle of about 45–70 degrees. One specimen, which is not shown in figures, has a straight, steep front.

Flake end-scrapers are short (Fig. 14: 2) and broad (Fig. 14: 9). Some are with lateral retouch which is the effect of recycling (Fig. 15: 2); recycling is confirmed by a variety of use-wears on the sides and in the proximal part (Fig. 15: 7). A flake end-scraper has a high, nosed front and a basal notch that, too, was formed during recycling.

Fronts of flake end-scrapers are weakly convex, straight or undulating.

If we assume that the end-scraper on a bilaterally retouched blade is an Upper Palaeolithic addition, then the inventory contains only one *lame retouchée* specimen

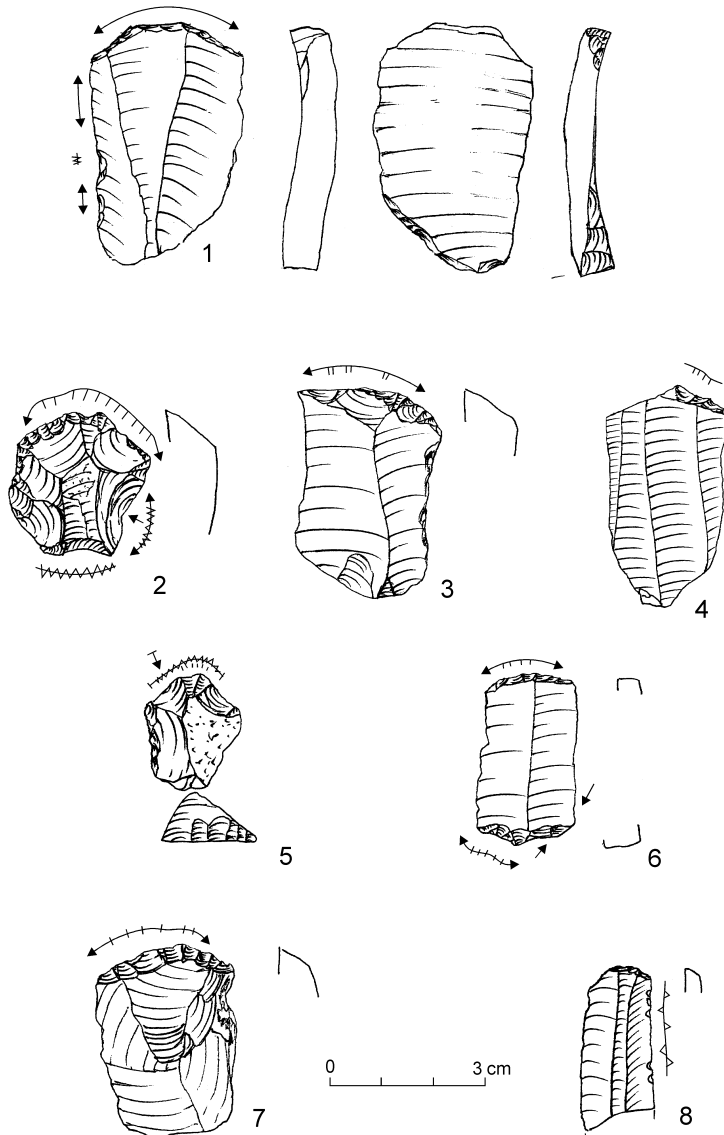


Fig. 15. Polgár 31. 1–8 – end-scrapers (1–7 – limnoquartzite; 8 – obsidian). 1 – feature 80; 2 – feature 23; 3 – feature 68; 4, 5 – feature 993; 6, 8 – feature 819; 7 – feature 620

with a finely retouched convex front and a partially retouched edge (Fig. 14: 3). The proximal break shows a transversal burin blow.

There are two double end-scrapers: a specimen on a small, partially cortical flake with one retouched edge and the second front with strongly steep retouch (Fig. 15: 5); the other end-scrapers is on a blade, with symmetrical, very steep, worn fronts (Fig. 15: 6).

A distal, blade end-scrapers is combined with a proximal truncation shaped by steep, inverse retouch (Fig. 15: 1).

Retouched blades (23)

The inventory contained 23 retouched blades (20.7%), the majority of which were made of obsidian (18), fewer from limnoquartzite/hydroquartzite (4), and one from menilithic hornstone. As the majority are obsidian specimens, with fine, often discontinuous retouch, we can assume that they were shaped in the effect of utilisation rather than in the effect of intentional modification of edges. In addition, the specimens do not show standardization of types of retouch.

In the group of one-sided retouched blades the following types occur:

- with semi-steep, continuous retouch, possibly intentional (Fig. 16: 2),
- with partial, fine, obverse retouch (4 specimens). One of these blades shows sickle use-wears (high gloss) subsequent to the retouch; in addition, on the dorsal side there are traces of hafting as a sickle insert. A mesial fragment of another specimen shows crushing of the retouched edge,
- with semi-steep, obverse retouch in the distal part; after the distal part had broken, the blade was used on the break as a side-scrapers for hard materials (bone, antler),
- with notched, obverse, discontinuous, fine retouch,
- with fine, inverse retouch (2).
- The double-sided specimens are characterized by the following types of retouch:
- fine, continuous, uniseriate (Fig. 16: 3; 17: 3). One specimen has fine, obverse retouch in the distal part and an impact fracture on the tip,
- two specimens have fine, continuous, obverse retouch on one edge, and denticulated (Fig. 16: 1) or notched on the other edge,
- fine, notched, discontinuous retouch (Fig. 16: 4; 17: 4),
- weakly concave, semi-steep, possibly intentional retouch (Fig. 17: 1),
- alternate, partially semi-steep retouch (Fig. 14: 10; 16: 7),
- alternate, steep: the specimen with this retouch is a mesial fragment of a blade with thinning, inverse retouch on one break; on the opposite break there is a Corbiac type burin blow,
- alternate retouch in combination with: semi-steep continuous on one edge and fine, partial on the other edge. This, too, is a mesial fragment of a blade; on one break – thinning inverse retouch occurs, on the other break there are use-wears from scraping hard materials (bone, antler?),
- a robust blade has bilateral, inverse retouch in the distal part; it is made from menilithic hornstone (Fig. 17: 2).

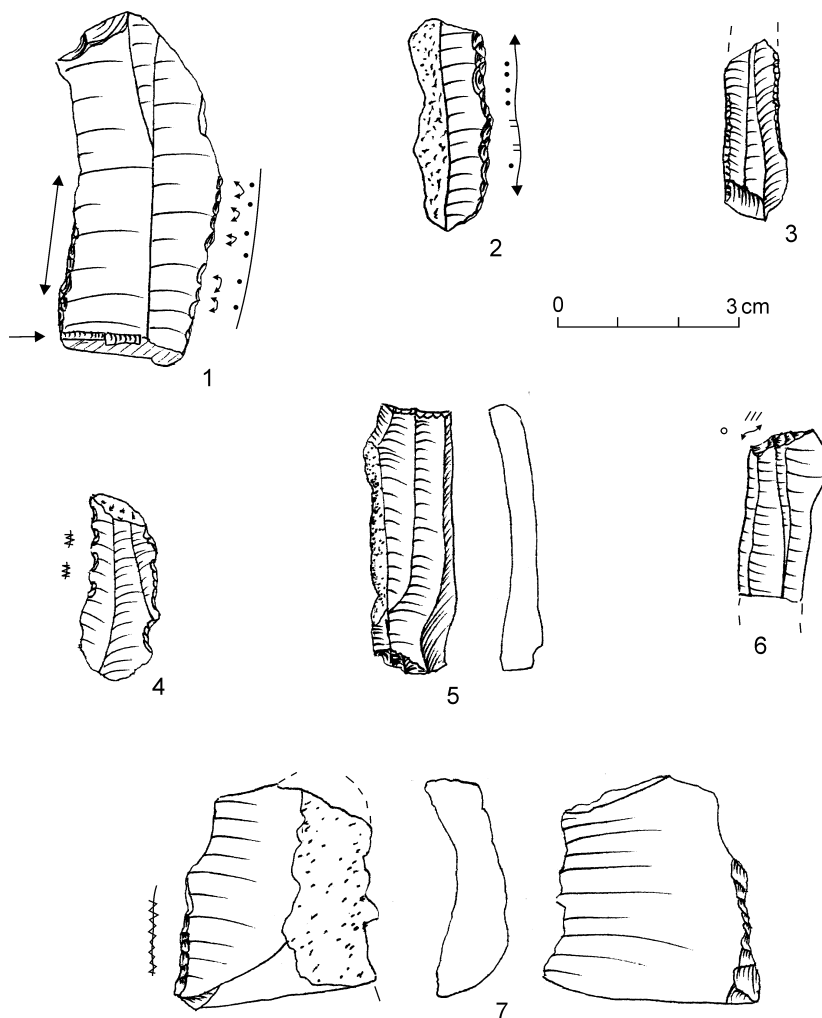


Fig. 16. Polgár 31. 1–4, 7 – retouched blades; 5, 6 – truncations (1, 2 – limnoquartzite; 3–7 – obsidian).
1 – feature 902; 2 – feature – 880; 3, 4, 7 – feature 819; 5 – feature 856; 6 – feature 180)

The lack of standardization of these tools leads to the conclusion that they do not form a homogeneous morphological group but, rather, a heterogeneous collection of utilised artefacts (although partly modified) as *ad hoc* tool types (also described as expedient tools).

Retouched truncations (11)

In this group of tools the number of obsidian (5) and limnoquartzite/hydroquartzite (6) specimens is equal. On the other hand, the group is morphologically fairly varied:

- straight truncations are represented by two distal specimens (Fig. 16: 5) of which one is on a crested blade; and the other is a proximal specimen (Fig. 17: 5) on a regular blade whose butt was removed by a very steep retouch,

- oblique truncations are represented by one distal specimen shaped by very fine, steep retouch (Fig. 17: 6), and one proximal specimen shaped by semi-steep retouch (Fig. 16: 6),
- there is only one convex truncation, possibly a fragment of a double truncation; with use-wears from the function as a knife for cutting meat (?) and not as a sickle insert (Fig. 17: 7).

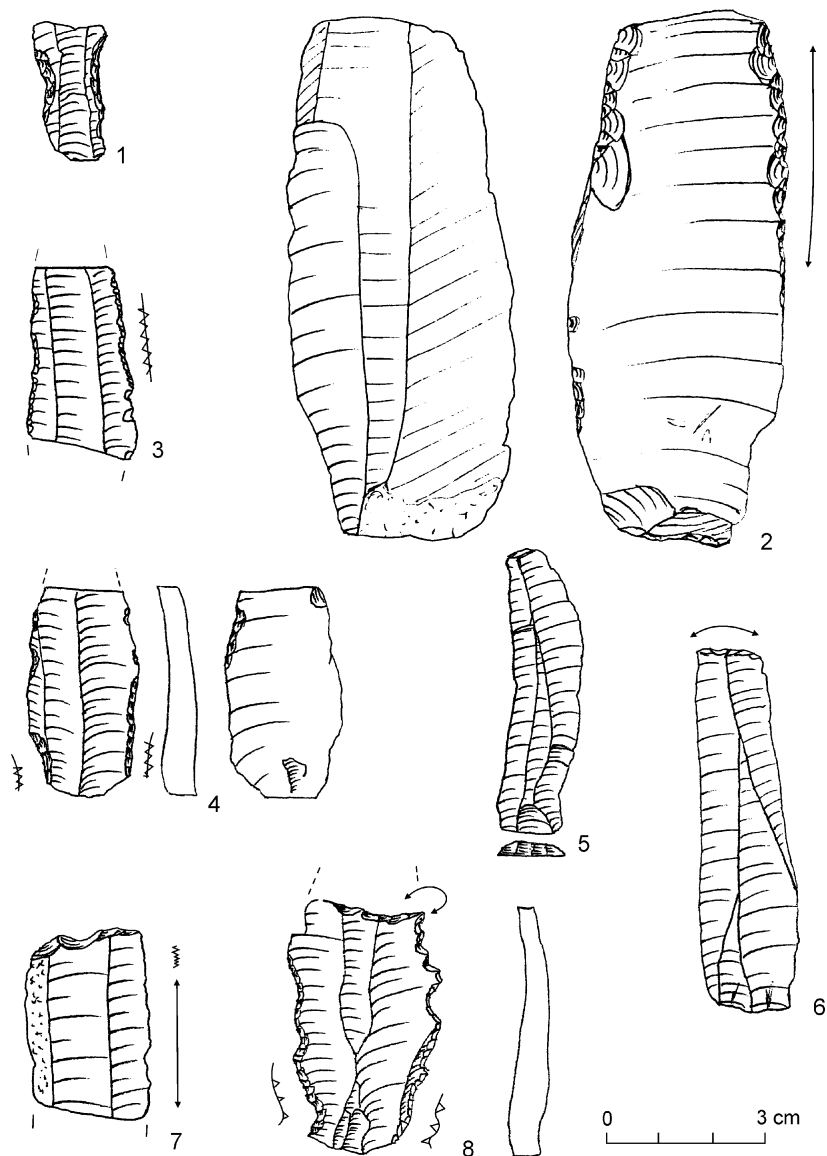


Fig. 17. Polgár 31. 1–4 – retouched blades (1, 3, 4 – obsidian; 2 – menilithic hornstone), 5–7 – retouched truncations (5, 7 – limnoquartzite; 6 – obsidian); 8 – perforator (obsidian). 1 – feature 819; 2 – 576; 3, 4, 8 – 625; 6 – 812; 7 – 993)

Of special interest are two truncations that were used as sickle inserts, but the sequence of use-wears and modification is complex:

- an oblique proximal truncation; the distal part was removed by deliberate breaking; then the artefact was used as a sickle insert obliquely hafted so that the transversal break protruded from the haft,
- a blade with use-wears from functioning as a sickle insert (high gloss) in the distal part; it was broken in the proximal part; on the break very steep retouch shaped a straight truncation.

We can see that the retouching of truncations was not necessarily a planned intention to modify a blade in order to enable better hafting, but could have taken place during utilisation as an element of recycling.

Perforators (5)

The group of perforators varies both as to raw materials and morphology. Two specimens are made from obsidian, from limnoquartzite, radiolarite and andesite one each.

All the perforators have weakly distinguished points and are asymmetrical:

- an atypical, asymmetrical bec on an obsidian blade, with fine irregular, notched retouch on lateral edges (Fig. 17: 8),
- a *bec burinant* on a heavy flake struck from a discoidal core, formed between two obverse Clactonian notches (Fig. 22: 6). Made from andesite,
- an atypical, alternate perforator, shaped by irregular obverse and inverse retouch, with a weakly distinguished point; made on a large laminar flake from limnoquartzite,
- an asymmetrical bec made on a transversally retouched obsidian blade,
- atypical perforator made from radiolarite with weakly distinguished point, inversely retouched on one lateral side (Fig. 18: 2).

None of these specimens is a typical perforator, although almost all show traces of drilling organic materials such as dry hide, shell or bone.

Retouched flakes (6)

Except for one retouched limnoquartzite flake (Fig. 20: 2) all the specimens (5) are made from obsidian. In terms of morphology the following categories can be distinguished:

- 3 specimens with fine, steep retouch resembling *raclettes* retouch; one specimen has retouch almost on the entire circumference, another has retouch on three distinct lateral edges, and the third specimen is a fragment of a flake with partial lateral retouch,
- a flake with bifacial, lateral retouch, shaping by splintered technique a weakly convex edge (Fig. 18: 5),
- an irregular cortical flake from obsidian with transversal, semi-steep retouch (Fig. 18: 6),
- two specimens show a more complex sequence of retouching and use-wears; one of them had partial lateral inverse retouch, subsequently it was broken and on the break there is inverse, flat retouch, probably from utilisation. The crushing on the

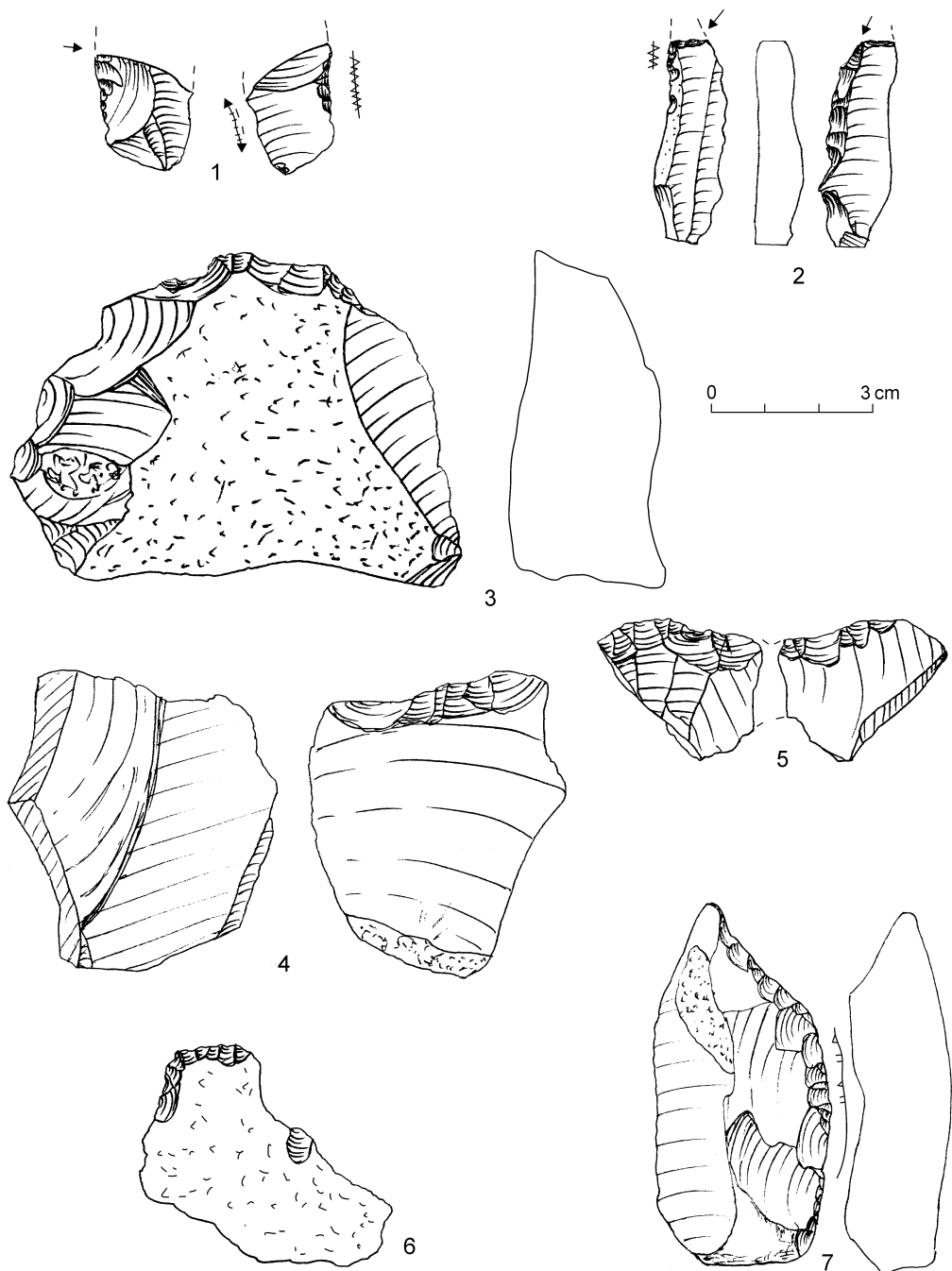


Fig. 18. Polgár 31. 1 – burin; 2 – perforator; 3, 4, 7 – macro-tools; 5, 6 – retouched flakes (1, 3, 5, 6 – obsidian; 2 – radiolarite; 4, 7 – limnoquartzites). 1 – feature 127; 2 – feature 244; 3 – feature 630; 4 – feature 169; 5, 6 – feature 819; 7 – feature 993

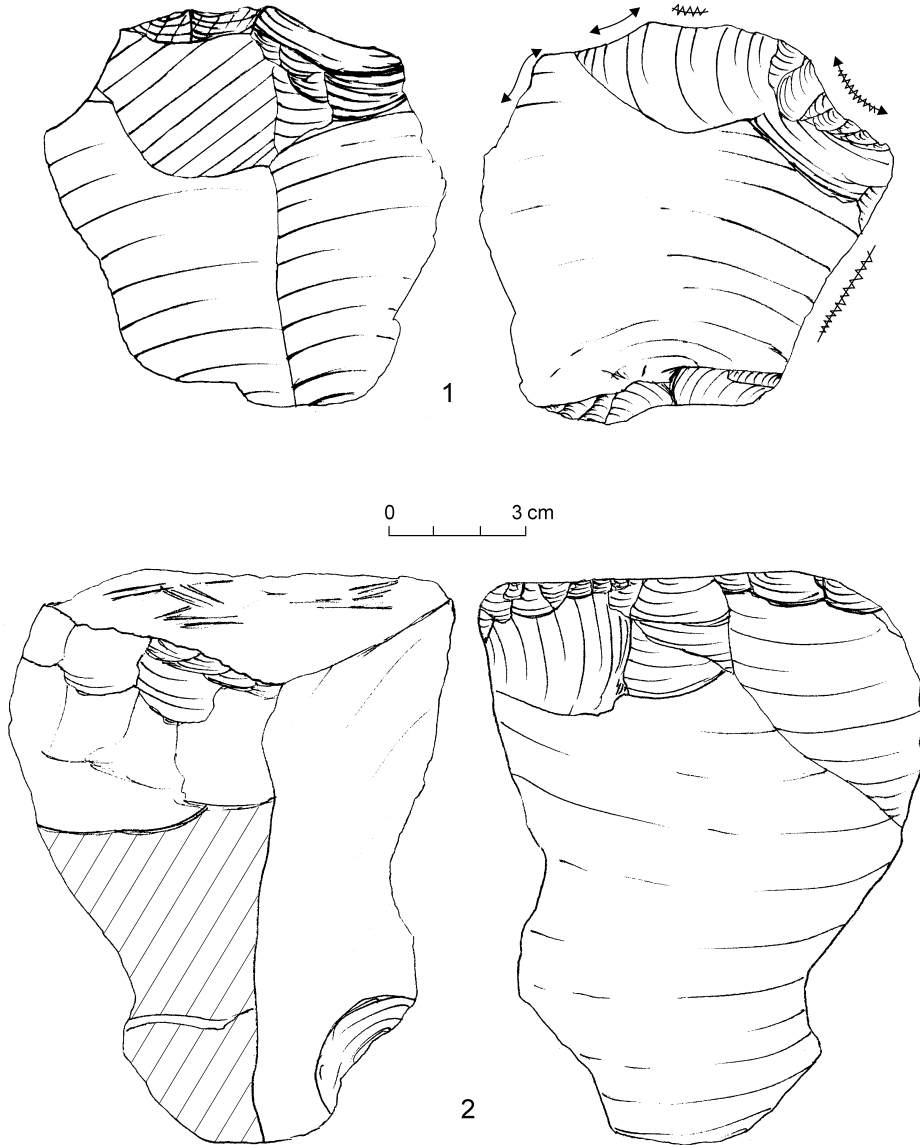


Fig. 19. Polgár 31. 1, 2 – macro-tools (1 – limnoquartzite; 2 – black quartzite). 1 – feature 21; 2 – feature 149

lateral edge at its contact with the break is also caused by utilisation (Fig. 20: 1). The other specimen is a short flake with a deep Clactonian notch and with bifacial retouch on the slightly convex transversal edge shaped by heavy pressure, with subsequent crushing of the same edge (Fig. 20: 2).

Retouched flakes do not form a morphologically homogeneous group, but, practically, each specimen has a different type of retouch, specific history of utilisation whose effect could have been also the modification of flake shapes.

Macro-tools (heavy duty tools – 7)

This group consists of chipped tools shaped on robust flakes, that represent either variants of standard tools or specific examples of heavy cutting tools (cleaver-like) with distal retouch. Four such tools were made of limnoquartzite/hydroquartzite, two of obsidian, and one from black quartzite.

To standardized tool forms can be assigned:

- a macrolithic end-scraper shaped on a big tablet removing the whole platform of an obsidian core (Fig. 20: 3). On the front traces of use as a scraper for dry hide are present,
- a macrolithic end-scraper shaped by denticulate retouch on a large, cortical obsidian flake (Fig. 18: 3). No use-wears,
- macrolithic end-scraper like tool made from limnoquartzite flake (Fig. 21: 1),
- a macrolithic perforator asymmetrically shaped on a thick, limnoquartzite flake with retouch along the whole length of the right lateral edge (Fig. 18: 7). The point is rounded by drilling soft materials.

Non-standardized tools are represented by:

- a partially cortical limnoquartzite flake with a transversal edge shaped by inverse retouch that forms a kind of slightly concave cutting edge (Fig. 18: 4). No use-wears.

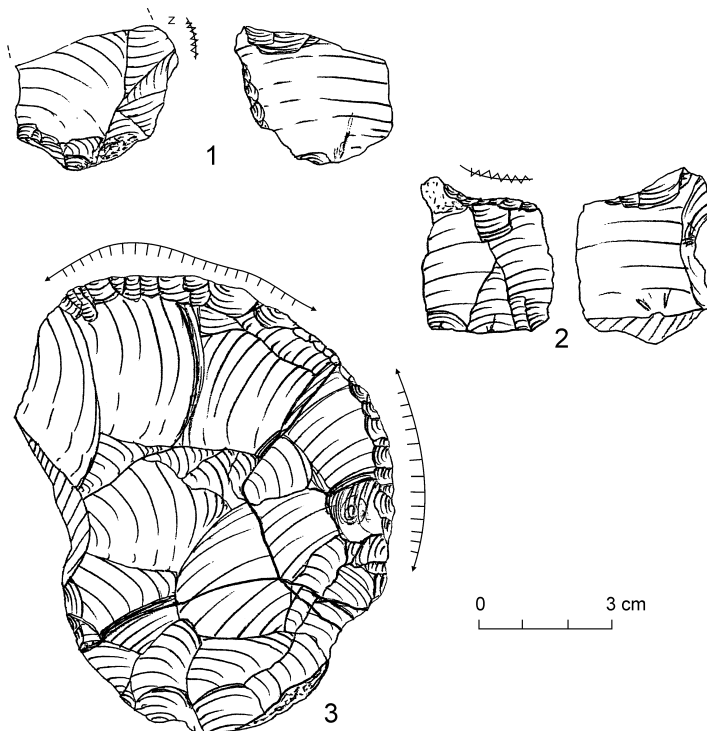


Fig. 20. Polgár 31. 1, 2 – retouched flakes; 3 – macro-end-scraper (1, 3 – obsidian; 2 – limnoquartzite).
1 – feature 265; 2 – 805, 3 – 322

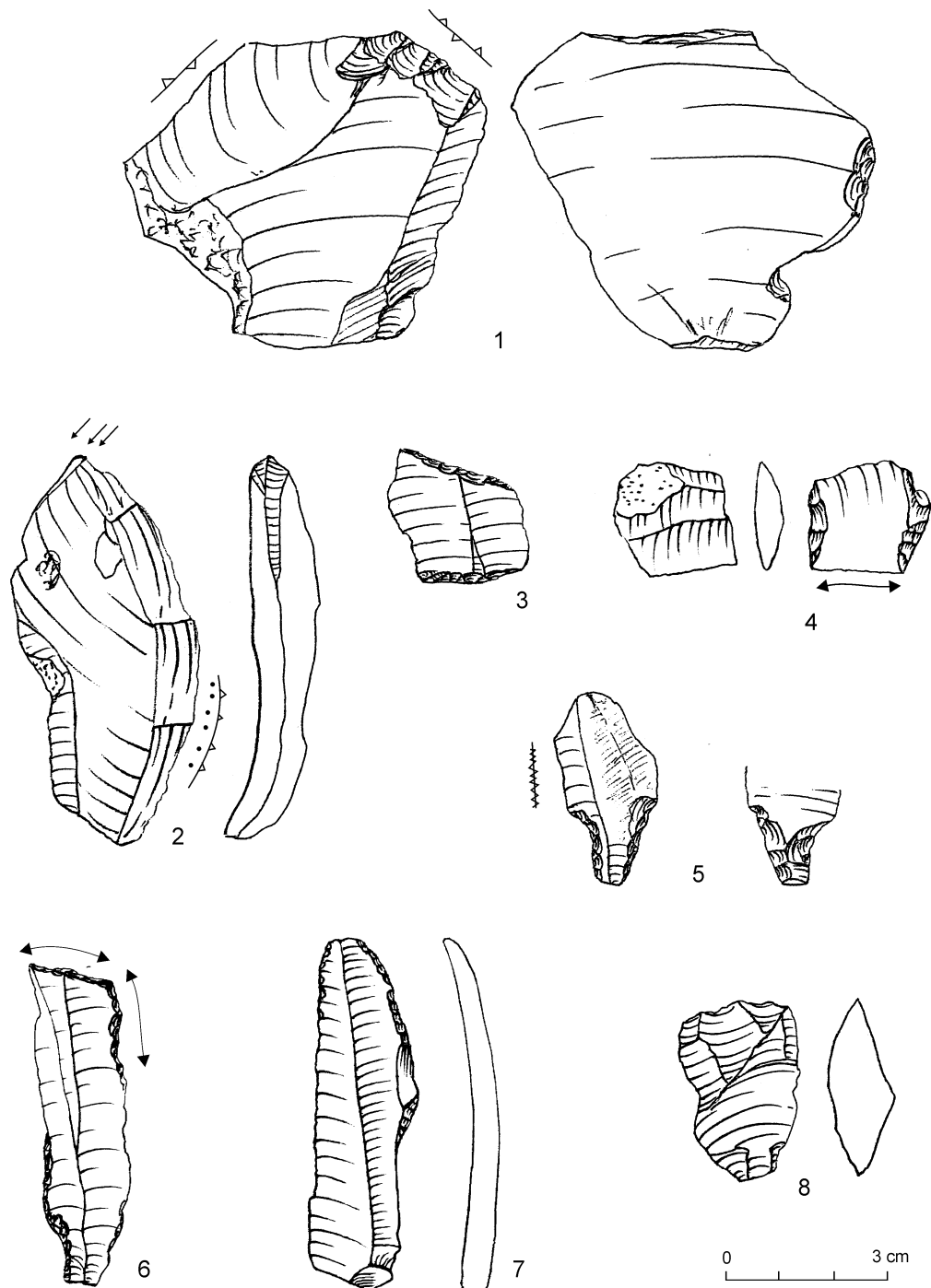


Fig. 21. Polgár 31. 1 – macro-tool; 2 – burin; 3, 4 – trapezes; 5, 6 – tanged (pendunculated) pieces; 7 – shouldered piece; 8 – splintered piece (1, 2 – limnoquartzite; 3–8 – obsidian). 1 – feature 169; 2, 3 – 636; 4, 5, 7 – 819; 6 – feature 34; 8 – 554

- a heavy limnoquartzite flake with transversal bifacial retouch forming a slightly convex cutting edge (with wears suggesting the use as adze for splitting wood – Fig. 19: 1),
- a very thick, quartzite flake (struck off-probably – from a lower grinding stone), with unifacial, proximal, transversal chipping that forms a kind of thick cutting edge (Fig. 19: 2).

Burins (5)

Burins are made from obsidian (3) and limnoquartzite (2).

One of the specimens is a typical dihedral burin on a thick flake (Fig. 22: 5). The other specimens could have been accidentally shaped in the consequence of pressure. These are:

- two Corbiac type burins; one on a blade with use-wears on the lateral edge (nibbling and crushing) (Fig. 18: 1); the other is on a regular blade. After the blade was used as a sickle insert the burin removed its distal part (Fig. 22: 1),
- a single-sided burin (three superimposed burin blows) made in the proximal part of a flake detached after the crested flake (Fig. 21: 2),
- single, transversal burin on a flake used as a sickle insert.

Notched implements (7)

Notched implements are made of limnoquartzite (6) and one tool is made of obsidian. The tools are made on flakes or robust, short blades. Four specimens have simple retouched notches, and two have Clactonian notches. One tool has two notches: a retouched notch and a Clactonian notch.

Microliths (4)

All the specimens are made of obsidian. There are two trapezes: one is asymmetrical with obverse retouch (Fig. 21: 3), the other is symmetrical with both truncations shaped by inverse retouch (Fig. 21: 4).

Two microtruncations are: a specimen with an oblique, fairly long truncation shaped by irregular retouch (Fig. 14: 8); a specimen broken in the proximal part, with a finely retouched, distal, straight truncation.

Tanged (4) and shouldered pieces (1)

Four specimens are made from obsidian and one from indeterminate, burnt flint.

- a specimen with bifacial retouch shaping the tang, similarly as on Swiderian points (Fig. 21: 5),
- a specimen with the tang shaped by obverse retouch and with a distal truncation (Fig. 21: 6),
- a proximal fragment of a flake with a fairly long, symmetrical tang shaped by fine, semi-steep retouch,
- a flake with a broad, robust tang.

Moreover, a blade with steep, regular retouch on the entire length of a lateral edge had a kind of shoulder in the proximal part (Fig. 21: 7).

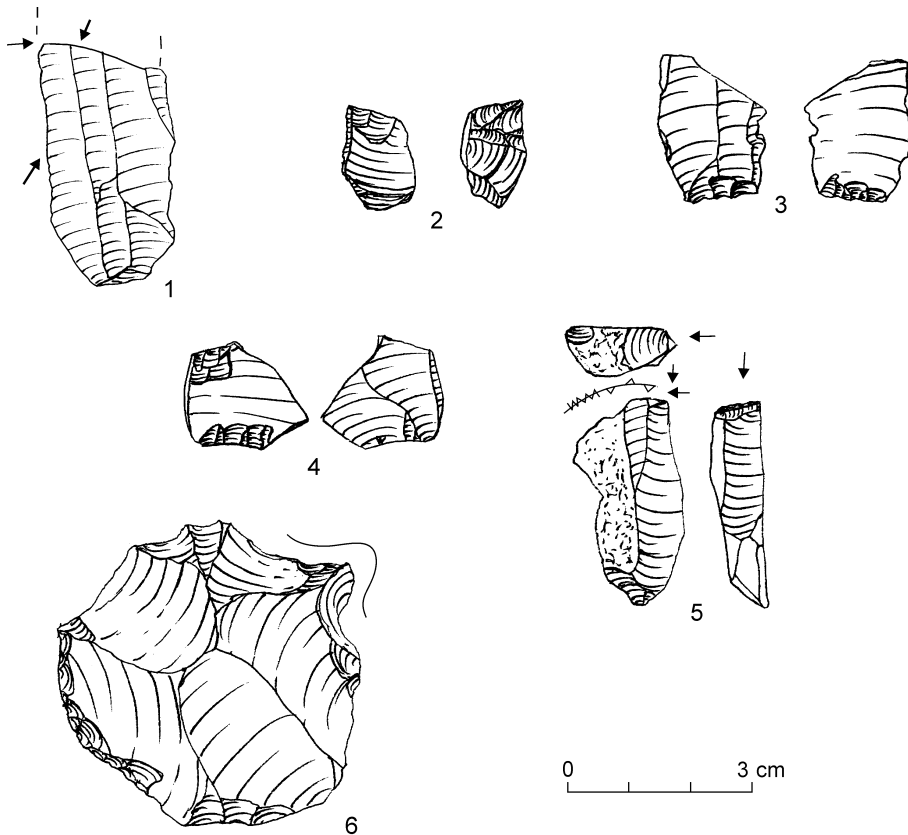


Fig. 22. Polgár 31. 1, 5 – burins; 2–4 – splintered pieces; 6 – perforator-bec (1 – limnoquartzite; 2–5 – obsidian; 6 – andezite). 1 – feature 241; 2 – feature 286; 3 – feature 812; 4 – feature 584; 5 – feature 731; 6 – feature 624

Denticulated tools (2)

The two denticulated tools are made of obsidian (1) and limnoquartzite (1).

One specimen is made on a thick flake with high, denticulated distal retouch. The other specimen is made on a regular blade with inverse, lateral, denticulated retouch.

Splintered pieces (8)

All the specimens are made from obsidian. Three are fragments. The remaining specimens are:

- a bipolar splintered piece-core (Fig. 21: 8),
- a bipolar splintered piece-core, residual (Fig. 22: 2),
- a splintered piece on a broken blade, with the pole in the proximal part of the blade (Fig. 22: 3),
- a bipolar splintered piece on a flake (Fig. 22: 4).

Some of the splintered pieces functioned as cores for microlithic flakes, and some were flakes or blades adapted for hafting.

2.7. Use-wear analysis

2.7.1. Results of low-power microscope analysis of retouched tools

Microscopic analysis of retouched tools has shown that they were strongly worn. We can assume that the tools were discarded after long use, which is in agreement with the thrifty economy of exploitation of lithic raw materials.

In the group of end-scrapers as many as 18, out of 25 specimens, show clear traces of use-wear. In addition, the use-wears are homogeneous i.e.: the front edges are polished and on the ventral side there are striations perpendicular to the front edge (Phot. 1, 2). This type of use-wear is identified with hide working. Only few



Phot. 1. Polgár 31. End-scraper front (feature 819)



Phot. 2. Polgár 31. Obsidian end-scraper front (feature 322)

specimens show other, later, use-wears such as: crushing on the side opposite to the front or on the front itself resulting from different, subsequent functions; in one case use-wears indicate that the end-scraper was used again as a sickle insert. It is likely that the blade end-scrapers experienced little reduction during utilization as some of the discarded specimens are on relatively long blades. Flake specimens, on the other hand, show stronger reduction.

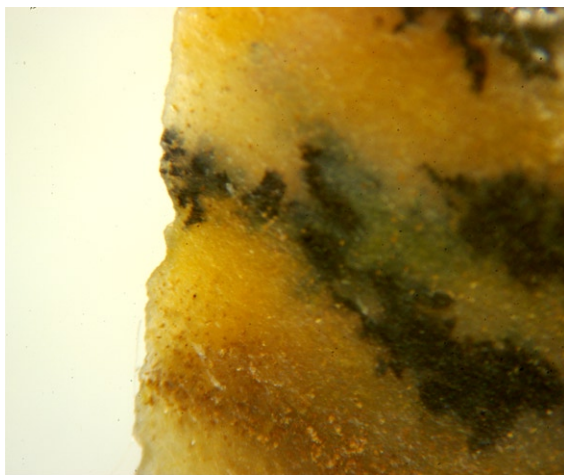
In the second most numerous group, namely blades with marginal retouch as many as 14 out of 21 specimens exhibit use-wears from utilization over a long period of time. The use-wears are diverse:

1. polish of the retouched edge (1) indicating working of soft materials (e.g. hide),
2. polish of the unretouched edge combined with nibbling (1) which indicates cutting of e.g. meat (Phot. 3),
3. polish of the edge combined with *micropolis* along the edge (2) possibly from cutting plant material,
4. polish of the edge combined with striations parallel to the tool axis which indicates cutting soft materials (e.g. meat),
5. polish of the edge in combination with striations: oblique and/or perpendicular to the tool axis (3), probably from scraping soft materials,
6. crushing of edges (especially in the notches made by retouch) (5) which suggests working hard materials (e.g. bone or antler).

We can conjecture that retouching and utilization were alternated because both the retouched and the unretouched edges show traces of utilization.

Just like end-scrapers almost all the perforators bear traces of intensive utilization. In all cases the retouched ends are rounded which means that these tools were used for perforating organic materials (e.g. dry hide, shell or bone).

Truncations exhibit two types of use-wears: either polishing of the lateral edge (2) indicating the use for cutting soft materials, or sickle gloss (2) indicating that they



Phot. 3. Polgár 31. Edge of retouched blade (feature 576)

functioned as sickle inserts. It should be emphasized, however, that most sickle inserts are unretouched blades or fragments intentionally broken off (in such situation sickle gloss covered the surface of the transversal break).

Of interest are use-wears on the few burins. A burin made on a tablet or a secondary crested blade has nibbling on the lateral edge and *micropolis* parallel to this edge. This suggests the use for cutting soft materials of organic origin. A lateral dihedral burin shows use-wears in the form of crushing on the edge of a transversal burin scar. The edge was probably used for scraping hard, perhaps mineral, materials. The two burins were intentionally made, unlike the accidental Corbiac type burin which, too, shows crushing next to a transversal burin scar. Similar crushing can be seen on a splintered piece with a burin scar on one lateral edge, which is also accidental, made when the specimen was used as a chisel-like tool.

The presence of cleaver-like macrotools (4) is noteworthy. These tools were used as axes or adzes which is confirmed by the crushing on their transversal edges. Moreover, macroscrapers (2) with use-wears from working hide, similar to those on end-scrapers, were also present.

2.7.2. Low power microscopy of use-wears on unretouched blades

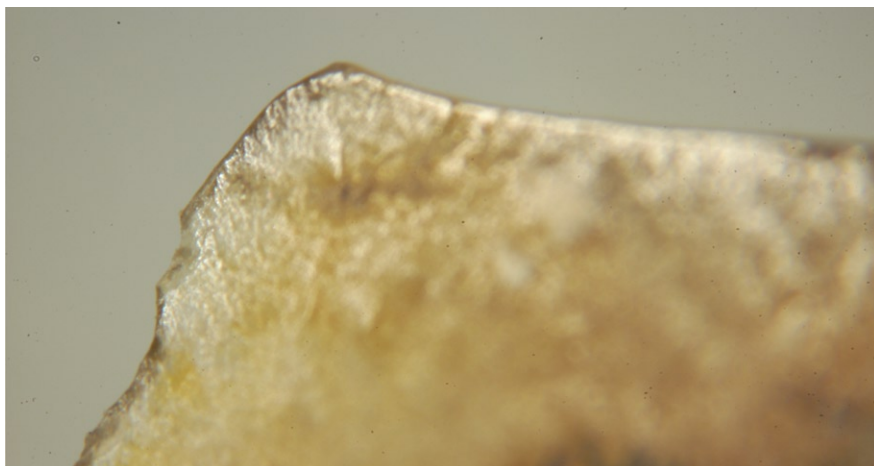
Only 14 out of 121 blades and fragments had use-wears that could be examined using low magnification. Such small proportion can be accounted for by the fact that most blades have been preserved as fragments; distal and proximal fragments could have been intentionally broken off and dropped and, for this reason, show no traces of utilization. It should be added that not all obsidian surfaces could be used for microscopic observation which caused that the analysed sample represents only a part of the whole assemblage.

Use-wears on unretouched blades are diverse, just like those on blades with lateral retouch (Fig. 11: 2, 3; 12: 6, 7). The polishing of edges is fairly frequent; striations are: parallel (3) or transversal (1) to the edge. These were probably knives used for cutting meat or other soft materials. Nibbling also occurs, often alternately on two sides of the same edge, which suggests that such specimens were used as knives for cutting e.g. wood (5). It is interesting that obsidian blades show polishing of the interscar ridges, which is probably the evidence of hafting these blades as knives (2). In some cases traces of crushing can be seen on the edge of transversal breaks.

A tool category which is also represented among unretouched blades are sickle inserts (Phot. 4). These were usually blade fragments: proximal-mesial or mesial. Sometimes they were obliquely mounted in hafts in a similar way as the Karanovo type sickle inserts. These blades show sickle gloss, sometimes alternately on two ends, which indicates re-utilization (also the blunt end was mounted in the haft).

2.7.3. General functional structure of chipped stone implements

The results of use-wear analysis presented here can by no means provide a basis for the reconstruction of the range of activities performed on the site, especially their



Phot. 4. Polgár 31. Edge of sickle-insert (feature 819)

intensity. This is the consequence of the conditions of deposition of lithic artefacts which depended on a number of determinants, most importantly on:

1. availability of lithic raw materials which influenced not only the number of tools that were used but also their discard,
2. intensity of the use of tools, their curation and transformations,
3. the way tools were hafted which also had some influence on how long they could be used,
4. the circumstances in which the inhabitants abandoned the site,
5. social determinants – especially in the case of raw materials that could have had symbolic significance as prestige goods – which could prevent discard of some artefacts. Behaviors from within the sphere of symbolic culture could have acted in the same way on the curation of artefacts from certain raw materials.

For these reasons the structure of activities registered in the use-wears on the tools discarded on the site can only serve as an additional index of activities that are reconstructed by other, direct and contextual methods.

The functions of the chipped stone industry from Polgár 31 are indicative of the following activities:

1. hide working (19 instances of hide scraping and 6 tools for hide perforation),
2. cereals and/or grass cutting (13 instances),
3. meat cutting (8 instances) or cutting and shaving wood (8 instances),
4. cutting bone or antler (5 instances),
5. wood scraping (5 instances),
6. engraving in mineral materials (dyes?) (1 instance – Phot. 5),
7. heavy duty tools used as adzes or axes (without polished axes) (4 instances),
8. chisel-like tools (2–3 instances).

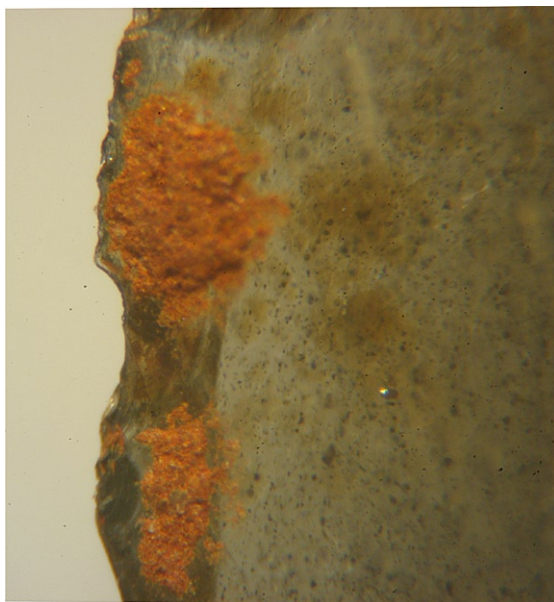
We can assume that perforators were used not only for hide perforating but also for perforating shell.

The studies of Neolithic chipped stone industries from the Great Hungarian Plain do not contain, so far, artefact use-wear analyses similar to the analysis presented in this work. The only site that has been studied in terms of use-wears are several features (pits) from the neighbouring site of Polgár-Csőszhalom (Polgár 6) corresponding to the Late Neolithic horizon of Tisza II – Csőszhalom, i.e. later than the materials from Polgár 31 described in this work (BÁCSKAY 2000 and pers. com.).

In the features from Polgár 6 end-scrapers are in ascendancy among retouched tools, and among debitage products flakes are much more numerous than blades.

In terms of function unretouched blades and unretouched blade-like flakes were used as cutting tools. The same situation can be seen at Polgár 31 where unretouched blades were used as cutting tools, mainly for meat and wood. The proportion of unmodified blades with striations and/or nibbling is relatively small (14 pieces out of 121); in addition, some of these specimens show high gloss which means that their primary or secondary function was that of sickle-inserts.

In the group of retouched tools in Polgár 6 first of all end-scrapers show use-wears; in pit 150 six end-scrapers out of 11 show use-wears, in pit 180 out of 25 end-scrapers 12 are with use-wears. The wears usually evidence scraping of dry hide (BÁCSKAY 2000). It is interesting that the end-scrapers used for the scraping of dry or semi-dry hide show no other use-wears (with the exception of 2 specimens re-used as sickle inserts). At Polgár 31 the use of end-scrapers for hide treatment is, too, fairly frequent (18 out of 25 specimens) evidenced by the polishing of the retouched edge and perpendicular striations. In pit 150 and 180 from Polgár 6 in addition to 14 specimens with



Phot. 5. Polgár 31. Obsidian blade with traces of red dye (feature 576)

perpendicular striations there are 7 end-scrapers with asymmetrical (oblique) striations. Thus, the method of hafting and the direction of scraping could have been somewhat different. Some end-scrapers from Polgár 6 were also used for scraping wood (9 out of 31) and as sickle-inserts (2 out of 31). At Polgár 31 only one end-scrapers (out of 25 specimens) served as a sickle insert, whereas 3 end-scrapers (out of 25) show crushing at the distal (retouched) or proximal end which indicates the use for working harder materials.

At Polgár 31 morphologically different tool types were used as sickle inserts, whereas at Polgár 6 mainly unretouched blades and flakes; but the method of hafting – oblique to the haft edge – was the same at both sites (as in the case of sickle inserts from Karanovo – GEORGIJEV 1967).

2.8. Chipped stone artefacts from Polgár 31 against the background of the Bükk Culture lithic industry

2.8.1. Raw material structure

Two raw materials played an essential role in the chipped stone industry of the Bükk culture: obsidian and limno/hydroquartzite. Other raw materials occur in minute amounts. In respect of the frequency of obsidian artefacts the following groups of sites can be distinguished:

1. Sites where the proportion of obsidian is more than 80%. Among these belong sites such as: Kašov situated directly in the region of deposits of Carpathian obsidian 1 on the Tokaj-Prešov Mountain (99.5% of obsidian – BÁNESZ 1991), Vel'ká Trňa, also in the immediate vicinity of obsidian deposits (JANŠÁK 1935), and Humenné situated on the northern boundary of the Eastern Slovakian Plain, i.e. at a distance of more than 55 km from obsidian deposits (as much as 99.4% of obsidian – KACZANOWSKA, KOZŁOWSKI 2002). All these sites are characterized by a high proportion of debitage products (among others flakes from 37 to 70%, blades from 23 to 40%) indicating that processing was carried out at a settlement near clay extraction pits close to dwellings. The processing took place successively in several episodes, in relatively small reduction activity areas. At Kašov a deposit of 13 cores was placed within a pit after it had been partially filled in. This must have been a store of raw material from which a large number of blades could still be detached. A somewhat smaller proportion of obsidian was recorded at other sites near the Tokaj-Prešov Mountain, that is close to the deposits of Carpathian obsidian 1 such as: Sátoraljaujhely-Ronyvpart in the Bodrog valley (82.1% of obsidian, BÍRÓ 1998), Encs-Kelecsény in the Hernád valley (89.4% obsidian – SIMÁN, WOLF 1986). At these sites limnoquartzite is second in importance.

2. Sites where the proportion of obsidian oscillates between 70 to 80%. In this group belong sites in the Eastern Slovakian Plain such as Čierne Pole (78.2% – KACZANOWSKA 1985), and from the Košice basin e.g. Bohdanovce (78.3% – KACZANOWSKA 1985). The second group at these two sites as far as frequency is concerned are limnoquartzites (17.8 and 13.3% respectively). Polgár 31 is also assigned to this group (obsidian – 72%, limnoquartzite – 25%), situated at about 50 km from the deposits

of Carpathian obsidian 2, and about 80–100 km south of the deposits of Carpathian obsidian 1 on the Tokaj-Prešov Mountain.

3. Sites where the proportion of obsidian is about a half of all chipped stone artefacts. In this group belong sites in the Hornád basin e.g. Ináncs-Dombrét (about 52% – obsidian – BÍRÓ 1998), Blažice near Košice (45% – obsidian, KACZANOWSKA 1985), and Borsod (43.3% obsidian – KACZANOWSKA 1985). The second position at these sites belongs to limno/hydroquartzite. However, Carpathian radiolarites also occur (at Blažice – 12.1%), and imports of northern, trans-Carpathian flint at Ináncs-Dombrét and at Borsod.

4. Sites where the proportion of obsidian is less than 30%. These are the sites on the northern boundary of the Bükk culture distribution such as: Šarišské Michal'any in the Šariš Basin, where obsidian is 28.4%, limnoquartzite nearly disappears (2.4%) replaced by Carpathian radiolarites (58.5%) and accompanied by imports of trans-Carpathian flints from the Vistula basin (Jurassic flint from the region of Kraków – 3.7%) and the Dnester basin (KACZANOWSKA et al. 1993). A still lower proportion of obsidian is recorded at sites which, although situated near the obsidian deposits on the Tokaj-Prešov Mountain, are – at the same time – situated in the immediate vicinity of limnoquartzite deposits. These are the sites on the left bank of the Hernád in the region of Arka and Boldogkőváralja (Tekeres patak, Tóhegy – BÍRÓ 1998). The proportion of obsidian at these sites is from 4.4 to 7%.

The above overview shows that there is no simple correlation between the distance from deposits and the proportion of obsidian. Thus, other determinants must have influenced the frequency of obsidian, mostly the chronological position of the assemblages in the frame of the Eastern Linear Pottery. In the case of Bükk Culture we are inclined to seek these determinants in the different social-technological contexts of the raw materials procurement systems as regards the two basic raw materials used in the Bükk culture namely: obsidian and limnoquartzite. Obsidian processing was the domain of specialized knappers, relatively few in the Bükk Culture communities, who mastered to a high degree the blade technique using a soft hammer or a punch, or even the pressure technique, detached blades in several episodes and provided them – as need arose – to the inhabitants of the settlement. In the case of limnoquartzites the main body of the production was based – just like at Polgár 31 – on *ad hoc* collected chunks and pebbles. From this material both flake and blade blanks were obtained using a hard hammer. However, specialized workshops producing blades from some types of limnoquartzite (e.g. in the region of Boldogkőváralja) produced standardized blades for export. In all likelihood, these blades were used as a commodity for barter at local markets. This has been confirmed by the well-known depot of 566 blades and retouched tools from Boldogkőváralja (VÉRTES 1965; MESTER, TIXIER 2013).

The different system of procurement of the basic raw materials in the Bükk Culture could also result from specific symbolic significance of obsidian as a mark of social status in the Bükk communities, which is additionally evidenced by the traces of red dye on some obsidian lumps and the deposition of unique obsidian cores close to a vessel with red dye in the grave furnishing at Polgár 31.

Unfortunately, little can be said about the diachronic variability of the relation between the use of obsidian and the use of limnoquartzite at the Bükk Culture sites. This is caused by the fact that we cannot correlate chipped stone artefacts with the chronological seriation of this culture which is based on ceramics from, mostly, multiphase settlements sites.

2.8.2. Morphology of retouched tools

Retouched tools of the whole Linear Complex shows numerous stylistic similarities. At the same time, the Eastern Linear Culture (AVK) is characterized by the predominance of retouched blades with marginal retouch, derived from the Starčevo-Körös tradition, whereas the distinctive feature of the Western Linear Complex (Bandkeramik, LBK) is the domination of tools with transversal retouch such as end-scrapers and truncations, the tools which – besides perforators – predominate also in the Vinča culture (KOZŁOWSKI 1990; KACZANOWSKA, KOZŁOWSKI 1990).

The chipped stone industry of the Bükk Culture shares the features of both these traditions which – apart from the overall similarity to all industries of the Linear Complex – causes that lithic assemblages of the Bükk Culture are considerably varied. In fact, we are unable to define a diagnostic group of tools for the Bükk Culture except for tanged tools (often points) which are unknown from other Linear units. A selection of such tools was discovered in a Bükk Culture pit from Humenné (KACZANOWSKA, KOZŁOWSKI 2002, Pl. 4). Some of these tools resemble Swiderian points. At Polgár 31 only one tool of this type was discovered.

For some Bükk Culture sites the occurrence of burins is characteristic, but the instability of their frequency, the difficulty in determining burins *sensu stricto* and artefacts with accidental burin scars precludes treating burins as diagnostic for the Bükk Culture. At Polgár 31 burins proper are absent, except for one dihedral specimen (Fig. 21: 2). Burins are known from Humenné, Arka, Encs, Čierne Pole and other Bükk Culture sites where they occupy a third or fourth position among major tool groups.

In general, retouched tools assemblages of the Bükk Culture can be divided into two groups:

1. Assemblages where tools with lateral retouch are in ascendancy or occupy the second position. The most characteristic assemblage for this group is pit 1/85 from Humenné where blades with lateral retouch account for 75% of all tools and truncations and burins are next in importance. The site of Polgár 31 has also yielded a large number of blades with marginal retouch (21 specimens) which are the second group, after end-scrapers (25).

2. Other Bükk Culture sites show either a decided domination of end-scrapers (e.g. sites: Borsod – 47% and Čierne Pole – 57%; KACZANOWSKA 1985; Arka and Boldogkőváralja – BÍRÓ 1998; MESTER, TIXIER 2013), or an approximately equal proportions of end-scrapers and truncations (Ináncs-Dombrét, Sátoraljaújhely – BÍRÓ 1998).

3. Sporadically, there are assemblages with the domination of truncations such as e.g. at Šarišské Michal'any where they account for 29.9% (KACZANOWSKA et al. 1993). At this site end-scrapers are only the second group (16.5%). Among sites like

this also belongs Encs-Kelecsény (BÍRÓ 1998) where, unfortunately, the series of tools is too small for analysis.

The occurrence of geometrical microliths in the Bükk Culture assemblages (especially trapezes) is undoubtedly the expression of the tradition that is present in the whole of the Linear Complex (KOZŁOWSKI ed. 1997) but such microliths are not a diagnostic feature of the Bükk Culture. At Polgár 31 two trapezes and two non-geometrical microliths (microtruncations) were present. More specific for the Bükk Culture seems to be the occurrence of macrolithic tools. Seven specimens like this were recorded at Polgár 31: two macro-scrapers, one macro-perforator and three cleavers (or adze)-like tools.

2.9. Horizontal distribution of finds

The average frequency of artefacts in the features is low, not exceeding 0.5 artefacts per feature. In some features chipped artifacts were more numerous (e.g. feature 819 – 189 specimens).

Most features – both pits and graves – yielded 1–3 artefacts. The individual items of flakes, blades or retouched tools found in the filling of pits are accidental. Processing – limited to exploitation of only one or several cores – was carried out in overground dwellings. This is evidenced by conspicuous concentrations of debitage within the clay “plohchadki” (the daub from disintegrated dwelling spread on their surface) (feature 819 – 189 artefacts, feature 812 – 27 artefacts). The structure of assemblages from these features shows a high proportion of chips from coring, retouching and rejuvenation of tools. Out of the total of 67 chips found on the site as many as 63 come from the overground dwellings. Otherwise the structure of cores and debitage in the relation to retouched tools (in feature 819 retouched tools are 13%) is typical of settlements inhabited by makers and users of chipped stone artefacts. The filling of the ditch surrounding the “tell” with the overground dwellings well preserved, notably its south section, also yielded a greater number of chipped stone artefacts. The fact that the filling of the ditch came partially from the destruction of clay dwellings standing by the ditch, could be an explanation.

The average frequency (5–10) of chipped stone artefacts was recorded in pits 241 (17 spec.), 244 (5 spec.), 322 (10 spec.), 576 (15 spec.), 624 (16 spec.), 636 (6 spec.), 648 (9 spec.), 933 (7 spec.), 993 (7 spec.). Among these artifacts were single cores, flakes, blades and tools, which confirms that processing was carried out in the overground features (houses or their yards) in single production episode (especially in features 241 and 624), but this situation could also be the result of discard of individual artifacts, also blades and tools, that were brought to the settlement.

Chipped stone artifacts were also found in 16 graves. The taphonomy of these artifacts cannot be unequivocally determined; it is particularly difficult to distinguish between the artifacts intentionally placed in the graves and those whose occurrence in the grave filling is accidental. The latter possibility refers, first of all to the individual flakes found in graves 353, 354, 363, 368. On the other hand, unique obsidian cores in the full phase of reduction, discovered in graves 697 and 867 are

related to burial rites, just like one well exhausted core in grave 636, accompanied by a blade, two tools and two flakes, also a tool, a blade and a flake from grave 899. One of the cores in full phase of reduction was found close to the vessel containing red dye which symbolic meaning is obvious (Grave 867). We can assume, though not without some doubts, that individual tools in graves 285, 448, 805 and individual blades from graves 345, 486, 801, and 807 were deposited in the graves as part of grave furnishings.

3. GROUND AND POLISHED STONE IMPLEMENTS

3.1. Raw materials

A total of 386 ground stone artefacts (including pestles and fragments of mineral dyes, often with traces of crushing) the biggest group are specimens from various types of rhyolite. To this group belong:

- rhyolite from the region of Tokaj Mts (outcrops of similar types of rhyolites are situated in the Kövecses-Hill at Tarcal, at the localities of Dereszla Hill – Phot. 6, and Henye Hill at Bodrogkeresztúr), (GYARMATI 1974, 1977),
- a special group is light pink rhyolite which occurs in the Mátra Mts (e.g. at Gyöngyössólymos – JÁMBOR 1971),
- rhyolite tuff, whose deposits occur in the region of the Kopasz-Hill at Tokaj (Bodrogkeresztúr, Mád), and on the Szerencs Hills (Monok); GYARMATI (1974, 1977),
- dacite, often with hyalite, occurs mainly in the region of the Kopasz-Hill at Tokaj (Phot. 7) (Tarcal, outcrops in the Citrom quarry, Tokaj – the quarry near the railway station, and open pits at Tarmag, Patkó and Csorgókúti), (KOZÁK, RÓZSA 1982; RÓZSA, KOZÁK 1981),
- perlitic rhyolite known in the region between Bodrogkeresztúr (Tokaj, Lebujsárda: and Tokaj – Phot. 8) (GYARMATI 1974).

All the deposits of rhyolite rocks are situated within the radius of 40–50 km north of the site of Polgár 31.

Sandstones are the second biggest group, of which about 50 specimens were made. Some of the sandstones have been identified as Oligocene sandstones from the surroundings of Parád in the Mátra Mts, that is from the distance of about 120 km from Polgár.

Andesites come next, represented by about 20 specimens. These andesites could come from the western part of the Tokaj-Prešov Mountain (near Tállya and Abaújkér where andesites co-occur with hydroquartzites) 60 km north of Polgár, or from the region of Sárospatak in the Bodrog basin and Boldogkőváralja in the Hernád valley even up to 80–90 km to the north-east.

The number of limestone artefacts is similar to that of andesite specimens. In all likelihood, these limestones come from deposits in the region of Rátka-Mád at the distance of 50–60 km north from Polgár (GYARMATI 1977).



Phot. 6. Region of rhyolite outcrops near Bodrogkeresztúr: Dereszla Hill



Phot. 7. Region of dacite outcrops near Tokaj: Kopasz Hill



Phot. 8. Section of quarry with perlitic rhyolite: Lebuj csárda near Tokaj

The next group of raw materials is represented by 10–20 specimens each. In this group belong the raw materials meant to be used for different functions:

- quartzites from the region of Erdőbénye on the Tokaj-Prešov Mountains, about 70 km north from Polgár, used mainly as pestles,
- limnoquartzites from the surroundings of Rátka (Koldu Hill), on the western edge of the Tokaj-Eperjes Mountain, also used as pestles. This material was worked by chipping.
- Red ochre used as mineral dye – these are first of all rhyolite tuffs with hydrothermal effect, and siderites. While rhyolite tuffs with the hydrothermal effect occur in extensive deposits at the foothills of the Bükk and Tokaj Mts., siderites – on the other hand – are known from the vicinity of Rudabánya i.e. from the distance of more than 130 km north-west of Polgár.

Other raw materials occur in trace amounts. These are:

- diabases from near Szarvaskő on the western side of Bükk Mts (1 specimen),
- basalt or diabase of unknown provenance (1 specimen),
- amphiboles-andesites of unknown provenance (3 specimens).

The zone of provision of raw materials for the production of ground stone implements embraces, first of all, the territories to the north of Polgár. Most rocks come from the distance of 40–50 km, although sandstones can come from even 120 km away. In between these distances andesite deposits are situated (at about 60 km to north-west and 80–90 km to north-east).

The raw materials for the production of pestles, that were also worked by chipping (quartzites, limnoquartzites/hydroquartzites) were obtained from deposits at similar distances and from the same geographical zone north of Polgár.

Some of mineral dyes come from relatively greater distances (more than 130 km) but they, too, were sought to the north-west of Polgár.

A large part of ground stone implements were brought to the site in the form of stone blocks, partially worked by means of chipping technique. The final stage of processing (also by pecking and polishing) was done on the site or its vicinity.

3.2. *Typological classification*

At the site of Polgár 31 ground and polished stone implements and their fragments are represented by numerous specimens. They are 38% of all the lithic artifacts, whereas at other Early and Middle Neolithic settlements chipped stone artefacts have clear ascendancy. The state of preservation of the lithic inventory, the fact that the tools were frequently transformed, utilized many times in different ways, and – finally – that the majority has been split or broken, causes that their classification, or even determining approximate frequency of the various types, is difficult.

In the investigated series the following major tool classes have been distinguished (Table 4):

- A. Tools connected with grinding food or non-organic substances such as dyes and mineral ceramic tempers,
- B. Implements for polishing stone tools,
- C. Handstones, pestles, retouchers and polishers,
- D. Axes, “hoes” (adzes), perforated axes etc.,
- E. Others.

Group A

The biggest number of specimens is connected with grinding foodstuffs or mineral dyes. Tools of this type occur at many sites, but usually little space is devoted to them in analyses of finds. Their classification is still awaiting thorough studies. The only more coherent classification systems have been elaborated by C. ROUBET (1989) and A. ZIMMERMANN (1988). When C. Roubet studied lithic materials from the Epipalaeolithic sites of the Eastern Sahara she drew attention to the role of grinding tools in terms of their functions. Roubet divided them into two groups:

- passive and static; in this group belong lower grinding stones, basin millers and stone bowls,
- active and mobile such as handstones, pestles and rubbing stones.

On the basis of analysis of materials from the Linear Band Pottery Culture (LBK) site of Langweiler 8 in the Rhein basin A. Zimmermann classified a number of grinding tools according to their size, morphology and use-wears. This author approached tools related to food processing as sets i.e.: a specific type of grinder (the upper, active part

Table 4. Ground and polished stone implements

Major tool Classes	Description	Number
A1 and A2	Grinding implements	
	upper grinding stones	53
	lower grinding stones	27
	undetermined	14
A3	Basin – like forms	11
A4	Tile-shaped grinding stones with one polished surface	13
	Tile-shaped grinding stones with both polished surfaces	23
	Fragments	49
B	Basin millers	13
C	Handstones, pestles, retouchers and polishers	37
D	Axes	18
	“Hoes”	5 or 6
	Chisel	1
	Perforated axe	1
	Dye lumps	10
	Others and undetermined	111
	Total	386

of a grinding stone) corresponds to a specific type of the base (the lower, passive part of a grinding stone).

In the present work we have used a system similar to that proposed by A. ZIMMERMANN (1988). But it should be mentioned that among the numerous grinding implements from Polgár 31 only one upper grinder (handstone) was intact (broken into two parts – Fig. 23). Similarly only one, almost intact, lower grinding stone could be reconstructed. The remaining specimens are fragments. These tools did not crack in the effect of strong wearing-out but seem to have been intentionally destroyed. Nearly all the implements were intentionally broken. Sometimes, the whole sequence of blows leading to the destruction of an implement could be reconstructed. Some of the stones with traces of grinding show contact with fire; the stones are burnt and blackened.

The basic difficulty when materials in such a state of preservation are being classified is to distinguish fragments of lower, passive grinding stones from those of upper, active grinding stones. In the case of specimens with a preserved fragment of a side the function was determined on the basis of the shape of the rim between the lateral wall and the working surface. On lower grinding stones rims are rounded, whereas on upper grinding stones the rims are fresh, sharp and have a distinct shape.

In the group of implements connected with crushing grain or mineral dyes several types have been registered, differing as to shape in the horizontal plane, dimensions, cross-section, and the structure of the working surface. Both the upper and the lower grinding stones were usually made from whitish rhyolite tuff. They are represented by the following forms:

A 1. Grindstones with the upper grinding stone bigger than the lower (Fig. 23, Fig. 24: 1–3); the upper grinding stone is longer than the width of the lower grinding stone

Lower grinding stones of such implements are usually rectangular or oval in outline, 18–22 cm broad about 30 cm long, with a flat working surface with slightly rounded corners in cross-section, and concave in profile (Fig. 25: 1). The direction of traces of work follow the axis of the lower grinding stone. The shape of the artefact is achieved by flaking technique, and often, the item is given the final shape by pecking. The working surface, too, was prepared by pecking and formed ultimately during use; the active implement – the upper grinding stone, reached the distal edge of the lower grinding stones in the section further away from the user, whereas in the section closer to the user the smaller pressure exerted onto the upper grinding stone by the movement “towards” the user caused that the tool did not touch the edge itself and – consequently – the proximal part of an artefact was unpolished. Lower grinding stones of this type have usually one working surface, their longitudinal cross-section is symmetrical or asymmetrical with one end thicker which made the process of grinding organic or non-organic substances easier.

The upper grinding stones in the case of A1 quernstones are rectangular in outline with rounded corners, 8–15 cm broad, the total length is about 30 cm, the length of the working part 18–22 cm, and thickness is from 2.3 to 5.5 cm (Fig. 23; 24: 1–3; Phot. 9). The length of the working part is limited by the width of the lower grinding stone, whereas the width of the upper grinding stone should enable firm handgrip that is: it should not be bigger than 15–16 cm. The working surface is almost flat. Direction of traces of work is transversal to the implement axis. Numerous fragments of

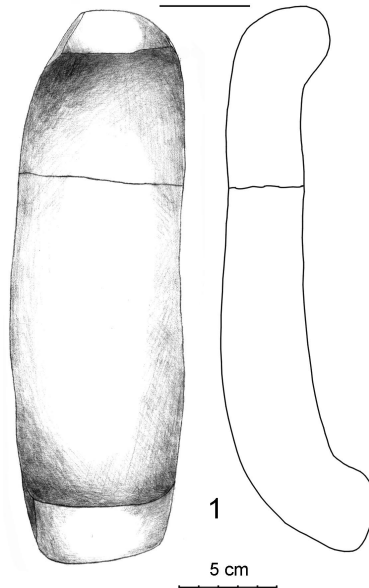


Fig. 23. Polgár 31. Upper grinding stone (feature 68)

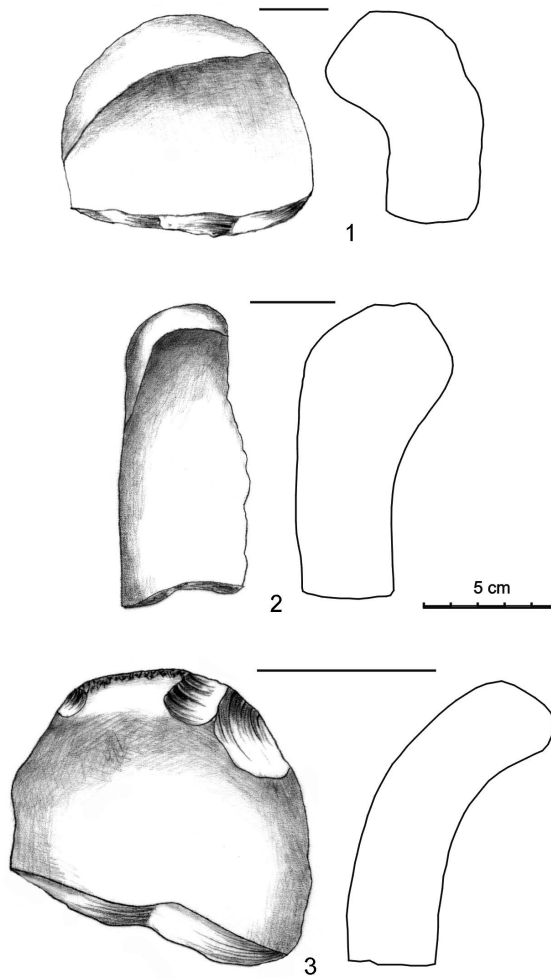


Fig. 24. Polgár 31. 1–3 – upper grinding stones (1 – feature 770; 2 – 180; 3 – 862)



Phot. 9. Polgár 31. Upper grinding stone (feature 68)

upper grinding stones like this show that they were very carefully and precisely formed by pecking technique, also by flaking and polishing of some sections. This type of grindstones is close to specimens assigned by A. ZIMMERMANN to group 1. But in the group of implements analyzed by this author the lower grinding stone was convex in profile, whereas at Polgár lower grinding stones are mainly with almost flat working surfaces. Because the surface of the grinding stone was intentionally formed the flat surface must have been of essential importance to the user.

A 2. Grinding implements where the length of the upper grinding stone is equal to the width of the lower grinding stone (acc. to A. ZIMMERMANN 1988: type 2)

In this group lower grinding stones do not differ from type A1, but in shape upper grinding stones resemble a loaf of bread (Fig. 25: 2). Because there were no wholly preserved lower or upper grinding stones a possibility that these specimens represent

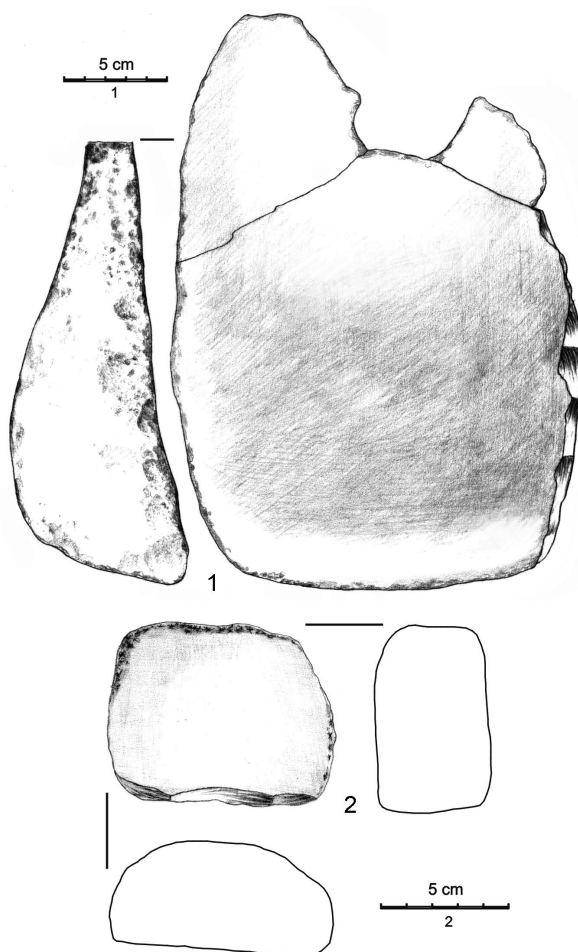


Fig. 25. Polgár 31. 1 – lower grinding stone; 2 – upper grinding stone (1 – feature 554; 2 – 845)

an initial phase of utilization of quernstones designated as type A1 cannot be excluded. This supposition is confirmed by the fact that the average thickness of bread loaf-shaped lower grinding stones is bigger. In the effect of intensity of work the central part became worn away more quickly, while the ends stabilized the upper grinding stone. The two types of quernstones described above were used in ancient Egypt (VANDIER 1958, Tabl. 37: 1, 4, 5, 7).

A 3. Grinding stones with concave surfaces: basin-like or oval hollows formed during utilization (Fig. 26: 1, 3)

In such cases the upper grinding stones approximate a spherical shape, the crushing of substances was done with rotational movements. Sometimes, stones like this have use-wears on both surfaces.

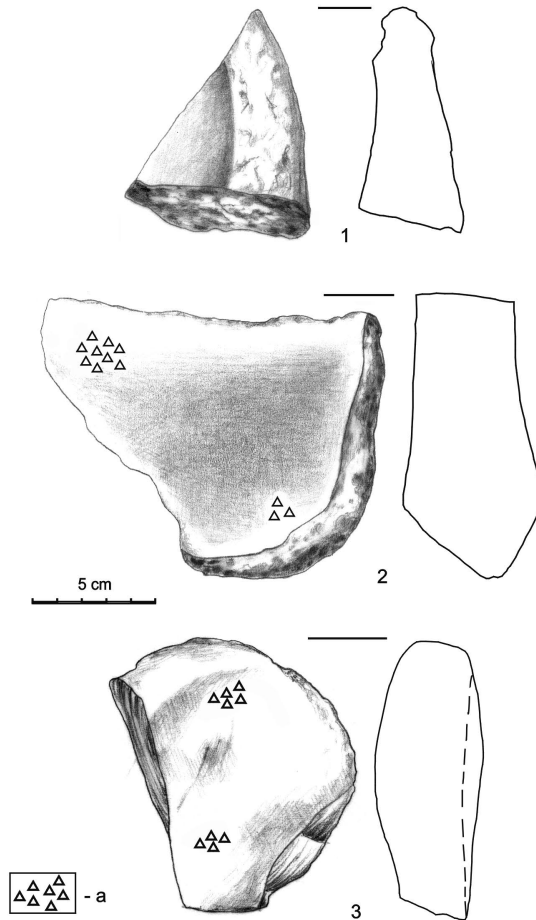


Fig. 26. Polgár 31. 1, 3 – grinding stone with basin like surface; 2 – biconvex grinding stone (1, 2 – feature 819; 3 – 624); a – traces of red mineral dyes

A 4. Tile-shaped grinding stones with one or both polished surfaces

When two surfaces were used they were either both slightly concave or both flat. It is likely that they were used in succession in a similar way for the same activity (Fig. 26: 2). In this group of artefacts a greater diversity of raw materials can be seen. About 50% of artefacts are made from the rhyolitic tuff. Some artefacts are made from travertine, conglomerates, dolomitized limestones and, occasionally, from sandstone.

Group B – basin millers

These implements are characterized by deep, basin-shaped or oval hollows, sometimes twin ones on one surface, made from flat, rectangular sandstone chunks (Phot. 10). The longer axis of the oval hollow is from 60 to 80 mm (Fig. 27: 1, 2). There were also bi-concave, symmetrical specimens which split in the thinnest place in the consequence of strong abrasion. All the specimens are made from soft sandstone

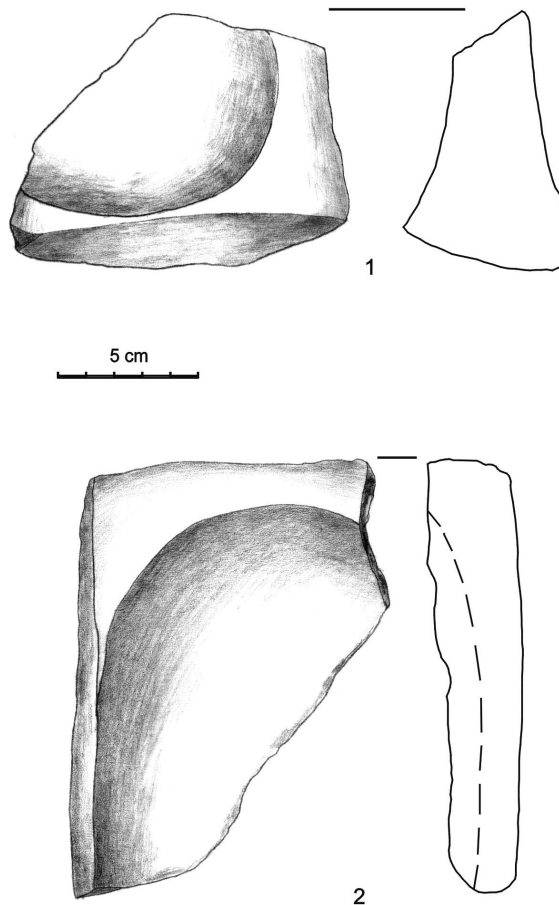


Fig. 27. Polgár 31. 1,2 – basin millers (1 – feature 478; 2 – 690)



Phot. 10. Polgár 31. Basin miller (feature 478)

that easily crumbles due to abrasion. During rubbing fine sand grains from the walls of the basin functioned like a sand-bed that accelerated the process of rubbing. Possibly, also some flat stones, especially the specimens with concave surfaces, functioned as rubbing stones.

Group C – handstones, pestles, retouchers and polishers

This group of implements has been defined in terms of use-wears observable on the surface. These implements, therefore, formed during utilization. Frequently, one stone chunk exhibits use-wears from various activities, but to establish their sequence is not possible. Similarly, in many cases the various functions are undistinguishable as the activities such as pounding, crushing or grinding were performed using the same tool in succession or alternately. Use-wears from these activities are especially well-documented on handstones from flint cores where “rosettes” formed by pounding hard materials were smoothed over by grinding. For these reasons we shall be, in many cases, using the term a handstone-pestle.

The tools occur in three shapes – spherical, discoidal and cylindrical. A specific form of spherical handstone-pestles are the specimens made from limnoquartzite (Fig. 28: 2) or obsidian. Traces from pounding can usually be seen in the distal part of a core. These handstones were used for crushing hard materials – e.g. mineral temper for ceramics. Limnoquartzite concretions, pebbles of quartzite, dolomitized limestone and sandstone were used as handstones. Traces of pounding cover one pole, opposite poles, or a large portion of the surface. On many tools of this type remains of red mineral dye have been preserved (Fig. 28: 3; 29: 1). At Polgár 31 iron oxides used as dyes were recorded as large chunks or microconcretions embedded in thick-grained rock.

Handstones from hard materials probably served for crushing rock chunks that contained dye, and – then – for crushing the dye itself. The presence in the graves of vessels filled with powdered hematite bears witness to the demand for dye in such form.

Also registered in the investigated series were handstones-pestles with traces of work round the circumference of flat, discoidal concretions or chunks (edge handstones).

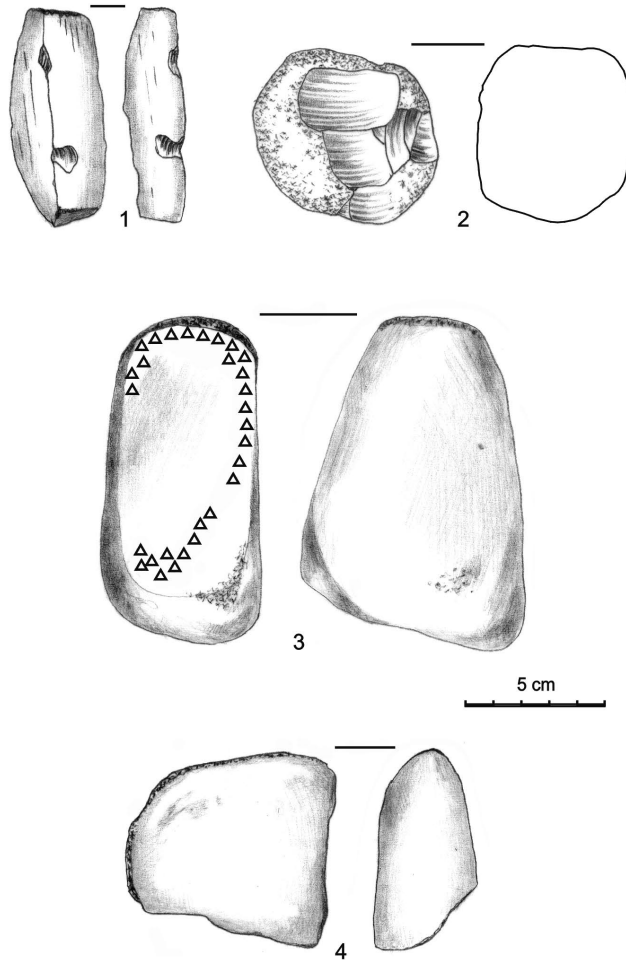


Fig. 28. Polgár 31. 1–4 – hammerstones and pestles (1 – feature 304; 2, 3 – 937; 4 – 631)

Occasionally, robust flakes were used as edge handstones. In one case an ovaloid concretion of dolomitized limestones was used as a bipolar handstone and a polisher. Handstone-pestles of approximately cylindrical shape (in one case trihedral – Fig. 28: 1) were used for other functions. Use-wears concentrate near the base of the tool, indicating that the function of crushing was more frequent than pounding. Damaged “hoes” in the form of a shoelast were also used like the tools mentioned above (Fig. 30: 1). Possibly, they served as handstones in crank stocks.

Feature 249 yielded a nested polished stone (Phot. 12) whose size corresponds to the forms of handstone-pestles or pestles, bear other characteristic use-wears namely: strong polish and gloss of the surface (Fig. 29: 2). Such traces can also be seen on the lateral face of a small, damaged stone axe. This use-wear is probably, the result of working soft material e.g. working hide, rubbing fat, or some other substance used for hide tanning, into hide. Possibly, the presence of tanning agents contributed to the formation

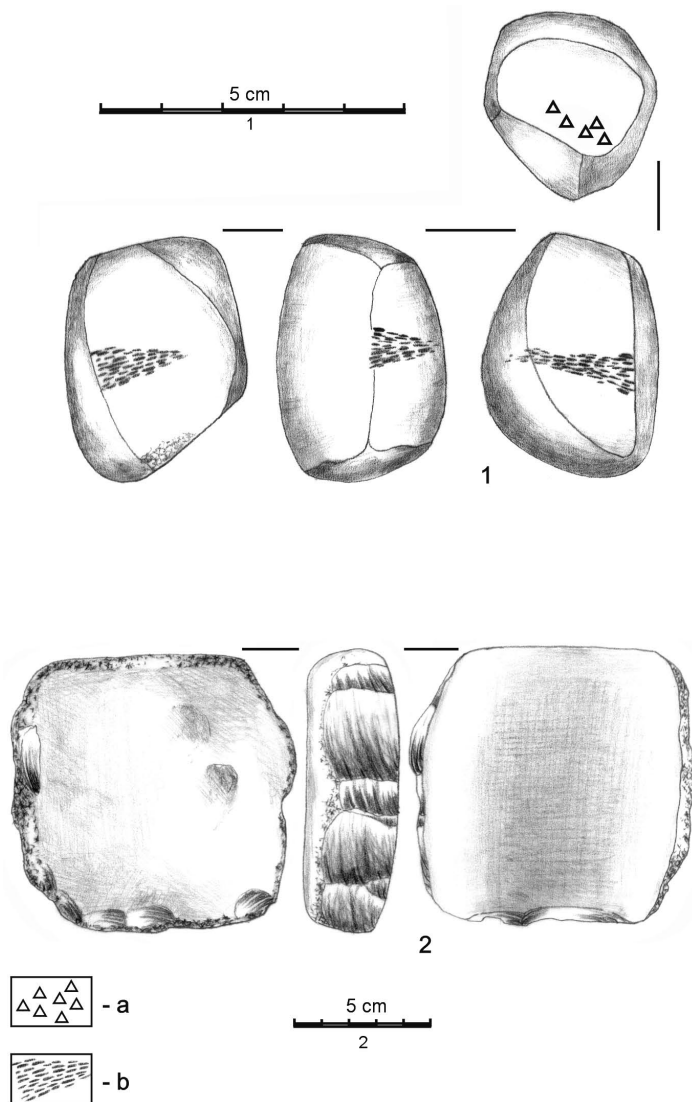


Fig. 29. Polgár 31. 1 – multifunctional hammer-pestle; 2 – polisher (1 – feature 772; 2 – 630); a – traces of red mineral dyes; b – traces of hammering

of the characteristic gloss on the surface. Two specimens with polished surfaces exhibit also other use-wears i.e. traces that appear when flint tools are retouched (Fig. 29: 1). The knapper, holding the stone in his hand, exerted on it strong pressure with the edge of a bladelet or a flake which was to be retouched. Under pressure retouch formed on the edge and oblique traces – so-called “microscars” appeared on the surface of the retoucher. Such “microscars” formed small oval areas on the surface of stone-retouchers. Some pebbles were used as pestles, polishers and retouchers. One of the handstone-pestles, triangular in cross-section, was also used as a base for cutting hard materials.

Group D – axes, “hoes” (adzes), chisels, perforated axes

In the group under discussion stone axes (Fig. 30: 2, 3) are best represented (18 specimens). They are trapezoidal in outline, nearly oval or rectangular in cross-section, with convex longer sides, in profile slightly asymmetrical. One specimen is triangular in outline. Their dimensions show some oscillation: length from 25 to 75 mm, width from 25 to 60 mm. In proportion the tools are robust, especially small specimens which were shortened and transformed from damaged, larger specimens.

The analysed inventory contained 5 (6?) strongly damaged “hoes” in the shape of a shoe-last (Fig. 30: 1), a small chisel (Fig. 30: 3) and a fragment of a perforated axe.

Just like other stone implements the majority of specimens under discussion are badly damaged and re-used as handstones, pestles for dyes, retouchers and polishers.

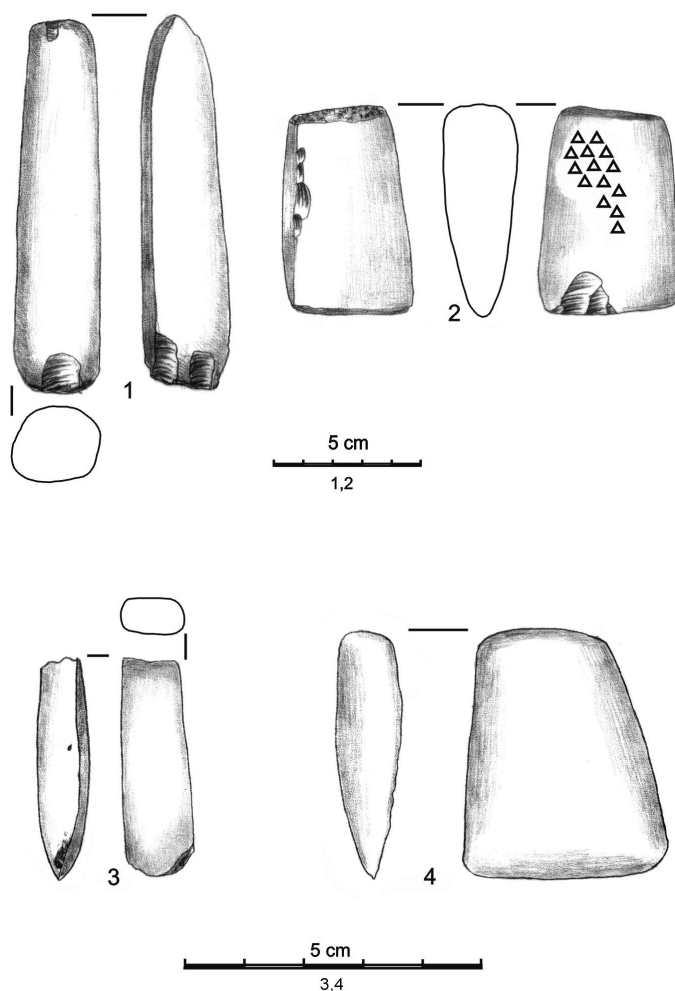


Fig. 30. Polgár 31. 1–4 – adzes and axes (1 – feature 554; 2 – 586; 3, 4 – 819)

Group E – Others

The inventory from the site of Polgár 31 yielded, moreover, several unusual implements that bear witness to the high skills of masters of stone working. Of interest is a stone weight or sinker with a groove for a rope (Phot. 11) and a small crank stock in the shape of a nested stone cube (Phot. 12). There were, besides, two fragments



Phot. 11. Polgár 31. Sinker with a groove (feature 501)



Phot. 12. Polgár 31. Nested polished stone (feature 690)

of upper grinding stones with drilled hollows measuring 1 and 2 cm in diameter, which could have formed when the fragments were used as support for alternate perforators.

Dye lumps

The site yielded 10 lumps of red dye. There are no traces of polishing on the surfaces which suggests pounding rather than grinding of this substance. Moreover, two conglomerate chunks also occurred (one with a polished surface) containing fine grains of hematite. Chunks like this could have been the source of dye. In order to obtain dye the rock chunks had to be broken into small pieces. The only concretion that contained white dye was powdered by rubbing against a rough surface.

3.3. The location of ground stone tools production

There are no traces of local ground tool production on the site, documented by storing of raw materials or half-products of such tools. All the specimens exhibit strong use-wears and repeated transformations. This situation indicates that implements were brought to the site as completed items, or – in the case of quernstones – in an advanced stage of manufacture, and given their final desired form on-site. Perhaps, the users improved and made working surfaces smooth using pecking only; but this kind of method does not basically leave any material traces on the site. That pecking was employed is evidenced only by the large number of pestles from hard materials such as e.g. limnoquartzites. Quernstones were as a rule made from rhyolite; the porous structure of this raw material and the occurrence of fine obsidian particles caused that the working surfaces were naturally rough, they did not become polished to a degree which would make crushing ineffective. It is striking, on the other hand, that nearly all the quernstones are damaged. The damage is not the result of intensive exploitation – which is the case of basin millers – but was an intentional, probably symbolic action not connected with use. For this reason it is difficult to determine the number of artefacts of this type used on the site. Quernstone fragments were sometimes used as pestle-grinders, bases for drilling etc. Some of the quernstone fragments bear traces of fire – possibly, they were used to form rings surrounding hearths. The majority of broken fragments, however, show no clear traces of transformation into other tools.

At Polgár 31 tools of the type of axes, perforated axes or adzes (“hoes”) were not manufactured, although other Bükk Culture settlements are known that specialized in the production of such tools (e.g. Šarišské Michal’any). These tools were of considerable value to their owners, and numerous repairs and re-shaping were done on-site. To do this basin millers could have been used. A possibility that basin millers were also used for the manufacture of bone and antler tools cannot be excluded.

The distribution of ground tools shows that their bigger concentrations occur in the overground structures, in the section of settlement which is surrounded by a ditch, namely in dwelling feature 819, in pit 689 situated between house 819 and the ditch, and in the filling of the section of the ditch nearest to these features.

Another concentration was registered near a hypothetical, rectangular house and the nearby pits 304 and 334 south of the ditch.

Moreover, large pits from clay extraction (58, 69, 131, 274, 322) contained – each – from 4 to 10 ground stone tools or their fragments.

Ground stone implements also occur in graves. Quernstone fragments come from graves 4, 288, 313 (2 fragments), 314, 350 (3 fragments), and 805 (2 fragments). In grave 805, besides the fragment of a quernstone, a fragment of a “shoe-last” type adze was deposited. This tool has a secondary function as a pestle for dyes and as a re-toucher. Grave 288, too, contained a sandstone pestle, and grave 314 yielded a lump of mineral dye.

We can draw a conclusion, on the basis of the above, that a certain similarity exists between the distribution of ground and chipped stone artefacts, that constituted the equipment of some of the habitation units, namely the overground houses. Ground stone implements in the graves should be differently interpreted, in particular the implements that bear traces of mineral dyes, or that occur in association with lumps of mineral dyes. We can conjecture that the presence of these items in the graves is not accidental (which is the case of the individual flakes in the filling of grave pits), but that they were intentionally deposited in graves and played a role in rites and burial ceremonies. A possibility can not be excluded that the concentration of ground stone implements in one section of the ditch surrounding the “tell” settlement was also the effect of intentional deposition of these artefacts in connection with cult or ceremonial activities. This concentration cannot, easily, be explained by the normal process of infilling the ditch.

4. CONCLUSIONS

The lithic artefacts from Polgár 31 that are analyzed in this paper come from ALP Phase IV, connected with the Bükk Culture. They included 455 chipped stone artefacts and 386 ground and polished stone implements and their fragments. In the series of chipped stone artefacts obsidian specimens predominate (69.5%), followed by a variety of limno-hydroquartzites (27.5%). Other raw materials occur in trace quantities. Thus, these two types of the most commonly used raw materials were exploited and used in different way:

1. most obsidian blade blanks were produced on-site from prepared cores, which does not rule out the possibility that a certain number of completed blades were transferred to the site from elsewhere. Local knappers commanded sufficient skill to be able to maintain and correct technical parameters of cores so that blade (possibly also bladelet) removal could be carried on until the final phase of reduction.

2. The question which is hard to resolve is whether obsidian precores or cores were transferred to the site by the inhabitants from their trips into the Tokaj-Prešov Mountain deposit regions, or whether they were obtained by means of barter exchange with the “owners” of the territories where deposits were located. The presence of the – almost – unworked obsidian lump covered with red dye could confirm that the procurement

systems of these two types of commodities, whose character was symbolic or prestigious, were embedded within a single system of acquisition.

3. The presence of only small concentrations of obsidian artefacts at the Polgár 31 settlement, the fairly uniform horizontal distribution of these artefacts in the pits seem to confirm the production of obsidian artefacts in the various household clusters. On the other hand, the exceptional measurable and technical parameters of the cores from graves 697 and 867 evidence the work of highly specialized, skilled knappers on the site. Possibly, these unique cores could be not so much the attribute of “professional” specialization of the dead but rather a marker of a social position. This issue requires further studies.

4. The system of acquisition and processing of limnoquartzites/hydroquartzites was totally different. Undoubtedly, blade blanks of highest metrical standards were transferred to the site in the completed form. This is in agreement with the more homogeneous character of the raw materials of which the blades and blade tools were made. On-site, on the other hand, flakes were produced mostly from more diverse and randomly selected pieces of raw materials.

5. We can, therefore, hypothesize, that the best limno- and hydroquartzite blanks came from specialized workshops in deposit areas (especially blanks from “Boldogkővárallya” type limnoquartzite), while chunks, concretion fragments and pebbles of other limno/hydroquartzites were collected from the surface within the range of subsistence activities of the inhabitants of Polgár 31, and randomly used for ad hoc production of flakes. Flakes were sometimes retouched to make tools, or were used without retouching. In this case we are certainly not dealing with specialized knappers but with production by various members of the community. That they were less skilled is corroborated by the use of a hard hammer for detachment of limno- and hydroquartzite flakes; the soft hammer was used only for detaching some of the blades from these raw materials.

Just as in other sites of the Late ALP – Phase IV, the group of 111 retouched tools is dominated by end-scrapers and blades with marginal retouch. Less frequently represented are retouched truncations, perforators, burins, retouched flakes, notched tools and macro-tools. Use wear analysis has shown that these tools were used, as a rule, for hide working and for cereals and/or grass cutting. Traces of cutting meat, bone or wood working are less frequent

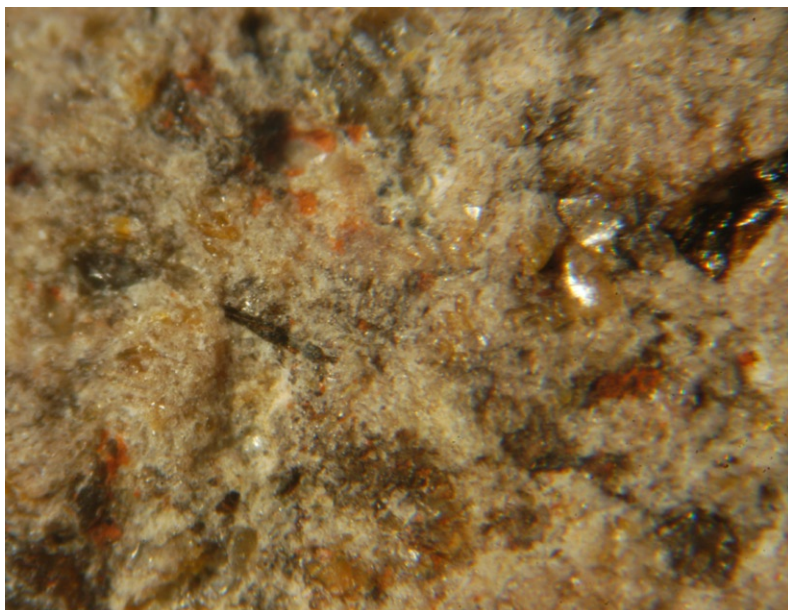
Analysis of ground and polished stone implements has shown that the most frequent raw materials are rhyolites from the region of the Tokai Mts and sandstones from the Matra Mts. Other rocks (e.g. quartzites from the Tokaj-Prešov range) are less frequent.

The majority of the tools analysed here are directly or indirectly associated with foodstuffs processing. These are, first of all quernstones used for grinding corn. The literature of the subject emphasizes the high efficiency of quernstones with the upper grinding stone longer than the width of the lower grinding stone. Experiments carried out using quernstones with a convex surface of the lower grinding stone showed that to grind 1 kg of corn takes from 30 to 40 minutes. It seems that the efficiency of quernstones with flat or nearly flat working surface is similar. We can assume that a portion of corn was not ground to flour but a thicker fraction was obtained to make

a kind of groats. Quernstones with a basin-shaped lower grinding stone occur relatively rarely and had a different function e.g. crushing seeds of oil plants – then the crushed seeds did not drop from the grinding stone but collected in the hollowed part of the lower grinding stone.

The literature of the subject assumes that work with quernstones was the domain of women. In the interior of a clay model of a house or a shrine (?) from Popudnia in western Ukraine, assigned to the Trypolye Culture, a female figurine was found close to the quernstones. On the other hand, analysis of burials from the LBK Culture cemetery in Vedrovice in Moravia showed that grinding stones are found both in male and in female graves, even in a child's grave (PODOBORSKY et al. 2002). The child's grave contained tool in the shape of a shoe-last which suggests that this was a boy's burial. At Vedrovice quernstones were found in four male graves and only in one female grave. It should be added that in none of the graves the quernstones were complete i.e.: with both the lower and the upper grinding stone. Only a fragment of the lower grinding stone was found in all the graves. Among the finds from LBK settlements at Aldenhovener Platte as well as from Polgár 31 the majority of identifiable stones are upper grinding stones. German researchers (ZIMMERMANN 1988) believe that this is caused by two factors, firstly: upper grinding stones became worn away more quickly and were frequently replaced, secondly: when the materials are badly damaged upper grinding stones are easier to identify. One of such fragments from a male grave at Vedrovice shows traces of red dye. Traces of hematite can be seen on a number of grinding stones in the analysed material. Such traces were also recorded on grinding stone fragments from the sites in the Aldenhovener Platte area. A. ZIMMERMANN believes that dye crushing took place after grinding stones had been destroyed, that is: crushing is a secondary function of these tools. We have already stressed that in the case of materials from Polgár 31 we are having to do with intentional, possibly ritual, destruction of grinding stones. Perhaps, hematite crushing was the last task performed with the use of these implements prior to their ultimate destruction (Phot. 13). Grinding stones and the function of grinding played – according to MAKKAY (1978) – an important role in the rites of the Neolithic farming communities.

As we have said almost all the quernstones were damaged. At other Neolithic sites the occurrence of damaged quernstones is also recorded. Some researchers believe that this phenomenon is the effect of natural wearing-out of tools whose fragments were then used for other purposes such as: to line hearths, to stabilize posts in building constructions, or to transform into other tools. However, instances of intentional destruction of quernstones are known, especially artefacts that were, beyond doubt connected with cult e.g. clay figurines. For example, at Hluboké Mašůvki, Painted Lengyel site in Moravia, such figurines were intentionally broken and their fragments discovered in various features (HÖCKMANN 1965). At the Early Eneolithic sites of the Gradeshnitsa-Krivodol complex in western Bulgaria (BIEHL 2000) clay figurines, too, were subjected to the procedures of intentional breaking. Other objects, for example the so-called “altar” were also intentionally fragmented – although E. BÁNFFY treats this supposition with scepticism (BÁNFFY 1997).



Phot. 13. Polgár 31. Surface of the upper grinding stone with traces of mineral dye (feature 624)

According to J. CHAPMAN (2001) all the products of material culture could have a symbolic function, including quernstones whose role was so important in the preparation of foods and dyes. It can be assumed that quernstones, like “altars” or clay figurines, were broken during special rites or ceremonies. This supposition is supported by the fact that quernstones were not fragmented by natural wear or cracking, but by usually series of blows with a hard hammer. At Polgár 31 several features contained quernstone fragments, but only in two cases reconstruction of the whole implement was possible. This suggests that some of the fragments were transformed into other tools and cannot make refits, but it seems more likely that – just like broken clay figurines – these fragments were re-deposited elsewhere, or in accordance with the principle of *pars pro toto* symbolized tools for food or dye processing, for example in grave furnishings or in rituals.

At the burial grounds of LBK at Vedrovice in Moravia, all the quernstones usually deposited behind the head of the dead person are fragments. Also the specimen from a child’s grave from the LBK cemetery at Těšetice (DOČKALOVÁ, KOŠTUŘIK 1997) is damaged.

Unlike the LBK burials from Vedrovice, where male graves were frequently furnished with “shoe-last” type adzes used for wood-working, and female graves contained simple axes, the Bükk Culture graves known so far are poorly furnished in stone implements (KALICZ, MAKKAY 1977). At Polgár 31 graves were furnished with fragments of grinding stones, pestles used in the mineral dye processing and lumps of mineral dye. All these implements were used in the mineral dye processing. Grave 697 contained a clay pot filled with ochre powder and large obsidian blade core with traces of use as hammerstone-pestle.

Relatively few implements were used in Polgár 31 for woodworking: shoelast adzes, polished stone tools and some chipped stone macrotools. Polished stone axes at Polgár 31 were found in 18 features. These tools were relatively less numerous than at LBK sites (see: Olszanica in southern Poland – 67 specimens – MILISAUSKAS 1986; Langwailer 9 in Rheinland – 31 specimens – KUPER et al. 1977; Bajč in western Slovakia – about 400 specimens). Woodworking and deforestation were, probably, less important at Polgár 31 than hide, meat and mineral dye processing.

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