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Marcin Szeliga[1], Grzegorz Osipowicz[2], Mariusz Bosiak[3]

ON THE ISSUE OF FUNCTIONAL USE OF PICKS DURING THE EARLY NEOLITHIC: A CASE STUDY FROM THE LINEAR BAND POTTERY CULTURE SITE IN WÓLKA WOJNOWSKA (S. POLAND)

ABSTRACT

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Picks are extremely rare artefacts associated with flint inventories of the Linear Band Pottery culture (hereinafter: LBK). Previously, only three such artefacts attributed to this culture have been found in the drainage basins of the Vistula and Oder Rivers. The contexts of discovery of picks dated to slightly later times indicated that they should be linked with mining activities of early agricultural societies. The presented collection from Wólka Wojnowska is one of the most numerous typological series of LBK picks found at a single site within the entire range of the LBK. The results of traceological and chemical SEM-EDX analyses of residues preserved on their surfaces indicate that these tools were used in processing hematite in order to produce ochre. The obtained data considerably broaden the scope of the functions of picks used during the Early Neolithic and allow us to question the interpretation that they were only employed in mining for siliceous materials.

Keywords: Early Neolithic, LBK, flint picks, use-wear analysis, SEM-EDX, ochre
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1 Institute of Archaeology, Maria Curie-Skłodowska University in Lublin; 4. M. Curie-Skłodowskiej sq, 20-031 Lublin, Poland; marcin.szeliga@mail.umcs.pl; ORCID: 0000-0002-5185-073X
2 Institute of Archaeology, Nicolaus Copernicus University in Toruń; 44/48 Szosa Bydgoska Street, 87-100 Toruń, Poland; grezegor@umk.pl; ORCID: 0000-0002-4393-655X
3 Faculty of Chemistry, Nicolaus Copernicus University in Toruń; 7 Gagarina Street, 87-100 Toruń, Poland; bosiu@umk.pl; ORCID: 0000-0002-5505-3746

INTRODUCTION

Picks are definitely ones of the rarest and – at the same time – most characteristic and original types of flint tools recorded in Early Neolithic inventories (6th-5th millennia BC) from the drainage basins of the Vistula and Oder Rivers. In the archaeological literature, they are interpreted as artefacts directly linked with mining activities performed by early agricultural societies. To be more specific, they have been regarded as one of several types of tools used in extraction of siliceous rocks (*e.g.*, Lech 1981a, 40-42; 1981b, 78). This assumption was confirmed by discoveries of single pick specimens in the fills of Early Neolithic mining shafts (in Jerzmanowice-Dąbrówka I and Tomaszów; see Lech 1981b, tabl. VIII: 5; Schild *et al.* 1985, 60, pl. 4: 2). Slightly greater numbers were also found at settlements, located close to such mines and contemporary with them (*e.g.*, Cabalska 1964, 123; Kaczanowska and Kozłowski 1971, 92; Kaczanowska 1977, 38-41; Balcer 1983, 91, tab. 14).

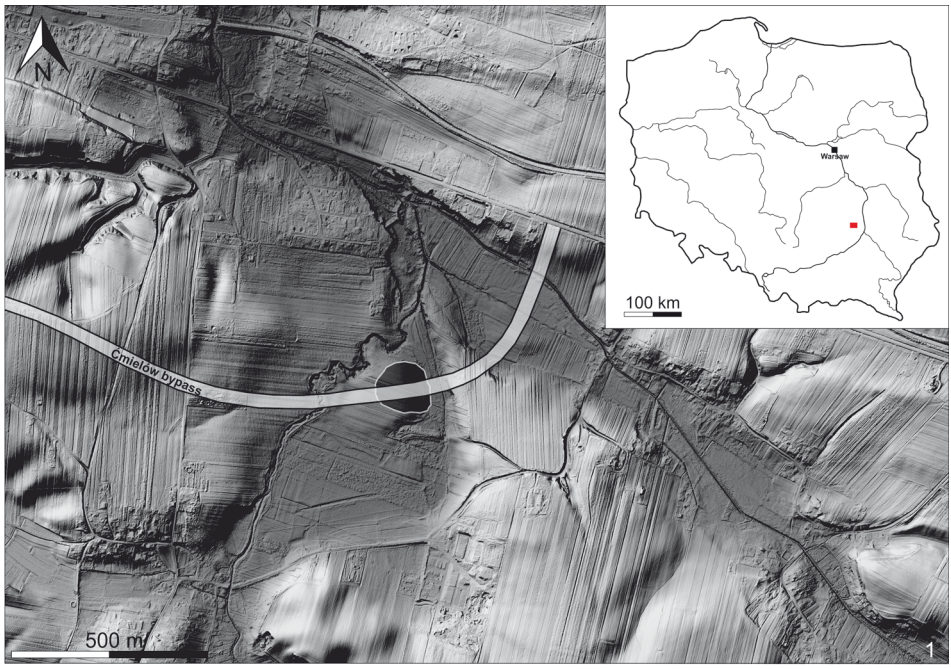
The currently accessible corpus of sources indicates that Early Neolithic picks were morphologically and typologically diverse. They were made of long blades, squat flakes as well as naturally formed chunks and exploited cores (*e.g.*, Cabalska 1964, 123, fig. 9: 2, 3; Kaczanowska and Kozłowski 1971, 92; Kaczanowska *et al.* 1987, 108, 109). These forms were transformed to different extents: with crude steep retouch near the edges, careful retouch on parts of the lateral surfaces or even surface retouch on the entire lateral sides. These procedures resulted in forming a narrow, pointed tip, located on one of the extremities of the tool and playing the role of the working part proper. Finished tools were small (their lengths usually did not exceed 7 cm) and had a triangular or quadrangular cross-section (Cabalska 1964, ryc. 9: 2-3; Kaczanowska and Kozłowski 1971, fig. 40: 3; Lech 1981a, fig. 8: 15; Kaczanowska *et al.* 1987, pl. 14: 3, 4; Michalak-Ścibior 1994; fig. 41: 10, 11), determined by the types of the initial forms as well as the character and final range of retouch on particular surfaces.

Currently, we know only a dozen or so picks discovered in the drainage basins of the Vistula and Oder Rivers and dated to the Early Neolithic. Until recently, a great majority of them were linked with later Danubian cultures, namely with the Malice culture and Lengyel cultural groups developing in these areas in the 5th millennium BC (see Cabalska 1964, 123, fig. 9: 2, 3; Kaczanowska and Kozłowski 1971, 105, fig. 40: 3; Więckowska 1971, pl. 30: 5; Kaczanowska 1977, 38-41; Lech 1981b, pl. 8: 5; Michalak-Ścibior 1994, 75, fig. 41: 10-11). Only several finds were indisputably associated with the earliest phase of the Neolithic, that is with the LBK. This collection was represented only by three specimens discovered at settlements in Mogiła and Bieńczyce, in the Nowa Huta region (Kaczanowska *et al.* 1987, 107-109, 115, pl. XIV: 4), and probably also two potential specimens of this kind from Kraków-Olszanica, which were assigned to the 'Miscellaneous Flint Tools' category in the source monograph (Milisauskas 1986, 137, fig. 115: D, H). Until recently, the above-listed specimens were the only known group of certain and potential LBK picks from vast

areas spreading north of the Carpathian and Sudeten mountains. Completely new and very important data were provided by a rescue excavation conducted in 2017 at site 33 in Wólka Wojnowska, Ćmielów Commune, Świętokrzyskie Voivodeship. The greatest number of known typological picks attributed to the LBK (jointly six specimens) were discovered at this site. Their characteristic features are macroscopic and very distinct use-traces on their edges and surfaces as well as residues of unspecified red substance preserved on the tips of certain specimens. These elements – besides the concentration of the picks at the site – were the main reason to conduct further research and analyses. They appeared to be especially important in the context of the location of the settlement in the direct vicinity of different outcrops of various Jurassic and Cretaceous flints distributed on the Mesozoic fringe of the Holy Cross Mountains and the mining character of the discussed tools suggested in archaeological literature. The main aim of this article is to present this unique collection as well as the results of the conducted traceological and chemical analyses. The information from this research makes a rather important contribution to studies on the role and scope of using such tools by agricultural societies during the earliest phases of the Neolithic.

SITE

Site 33 in Wólka Wojnowska is located within the edge zone of the Sandomierz Upland, occupying part of the culmination and gentle slope of a small promontory on the edge of a loess upland. This promontory is split from the north and west by a valley of a minor watercourse – the Krzczonowianka, near the place where it meets the Przepaść, which is a left-bank tributary of the Kamienna River (Fig. 1: 1). The discussed site was discovered in the 1990s during a surface survey conducted within the framework of the Polish Archaeological Record (Polish: Archeologiczne Zdjęcie Polski, AZP). Verification research carried out several times in the subsequent years made it possible to state that the site was settled by different cultures for a long time, from the Neolithic to the Early Middle Ages. In 2017, a rescue excavation (prior to the construction of the Ćmielów bypass) was conducted in the central part of the site. It resulted in researching an area of 72.4 ares as well as discovering and exploring 115 features, including 49 features attributed to the LBK (Matyaszewski 2017). The remains of the Early Neolithic settlement were mainly concentrated in the western part of the researched area. They were remains of at least several longhouses oriented along a N-S axis (Fig. 1: 2). The results of stylistic analyses performed on the discovered ceramic materials indicate that the settlement was linked with the Želiezovce phase of the LBK (Matyaszewski 2018). The finds made at the site prove that the settlement was clearly influenced by the Eastern Linear cultural circle from the Transcarpathian territories (Szeliga and Gawryjołek-Szeliga 2022).



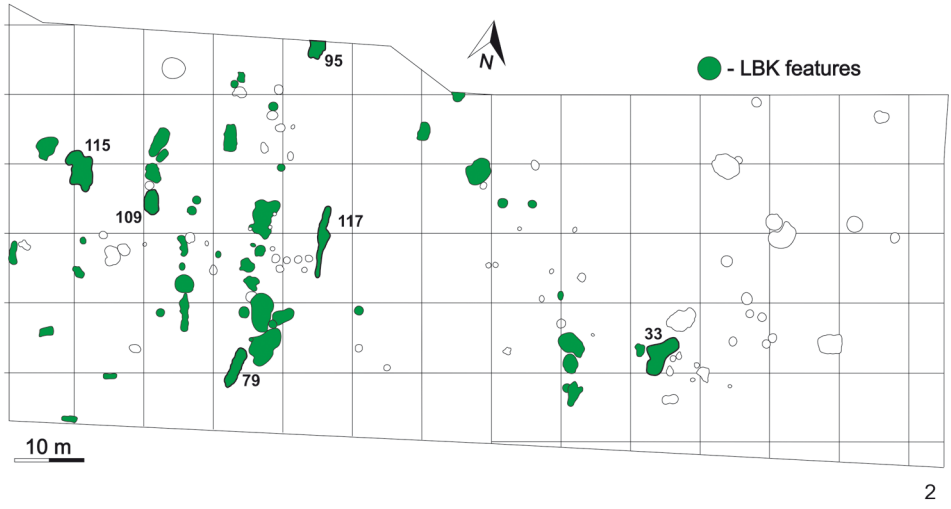


Fig. 1. Wólka Wojnowska, Site 33. Location of the site (1) and LBK features discovered during the excavations prior to building the Ćmielów bypass (2); the numbers indicate features with the picks (after Szeliga and Gawryjołek-Szeliga 2022, fig. 1, with modification)

FLINT INVENTORY AND THE ASSEMBLAGE OF PICKS

The research conducted at the discussed site resulted in discovering a total number of 533 flints and five obsidian artefacts. The numbers of these finds in particular LBK features (pits) were considerably diverse: from one to 97 specimens (Matyaszewski 2018). In terms of raw material, decidedly the most numerous group are artefacts made of Świeciechów flint (82.16% of the total number). Forms made of other siliceous materials and obsidian are much rarer. Morphologically, the most frequent category of products are different flakes, which make up over half of all the finds. They are clearly more numerous than other groups of the inventory, including prepared (retouched) tools, which constitute 15.24% of the entire collection (82 specimens). Among them, the most numerous are endscrapers and retouched flakes (jointly 68.29%). Other intentionally retouched forms are decidedly less frequent. The picks that are the main subject of this study are represented by a total of 6 specimens, constituting 7.32% of all retouched tools and 1.12% of the entire inventory. It should be stressed that these forms generally constituted definitely higher percentages in particular features: from about 7% to as much as roughly 50% (Feature 117) of all the tools discovered within their limits.

All the picks were discovered individually within the features, which were somewhat evenly distributed within the settlement (Fig. 1: 2). They are morphometrically diverse, which is mainly the result of differences between the used initial forms as well as the fact that they were shaped by retouch to varying extents (this mainly applies to preparing particular surfaces and tips). The individual specimens are represented by:

a) A pick broken on both sides, with a quadrangular cross-section; made of Świeciechów flint; discovered in Feature 33; dimensions: 66 × 22 × 22.5 mm (length × width × thickness); weight: 45.59 g (Fig. 2). The specimen was made on an unspecified initial form (exploited blade core having a natural surface or massive flake with a longitudinally natural dorsal surface). It has two surfaces formed with a series of multiple, mainly unidirectional strikes, a single cortical surface and a flaked surface (Szeliga and Gawryjołek-Szeliga 2022, 103, fig. 5: 1);

b) A pick broken on one side, with a quadrangular cross-section; made of Świeciechów flint; discovered in Feature 115; dimensions: 57 × 24 × 19 mm; weight: 30.13 g. The specimen was made of an unspecified initial form. Its three surfaces were shaped with a series of multiple, mainly multidirectional strikes forming surface retouch, the fourth surface is partly natural, with edge retouch and precise, multidirectional strikes shaping the tip (Fig. 3);

c) A pick with a quadrangular cross-section; made of chocolate flint; discovered in Feature 109; dimensions: 52 × 27 × 24 mm; weight: 38.10 g. The specimen was made of an unspecified initial form. All the surfaces were formed with a series of multiple, usually unidirectional strikes forming surface retouch (Fig. 4);

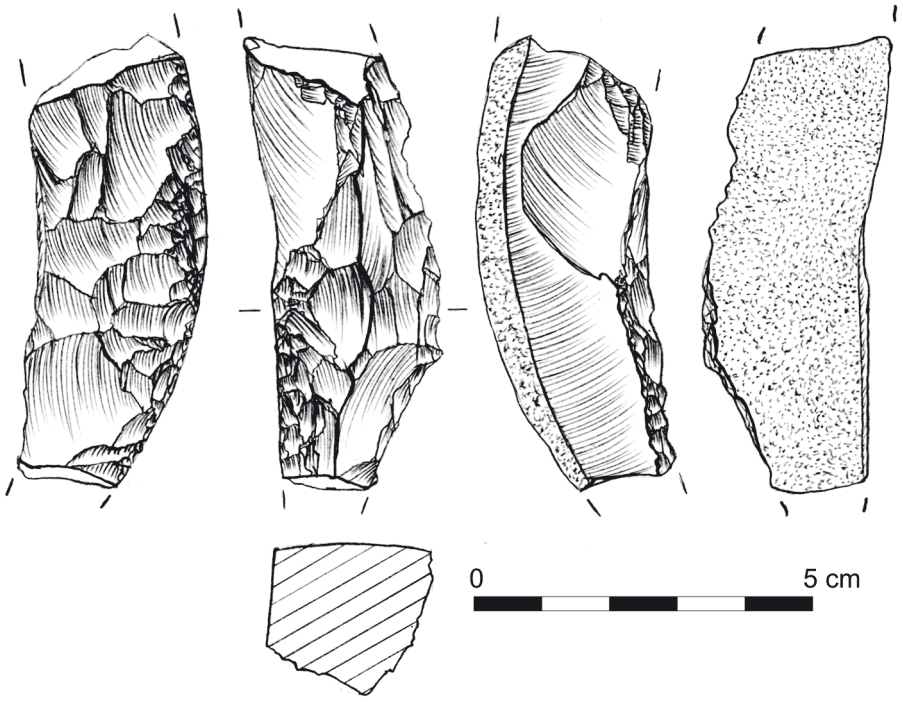


Fig. 2. Wólka Wojnowska, Site 33. Pick made of Świeciechów flint without any use-wear traces from Feature 33 (after Szeliga and Gawryjołek-Szeliga 2022, fig. 5: 1)

d) A pick broken on one side, with a triangular cross-section; made of Świeciechów flint; discovered in Feature 117; dimensions: 34 × 21 × 17 mm; weight: 13.04 g. The specimen was formed on a massive crested blade, whose ventral side was shaped with a series of strikes struck from the left edge. The tip of the tool, formed with multidirectional strikes, is located in the distal part of the crested blade (Fig. 5);

e) A pick broken on one side, with a triangular cross-section; made of Świeciechów flint; discovered in Feature 95; dimensions: 49 × 25 × 20 mm; weight: 23.28 g. The specimen was formed on a massive blade with a completely natural dorsal surface (natural crested blade). One of its natural surfaces was shaped with edge retouch. The ventral surface was formed with edge retouch and in part with surface retouch, with a series of strikes struck from both sides. The edge of the tool is located in the distal part of the blade (Fig. 6);

f) A pick broken on one side, with a triangular cross-section; made of Świeciechów flint; discovered in Feature 79; dimensions: 30 × 20 × 18 mm; weight: 11.3 g. The specimen was formed on a massive crested blade with a partly natural dorsal surface, which was shaped with surface retouch by strikes from the right side. The tip of the tool is located in the distal part of the blade (Fig. 7).

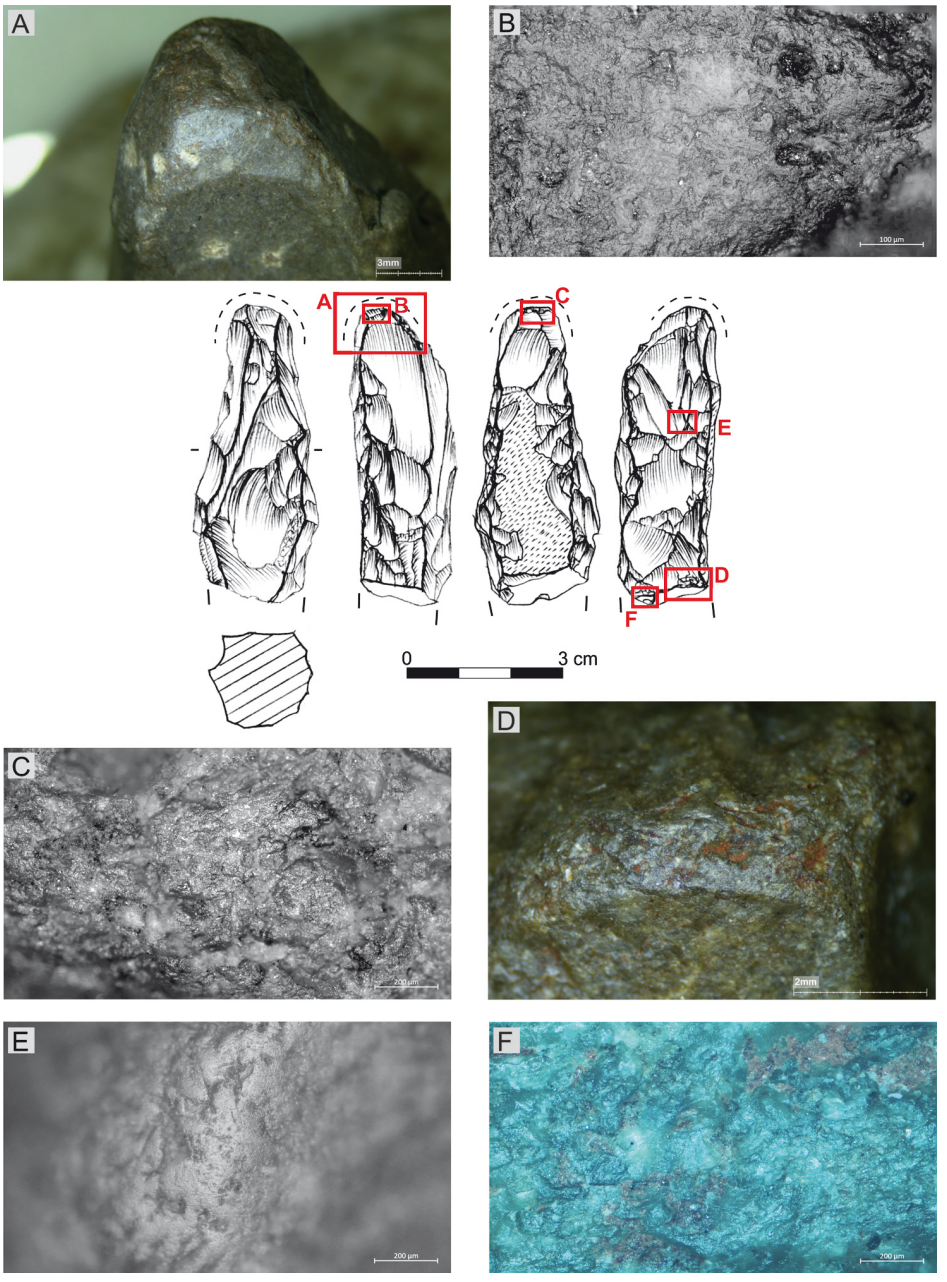


Fig. 3. Wólka Wojnowska, Site 33. Pick made of Świeciechów flint from Feature 115. In the drawing, the dashed line indicates the extent of macroscopic traces of damage of tool (abrasions and crushing). Detailed explanations of the use-wear traces documented in individual photographs are provided in Table 1 (drawn by M. Szeliga, photo by G. Osipowicz)

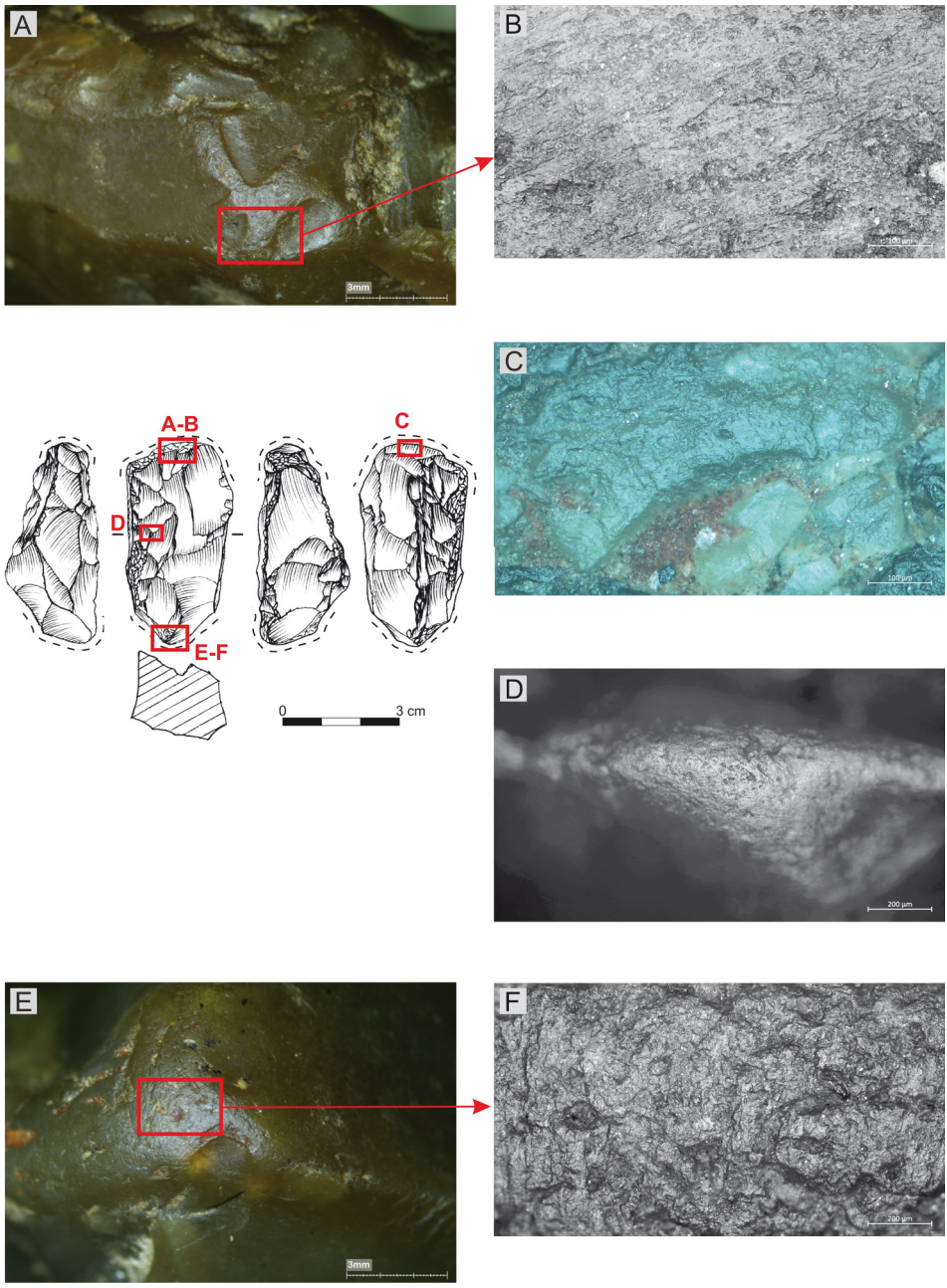


Fig. 4. Wólka Wojnowska, Site 33. Pick made of Chocolate flint from Feature 109. The explanation of markings in the drawing and the information on documented use-wear traces – see caption under Figure 3 (drawn by M. Szeliga, photo by G. Osipowicz)

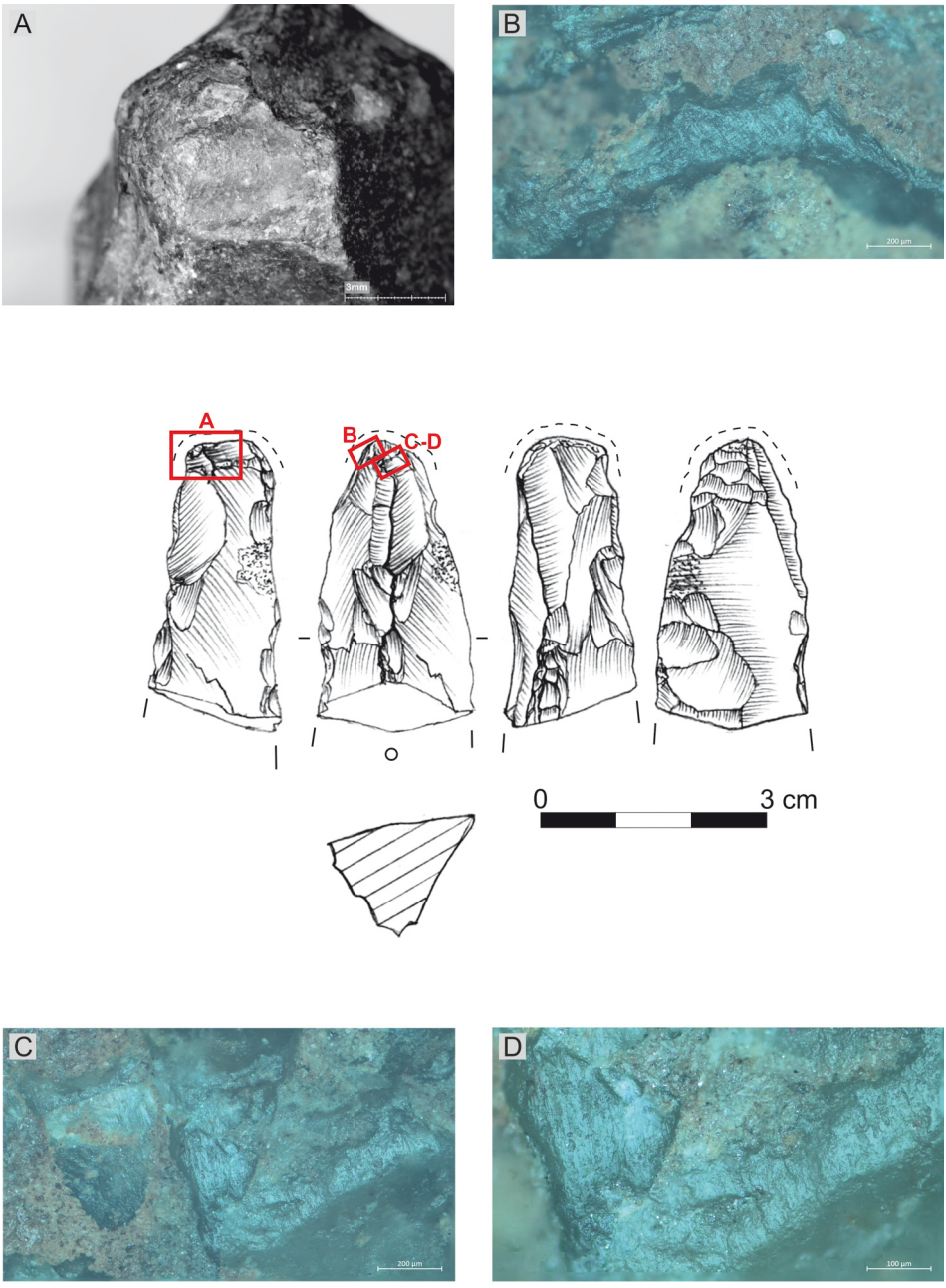


Fig. 5. Wólka Wojnowska, Site 33. Pick made of Świeciechów flint from Feature 117: The explanation of markings in the drawing and the information on documented use-wear traces – see caption under Figure 3 (drawn by M. Szeliga, photo by G. Osipowicz)

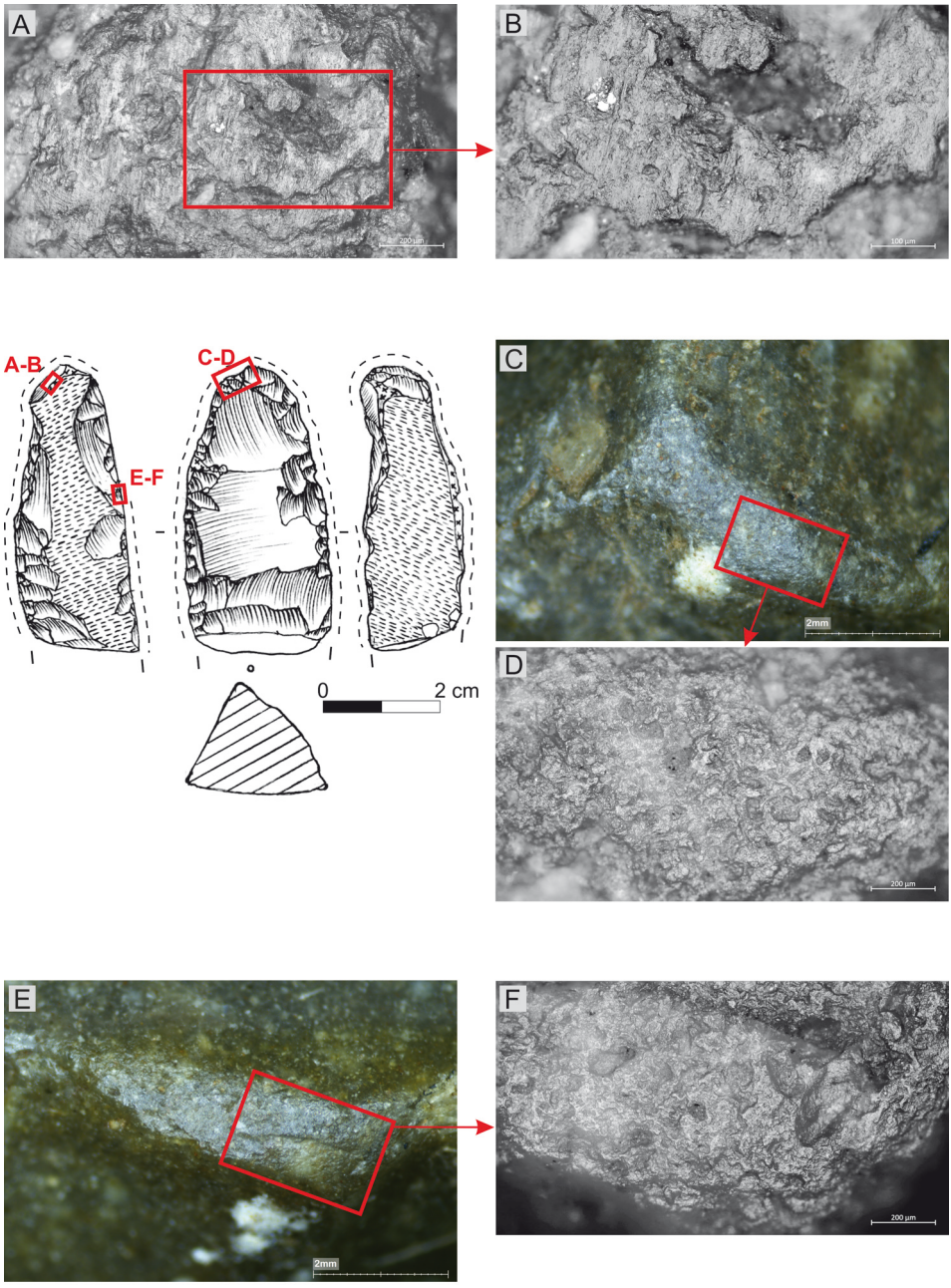


Fig. 6. Wólka Wojnowska, Site 33. Pick made of Świeciechów flint from Feature 95. The explanation of markings in the drawing and the information on documented use-wear traces – see caption under Figure 3 (drawn by M. Szeliga, photo by G. Osipowicz)

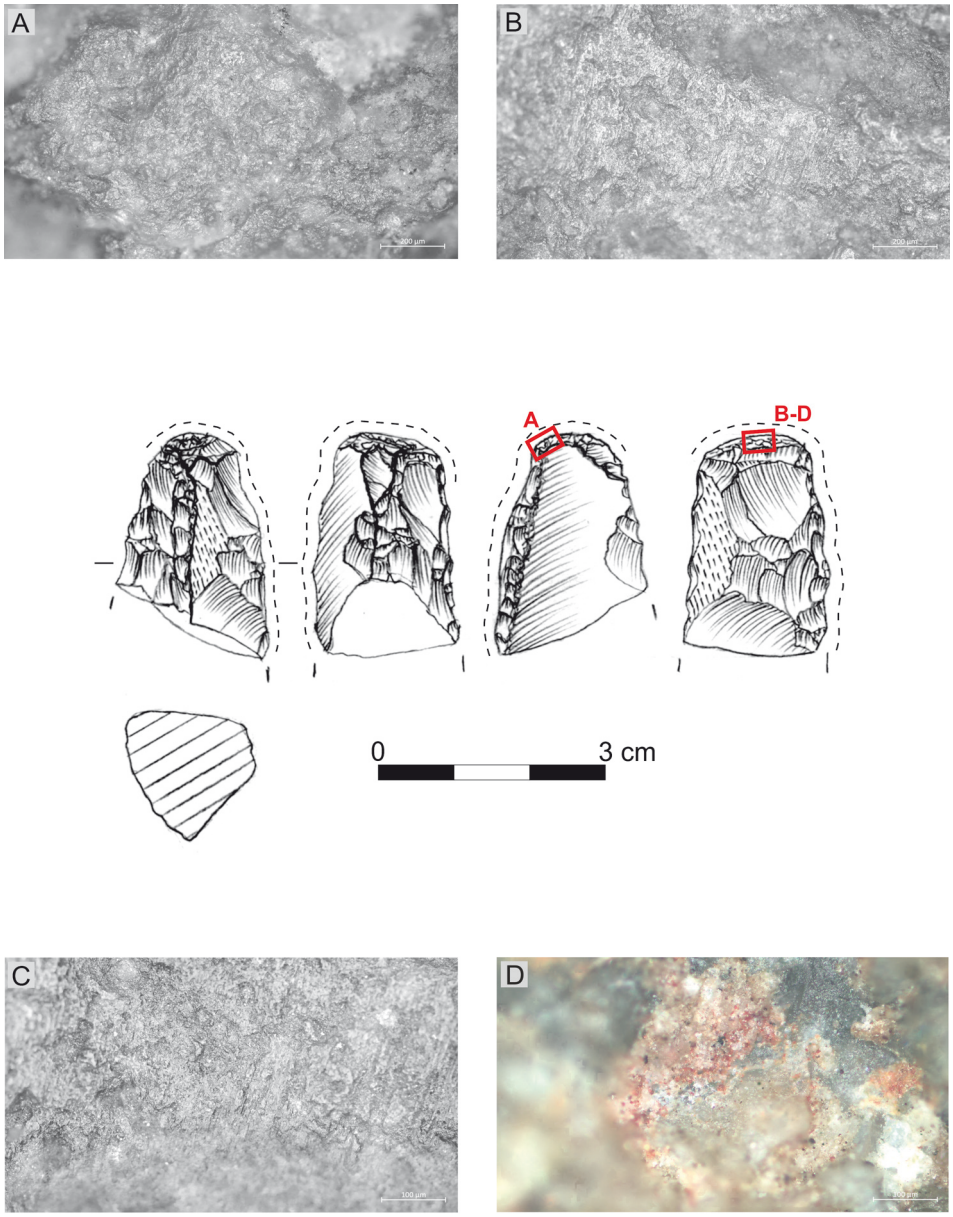


Fig. 7. Wólka Wojnowska, Site 33. Pick made of Świeciechów flint from Feature 79. The explanation of markings in the drawing and the information on documented use-wear traces – see caption under Figure 3 (drawn by M. Szeliga, photo by G. Osipowicz)

METHODS

All the picks discovered at the discussed site were subjected to a traceological analysis. An optical Nikon SMZ-745T microscope (equipped with a Delta Pix Inventio 6EIII camera) – which allows obtaining up to x50 optical magnification – was used to evaluate the state of preservation of the artefacts as well as the features of their working edges and utility retouch. This apparatus was used to take the microphotographs presented in Figs. 3: A, D; 4: A, E; 5: A, 6: C, E, 9: A, B.

A metallographic Zeiss Axioscope 5 Vario microscope, equipped with an Axiocam 208 camera was used to analyse the polish. This piece of equipment allows obtaining up to ×50 lens magnification (optical magnification up to ×500). All the remaining microphotographs presented in this article were taken with the use of this device.

The applied traceological terminology was based on the concept system existing in the subject literature (HoHo Committee 1979, 133-135; Vaughan 1985, 10-13, Glossary, p. VII; van Gijn 1989, 16-20; Juel Jensen 1994, 20-27; Korobkova 1999, 17-21; Osipowicz 2010, 24-35), which was adapted to the needs and requirements of the conducted analysis.

Residue samples for SEM-EDX research were taken from two artefacts. The analysis was conducted using a scanning electron microscope by LEO Electron Microscopy Ltd, England, model no. 1430 VP from 2001. The device is intended for analyzing surface topography of solids and enables controlled vacuum conditions (1e270 Pa), allowing low-conductive and low-hydrated samples to be investigated without prior treatment (*e.g.*, application of a conductive coating). The device was connected to an energy-dispersive X-ray spectrometer (EDX) Quantax 200 with a XFlash 4010 detector produced by Bruker AXS, Germany in 2008, owing to which it was possible to determine the elemental composition of various parts of the investigated objects.

Two experiments were conducted for the studies reported in this article. Both used cores made of chocolate flint, which were used to obtain ochre powder from a hematite lump coming from the prehistoric ochre mine in Rydno, Poland (Schild *et al.* 2011). One of the tools was used for scraping, and the other for chipping. Each tool was worked for 30 minutes. The comparative material for the results of these experiments were experimental tools from the reference base comprising several hundred specimens, gathered at the Institute of Archaeology, Nicolaus Copernicus University in Toruń, primarily the products used as strike-a-light and various tools for processing mineral raw materials such as limestone, sandstone and clay.

RESULTS

Use-wear analysis

Five out of the six macroscopically analysed artefacts bear somewhat homogeneous use-wear traces. They are usually concentrated on the tips of particular specimens, which

can be observed by distinct polished-abraded/matted areas (Fig. 3: A, D; 4: A, E; 5: A; 6: C, E). The highest points of the flint micro-relief are slightly rounded and usually covered with scattered polish here (Fig. 3: B-C; 4: D, F; 5: B, D; 6: A, D, F; 7: A). In the most worn places, there is also bright polish with flat/corrugated topography and rather coarse texture, often connected to numerous linear traces – black striation and grooves (Fig. 3: B; 4: B; 5: C-D; 6: A-B; 7: B-C). The detailed description of the use-wear traces observed on particular artefacts was presented in Table 1. In almost all cases, they indicate that the analysed tools were probably used in percussive grinding of hematite lumps. Only on one pick – the specimen from Feature 33, broken on both sides (Fig. 2) – there are no recorded traces resulting from using the tool. Still, this might have been caused by the fact that the artefact was not completely preserved.

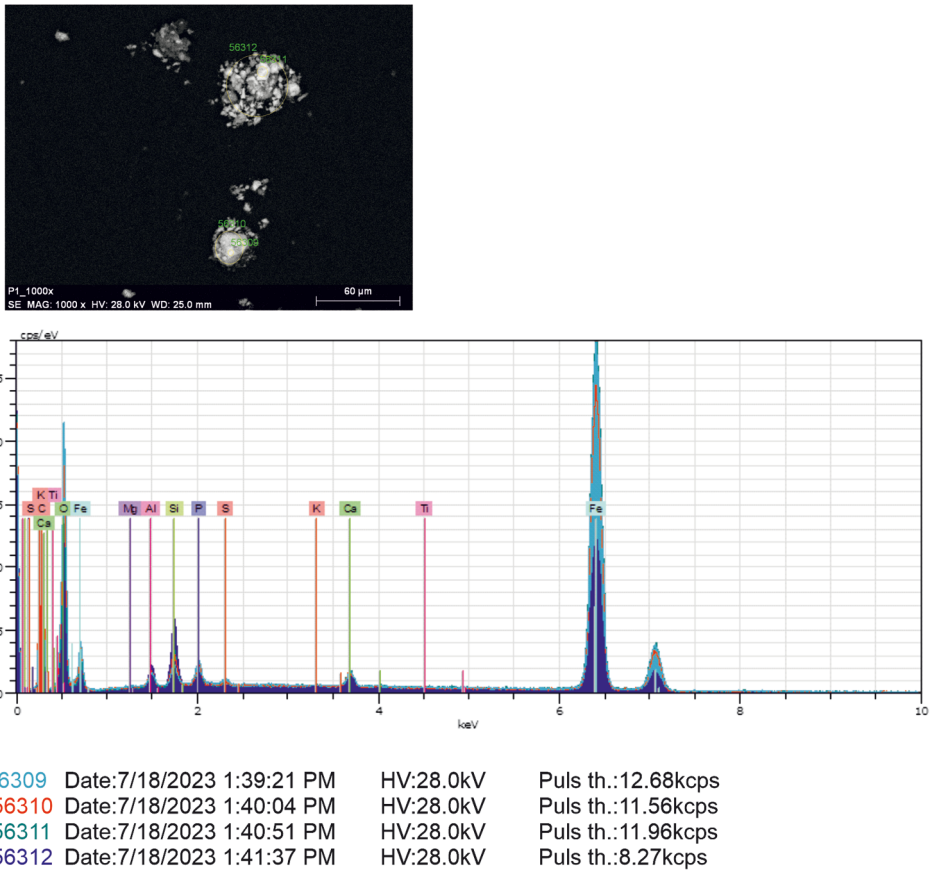


Fig. 8. Wólka Wojnowska, Site 33. Results of the SEM-EDX analysis of residues identified on the surface of pick from Feature 115 (prepared by M. Bosiak)

Table 1. Wólka Wojnowska, Site 33. Results of the traceological analysis of picks (prepared by G. Osipowicz and M. Bosiak)

No.	Inv. no./ feature	Morphological description/ raw material	Use-wear	Residues	Function	Comments	Figure
1	Feature 33	Pick/ Świeciechów flint	No use-wear traces were found on the specimen	lack	Undefined	Tool broken on both sides	Fig. 2
2	Feature 115	Pick/ Świeciechów flint	Both artefact tips are heavily polished-abraded/ matted on all edges (Fig. 3: A). In the polished areas, a visible delicate peck-ness deepens the coarsely crystalline structure of a flint (Fig. 3: C). The higher parts of the micro-relief are smoothed and covered with bright, linear polish with flat topography and smooth texture. It is connected to not numerous linear traces (linear striations and grooves) with irregular edges (Fig. 3: B). The side edges of the specimen and the negative ridges show rounding/ smoothing and polish with a well-developed domed-cratered topography (Fig. 3: E).	On both tips, in the hollows of the negative scars, there is a red mineral substance (Fig. 3: D, F)	Chipping the ocher	The polish on the lateral edges is a result of keeping the artefact in a hide container and/or using it for a long time by holding it in hand. The traces on the tips are not characteristic, changed by 'hide" traces.	Figs. 3, 8; Tab. 2
3	Feature 109	Pick/ Chocolate flint	Both artefact tips are strongly rounded on all edges (Fig. 4: A, E). In the rounded areas, there is a clear peck-ness and linear matting of the higher parts of the flint micro-relief (Fig. 4: F). On the „upper tip", at the higher magnifications, linear polish with flat/ corrugated topography and slightly rough texture is visible. It is connected with numerous linear traces (black striations – Fig. 4: B). The side edges of the specimen and the negative ridges show rounding/ smoothing and polish with a well-developed domed-cratered topography (Fig. 4: D).	On both tips, in the hollows of the negative scars, there is a red mineral substance, which is often legible in the context of distinct use-wear traces (Fig. 4: C).	Chipping the ocher	The traces on the lateral edges are a result of holding the tool in hand or keeping it in a hide container.	Fig. 4

4	Feature 117	Pick/ Świeciechów flint	The tip of the specimen is polished (Fig. 5: A). Here, a bright linear polish with flat/corrugated topography and quite smooth texture was observed, strongly abrading the upper parts of the micro-relief (Fig. 5: B-D). It is associated with linear traces (black striations).	In the hollows of the working surface, there are remains of a reddish mineral substance (Fig. 5: B-D). Its presence is linked mostly with parts which bear use-wear traces	Chipping the ocher	Broken tool	Fig. 5
5	Feature 95	Pick/ Świeciechów flint	There are visible smoothed-abraded/matted areas on all edges (including the side ones) (Fig. 6: E). The highest parts of the flint micro-relief are, in these places, slightly rounded and covered with scattered polish (Fig. 6: F). These traces are best legible at the tip of the specimen (Fig. 6: C, D). Here, in addition, locally bright polish/abrasion with flat/corrugated topography and quite rough texture is visible. It is associated with numerous linear traces - black striations (Fig. 6: A, B).	-	Chipping the ocher	Broken tool	Fig. 6
6	Feature 79	Pick/ Świeciechów flint	Matte smoothing/abrasion is visible on the tip of the specimen. These traces go to one of the side edges and cover about 1 cm of its length. At higher magnifications, roughening of the surface texture connected to scattered polish is visible (Fig. 7: A), and in places, bright polish/abrasion with flat/ corrugated topography and quite rough texture. It is associated with numerous linear traces - black striations and grooves (Fig. 7: B-C).	In the hollows of the working surface, there are remains of a red mineral substance (Fig. 7: D).	Chipping the ocher	Broken tool	Fig. 7

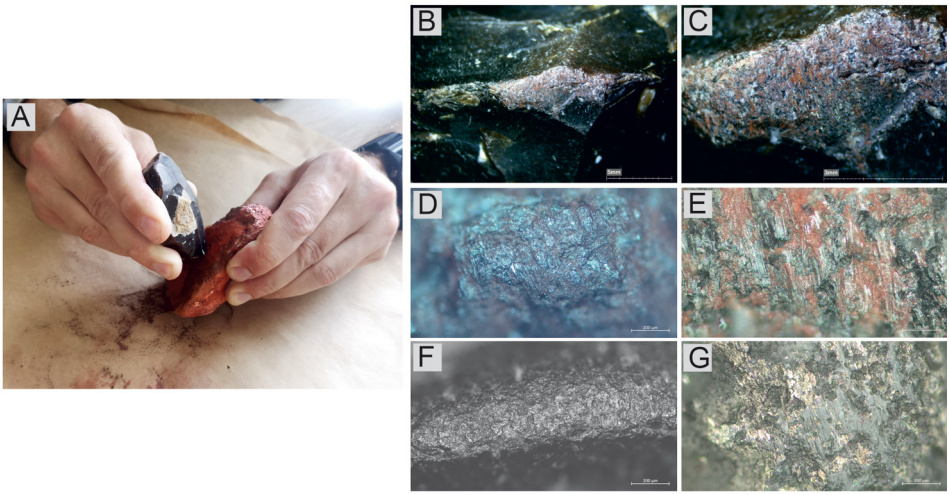


Fig. 9. Wólka Wojnowska, Site 33. Experimental percussive grinding ochre using flint tools (A), the use-wear traces formed during this work (B-E), use-wear traces formed during processing limestone (F), and the traces and residues created during experimental use of strike-a-light (G) (photo by G. Osipowicz)

Table 2. Wólka Wojnowska, Site 33. Results of the SEM-EDX analysis of pick from Feature 115 (prepared by M. Bosiak)

Mass percent (%)											
Spectrum	**C**	**O**	**Mg**	**Al**	**Si**	**P**	**S**	**K**	**Ca**	**Ti**	**Fe**
56309	9.27	41.14	-	0.72	0.87	0.98	0.18	-	0.84	-	46.01
56310	11.58	42.47	0.04	0.66	1.24	0.80	0.15	-	0.89	-	42.16
56311	9.90	33.97	0.15	1.12	2.13	1.07	0.16	-	0.90	-	50.61
56312	13.76	50.39	0.10	1.33	3.70	0.63	0.06	0.20	1.09	0.14	28.60
Mean value:	11.13	41.99	0.07	0.95	1.98	0.87	0.14	0.05	0.93	0.03	41.85
Sigma:	2.01	6.73	0.06	0.32	1.26	0.19	0.05	0.10	0.11	0.07	9.48
Sigma mean:	1.00	3.37	0.03	0.16	0.63	0.10	0.03	0.05	0.05	0.03	4.74

SEM-EDX

The SEM-EDX analysis of a brown substance scraped from the surface of the flint revealed a very high iron content in the range 28-50% for all analysed fragments (Table 2; Fig. 8). The negligible amount of other elements, such as sulphur, combined with the significant amount of oxygen, indicates that the iron does not come from minerals such as pyrite or marcasite, but from iron (III) oxides, possibly ochre.

DISCUSSION

The analysed assemblage of LBK picks from Wólka Wojnowska is the largest known collection of such tools discovered in the drainage basins of the Vistula and Oder Rivers. At the same time, it is one of the most numerous groups of such artefacts found at a single site from the entire range of the discussed culture. This very fact indicates how exceptional it is. Previous finds of this type are known mainly from Western Europe (*cf.* Caspar *et al.* 1989, 202) and are characterized by a relatively high degree of territorial dispersion. Usually, only small numbers of picks, or even single specimens, have been discovered at Belgian, Dutch and German sites – both in settlement and burial contexts (*e.g.*, Modderman 1970, 46, 63; Newell 1970, graph 2; Taf. 122: 11; Farruggia 1973, 124, 125; Cahen *et al.* 1986, 36, fig. 17). Generally, they do not differ from the artefacts from Wólka Wojnowska – in respect of initial forms used in their production as well as the ways of shaping their tips and lateral surfaces. Also, the metric parameters of particular specimens correspond to some extent to the dimensions of the picks analysed in this article (Modderman 1970, Taf. 122:11; 161: 6; Newell 1970, 157; Taf. 229: E334, E170, E137; Farruggia 1973, Taf. 38,4-5; 39,2). Unfortunately, the scope of information presented in source papers does not always allow us to definitely verify and compare particular finds, *e.g.*, due to different ways of their interpretation, and, as a result, differences in final classifications. It appears that two specimens from Kraków-Olszanica – one created on an unspecified form and the other shaped on a conical blade core – can serve as an example (Milisauskas 1986, 137, fig. 115: D, H). Both specimens (especially the former) – presented in the source work as 'miscellaneous tools' – appear to show a clear morphological and metric similarity to the discussed tools from Wólka Wojnowska. This fact indicates that it is possible to interpret them as potential picks, but corroborating this assumption requires a direct and detailed study of the sources. There is a possibility that the same applies to the LBK site in Bolechowice-Zielona, Zabierzów Commune, from where comes an unspecified "macrolithic adze-shaped tool, formed on one side with massive surface retouch" (Breitenfellner and Rook 1991, 17). The fact that there are no illustrations of this specimen makes it impossible to verify the above-presented description.

Putting aside the actual typological classification of the specimens from Kraków-Olszanica and Bolechowice-Zielona, we should stress that there are only three specimens of picks from the drainage basins of the Vistula and Oder Rivers that are definitely attributed to the LBK. They were discovered in features dated to the Želiezovce phase from the Nowa Huta region – in Mogiła (two specimens) and Bieńczyce (one specimen). They were all made on chunks and had a triangular cross-section. One of the artefacts from Mogiła is retouched on three surfaces, and the remaining tools – on two (Kaczanowska *et al.* 1987, 108, 109, Pl. 14: 3, 4). Their morphometric features are similar to the features of the specimens from Wólka Wojkowska. Unfortunately, none of the artefacts from western Lesser

Poland has been subjected to traceological analyses, which makes it impossible to conduct comparative research in this respect.

Because the analysed tools do not find many analogies in Early Neolithic materials from other territories inhabited by LBK societies, it is very difficult to correctly interpret their functions. The character of the use-wear traces observed on the working edges of particular specimens indicates that they were used in processing mineral material (Table 1). Nevertheless, the type of the performed activity and the type of the processed material may be debatable. Characteristic polish/abrasion and roughing of working edges, with scattered polish mainly in the upper parts of the micro-relief, were detected on all the analysed specimens. This type of use-wear is a typical result of processing soft mineral materials, like clay, ochre (Fig. 9: B-E) or limestone (Fig. 9: F). On the most worn parts (not of all the specimens), there was also bright polish with corrugated topography and rather coarse texture, linked with linear traces of a various characteristic having irregular edges (Figs 4: B; 5: C-D; 6: A-B; 7: B-C). This type of polish is a result of processing materials containing harder fractions, which are more resistant to crushing and have a more damaging influence on the working edges of flint tools. Hematite can serve as an example here. During the experiments we have carried out so far, only as a result of processing this mineral (in order to obtain ochre), on the surface of flint tools were created use-wear traces with characteristics corresponding to those observed on specimens from the site in Wólka Wojnowska (Fig. 9: E).

Polish with similar characteristics, but definitely more abrasive, bright and smooth in terms of texture, is a distinctive (and dominant) type of use-wear damage in the case of tools used as strike-a-light (Fig. 9: G). However, on tools with this function, there are rarely such clearly developed use-wear traces typical for the processing of "soft" mineral substances, *i.e.*, matting/rounding of the microrelief with scattered and quite dull polish, which basically dominates in the case of the analysed tools. Therefore, although it cannot be definitively ruled out that some of the studied Neolithic tools were also used as strike-and-light, from the perspective of the overall characteristics of the traces of use, this is unlikely.

The SEM-EDX analysis results on residues taken from the working edges of the discussed Neolithic artefacts proved that the red substance is almost pure iron oxide that may have come from ochre powder. Sulphur (whose presence could indicate that the tools were used in striking fire with pyrite; *cf.* Polit *et al.* 2023) was detected only in very marginal quantities. However, its near absence doesn't necessarily preclude the use of tools for making fire, as this assumes that the pyrite hasn't been post-depositionally remineralized into iron oxide (Leduc *et al.* 2012). For this reason, it cannot be ruled out that the analysed tools were in contact with pyrite or marcasite, even if it seems less probable.

Also, differences in the morphology of residues after ochre processing and striking a fire with pyrite observed in the case of experimental tools (Fig. 9: E, G) do not necessarily have to be significant in the case of artefacts. Red residues similar to those observed on the tools

for ochre processing can be observed on prehistoric strike-a-lights. They results either from in situ remineralization of pyrite residue to iron oxide in some depositional contexts, or from incidental contact with the iron oxide cortex of a pyrite nodule during fire making (see: Sorensen 2019; Sorensen *et al.* 2014; 2018). However, they are usually present in very minor amounts and distributed in specific points. In a case of the analysed artefacts, a red substance was observed in "huge" amounts and in their various parts, although it was concentrated (and most visible) on their working edges, exactly in the same way as with the experimental tools used to ochre processing. This is an indirect argument supporting the hypothesis that we are dealing here with tools for extracting ochre and not the strike-a-lights, in our opinion, quite a strong one. This interpretation, connected to other clues like the widespread use of ochre at the site, the presence of other types of tools related to its processing, i.e., scrapers (certainly not strike-a-light), on which analogical residues were observed, and finally the characteristics of traces of use visible on the analysed artefacts that differ from those typical of strike-a-light are, in our opinion, sufficient grounds to assign them a function related to the processing of ochre (without, of course, excluding, as already mentioned, the possibility of using them also in a different way).

The character of the use-wear traces observed on the artefacts from Wólka Wojnowska allow us to determine the type of activity that they were used for. Most probably, the great majority of them were used in percussive grinding of hematite lumps, that is the removal of material from their surfaces through repeated striking. Performed experimental analyses indicated that it is a very effective method of obtaining ochre powder (Fig. 9: A). The tools from the settlement in Wólka Wojnowska might have been held directly in the hand, which resulted in forming the 'hide-like' polish observed on their surfaces. Still, it should be stressed that these patterns might have been caused by the long-lasting keeping of the artefacts in hide containers or the use of handles lined with hide. The state of preservation of the analysed specimens and, as a result, their present dimensions – especially their lengths, which never exceed 70 mm (only two specimens are longer than 50 mm) – are somewhat troublesome in this context. Most of the picks have fracture surfaces located on the extremities opposite to their tips and formed on already finished tools (Figs 3, 5-7). Unfortunately, their morphological features and the results of the traceological analyses are not enough to help us determine if the artefacts were broken by accident (transverse fracture resulting from using a tool) or intentionally (breaking/detaching the broader part of a finished tool in order to adjust it to its owner's hand or in accordance with its planned function). In most cases, it appears that the latter suggestion is more probable. It may be indirectly corroborated by considerable metric similarities between the analysed specimens and only completely preserved specimen in the collection (Fig. 4) as well as between them and picks discovered at other LBK sites, which are also often transversally broken (*e.g.*, Kaczanowska *et al.* 1987, pl. 14: 4). It appears that the only accidentally broken specimen was found in Feature 33 (Fig. 2). Nevertheless, even in this case, only detaching of its tip can be undoubtedly described as unintentional – result of using the tool (?).

On the other hand, the current state of preservation of the analysed picks does not allow us to exclude the possibility that they are only fragments of more massive, destroyed tools originally used for other activities outside the settlement, *e.g.*, during the extraction of flint raw material or digging in the soil, *etc.*). They may have been brought to the settlement in this form (hence the lack of refits), and then they were recycled/repurposed and used as tools for hematite processing by the people at the settlement. Although this possibility seems less likely due to the lack of clear traceological data, it cannot be clearly ruled out at present.

The conducted experiments allow us to suspect that the working edges of tools used in processing mineral materials (like ochre) get damaged after a very short time. The features of the use-wear traces present on the tools from Wólka Wojnowska indicate that they were not typical 'household goods' intensely used for a long time. They were rather occasionally used in extracting raw materials for current needs. At the same time, the dispersion of the tools (Fig. 1: 2) suggests that they were used by different people, probably in different parts of the settlement. This fact allows us to rule out an assumption that they are remains of a single workshop specialising in processing ochre. At the same time, it indicates that hematite was commonly processed in particular households and that there was considerable demand for ochre among the local society. This is confirmed, on the one hand, by the quite common use of ochre as an intentional admixture in the production of vessels by the inhabitants of the settlement, and, on the other hand, by the presence of its residues documented on the surfaces of other types of flint tools in the collection, including primarily on the "scraping" tools.

The mineral processed with the analysed tools could probably have been better (softer) than the materials used in the previously-mentioned experiments, which is indicated by a relative scarcity of use-wear traces in the form of bright polish/abrasion on the working edges of the artefacts from Wólka Wojnowska. It is possible that this type of hematite was specially selected or prepared in some other, unspecified way. So far, the location of the deposits of the raw material used is unknown.

CONCLUSIONS

The results of the traceological analyses allow us to state that the picks found at the LBK settlement in Wólka Wojnowska were used only to process hematite. The uniform shapes of the discussed artefacts, which are linked with performing similar functions, make us suspect that they were specialist tools formed in a rather standardised way to process the raw material in question. In this context, it is important to answer a question concerning the geographical as well as chronological and cultural origin and scale of this phenomenon. Suggestions – made in some older publications in Western Europe – that this type of tools should be associated with Mesolithic traditions (Newell 1970, 170) were questioned by certain scholars (Farruggia 1973, 124; Löhr *et al.* 248). What is more, ana-

lysed picks from the northern edge of the Sandomierz Upland and specimens discovered across western Lesser Poland (Bieńczyce, Mogiła and possibly Kraków-Olszanica) do not provide us with any typological and cultural link with the local Mesolithic tradition. It appears to be important that all the previously discovered picks explicitly linked with the LBK (Mogiła, Bieńczyce, Wólka Wojnowska) were found in the context of ceramic materials dated to the Želiezovce phase. The authors of previous papers paid attention to this fact (Caspar *et al.* 1989, 180). The lack of such artefacts in assemblages associated with the pre-Music note and Music note phases of the LBK appears not to be accidental or resulting from an insufficient state of research and modest character of the corpus of sources. Then, in the light of the accessible sources, should we consider the appearance of picks in LBK materials as an indication of a growing demand for ochre in the latest phase of this culture? Were these types of tools a completely new technological invention, created solely to meet these needs effectively? Were they a continuation of older forms or adaptation of other, unspecified – and so far absent from the accessible corpus of sources – traditions of the production of specialist tools used in crushing hematite? Or maybe they are just the manifestation of ad hoc reutilization of other, more massive tools, perhaps damaged as a result of earlier use (*e.g.*, mining tools)? The above-posed questions remain unanswered. Finding the answers undoubtedly requires further research, especially augmenting the corpus of sources and widening the scope of specialist analyses. Irrespective of these issues, the obtained results allow us to considerably widen the range of the functional use of picks during the Early Neolithic and definitely discard the interpretation that they were used solely to mine siliceous raw materials. These results correspond very well with previous findings on Late Mesolithic/Early Neolithic picks discovered at Dąbki, which were used for bone/horn processing (Kabaciński 2001; Winiarska-Kabacińska 2015).

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