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FIELD SURVEY AND MATERIALS

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PRELIMINARY CHARACTERIZATION OF THE PREHISTORIC MINE OF CHOCOLATE FLINT IN PORĘBA DZIERŻNA, SITE 24 (WOLBROM COMMUNE, LESSER POLAND VOIVODESHIP)

ABSTRACT

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Researches on prehistoric flint mines are currently widely developing, as they allow a deep insight into the past economy, early industry, and the network of trading routes and inter-regional contacts. In the territory of Poland and in general, Central Europe, one of the most important flint raw materials was an Upper Jurassic chert, so-called chocolate flint. In this paper are presented preliminary results of the research of chocolate flint mine in Poręba Dzierżna, site 24 (Kraków-Częstochowa Upland, southern Poland). The outcrop, and anthropogenic relief indicating the activity of prehistoric miners, were discovered in 2013. Recently excavations undertaken on the site recorded the remains of mining shafts, spoil heaps, and rich traces of workshops. The deposits of chocolate flint were previously known only in the Holy Cross Mountains, 130 km to the NE. The research undertaken has therefore a significant impact on the existing interpretations related to the extraction, use, and distribution of chocolate flint by prehistoric communities in Central Europe.

Keywords: geoarchaeology, Stone Age, raw material, Poland, Kraków-Częstochowa Upland, prehistoric communities

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1. INTRODUCTION

Several prehistoric flint mines are known so far from the hilly region of Kraków-Częstochowa Upland (Dagnan-Ginter 1974; Ginter 1974; Kozłowski *et al.* 1976; Lech 1981; Ginter 1983, 24-28; Kopacz and Pelisiak 1986; Bańdo *et al.* 1992; Sobczyk 1993; Pelisiak 2006; Kopacz 2017). The object of exploitation was there a particular type of chert raw material – so-called Polish Jura flint or Kraków flint (Polish: *krzemień jurajski* or *krzemień podkrakowski* according to Ginter and Kozłowski 1969, 18). These mines are concentrated in the southern part of the Upland, near the Ojców National Park, *e.g.* at Sąspów and Będło, in Kraków district (*e.g.* Lech 1981, 22ff; 2011), although some of them are situated in the central part of the Upland. Most of these mines have been interpreted to represent Neolithic Danubian communities (Linear Pottery Culture, Pleszów group of the Lengyel-Polgár Cultural Complex, and Malice Culture). Some much later mines, related to the manufacturing of gunflints during the 19th century, are also known, for example in Zelków and in Mników (*e.g.* Ginter and Kowalski 1964; Werra *et al.* 2019).

The region of Kraków-Częstochowa Upland has been for a long time considered as a source of the Polish Jura flint (or the Kraków flint) only. In recent years, research on silicite raw materials in this region has been very popular (*e.g.* Krajcarz *et al.* 2012; Kochman *et al.* 2020; Matyszkiewicz and Kochman 2020). As a result of this research, two other silicite raw material types was discovered, *i.e.*, the *Kraków-Częstochowa striped flint* and especially the *Kraków-Częstochowa chocolate flint* (Krajcarz *et al.* 2012, 418; Krajcarz *et al.* 2014). The discovery of previously unknown raw materials in this region, with a very good knapping quality, has provided new perspectives in terms of prehistoric flint procuring and mining in the area (Sudoł-Procyk *et al.* 2018a, 93). Detailed geological mapping and archaeological survey within the outcrops of the Kraków-Częstochowa chocolate flint in Udorka Valley resulted in further discovery of a characteristic relief, resembling prehistoric flint mines. The area has been appointed an archaeological site and registered at the Lesser Poland Voivodship Heritage Office in Kraków as Poręba Dzierżna, site 24 (Wolbrom community, Olkusz district) (Fig. 1: A, B).

The site is located in the south-western part of the Ryczów Upland, which is one of the central microregions of the Kraków-Częstochowa Upland (N 50 °26'16.78", E 19°45'37.24", at an altitude of about 355 to 372 m above the sea level). It is separated from the surrounding villages and farmlands by forested hills. The site is located on the eastern bank of so-called Udorka Valley – a valley of a small temporary stream Udorka, a tributary of Pilica.

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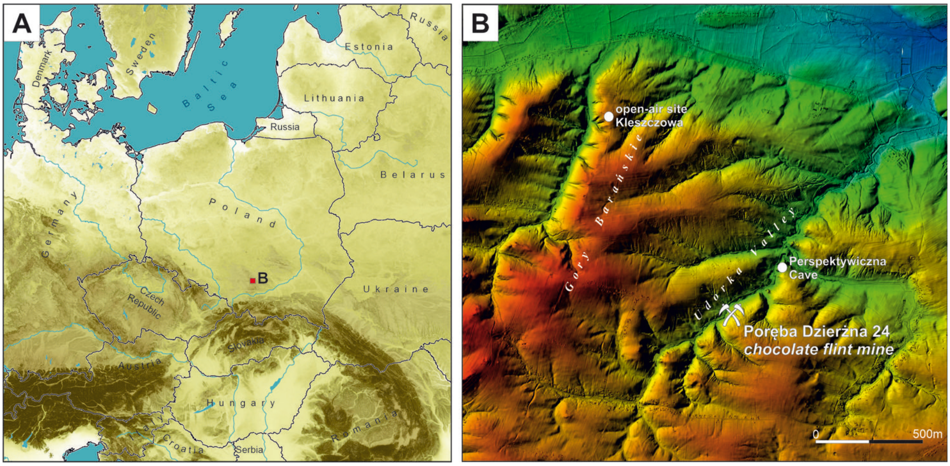

Fig. 1. Location of site 24 in Poręba Dzierżna. A – location of the Udorka Valley region on the map of Poland (drawn by M. Skrzatek, with authors' changes), B – location of the sites described in the text (drawn by M. Jakubczak and M. Szubski, with authors' changes)

In the vicinity of the site, another similar but much smaller cluster of pit-like landforms has been identified during a detailed analysis of the numerical terrain model and field surveys (Sudoł-Procyk *et al.* 2018a, 93). Similar relief was also observed in the area of striped flint deposits, located about 3 km to the west (Sudoł-Procyk and Krajcarz 2021). Future research should provide additional data about these sites.

2. HISTORY OF RESEARCH

Research on the occurrence of flint outcrops in the central part of the Kraków-Częstochowa Upland was started in 2007 by a research team composed of: Maciej T. Krajcarz, Magdalena Krajcarz, Magdalena Sudoł and Krzysztof Cyrek. During the next years, the field survey was supported by Jadwiga Wodarz, Lucjan Wodarz, Teresa Madeyska, Tadeusz Wiśniewski, and BSc and MSc students of archaeology from the Nicolaus Copernicus University in Toruń (Poland) and University of Warsaw (Poland). Initially, this work was aimed at identifying potential deposits of raw materials used for making tools found in the Biśnik Cave (Sudoł *et al.* 2016, 63). In the following years, the research area was extended to the entire Ryczów Upland. This task was executed by the detail field geological mapping of the area, with special respect given to the Jurassic silicites.

Much of the Udorka Valley is today heavily forested and cut with deep ravines, which makes it very difficult to conduct surface prospecting. Therefore, tracking the chocolate flint outcrops took several seasons, and it was only in 2013 when we succeeded to locate the deposits of this raw material (Sudoł-Procyk *et al.* 2018a, 91). During field surveys in this region, some fragments of chocolate flint were found in the currently dry stream bed. The so-called 'chert from Udórz' (Krajcarz *et al.* 2012, 415) is the dominant type of the silicite material here, and chocolate flint is an accessory material. Surfaces of flint pieces found in the stream bed bear signs of transport by water (reddish patina, smoothing, and chipping). Later, the occurrence of this raw material was also recognized in the vicinity of the valley, near the villages of Kąpiele Wielkie and Miechówka. The nodules of chocolate flint are distinguished by their regular, tabular form, and smooth homogenous silicite material without intraclasts, usually brownish in colour (Sudoł-Procyk *et al.* 2018a, 91).

Further survey in the outcrop area led to the discovery of numerous pits, certainly of anthropogenic origin and clearly resembling a prehistoric flint mine relief. Detailed archaeological survey within the field of pits revealed the remains of lithic workshops related to the initial processing of the chocolate flint raw material (Sudoł-Procyk *et al.* 2018a, 91; Krajcarz and Sudoł-Procyk 2019a, 14). The discovery of the traces of mining exploitation and the evidence of systematic processing in the adjacent flint workshops allows to classify this complex as a significant source of raw material used in the past (see Lech 1981, 7).

Further surveys and trial excavations conducted in 2018 and 2019 confirmed that the pits were indeed connected with prehistoric mining (Sudoł *et al.* 2018b; Krajcarz and Sudoł-Procyk 2019b). In 2020, an interdisciplinary research team (M. Sudoł-Procyk, D. H. Werra, M. Malak, M. T. Krajcarz) began comprehensive excavation research as a part of a five-year project funded by the Polish National Science Centre.

3. GEOLOGY AND GEOMORPHOLOGY OF THE SITE

The Udorka Valley is assymetric, with a slightly inclined left (western) slope and a steep right (eastern) slope, which is additionally undercut by the stream erosion, resulting in a 4 m up to 6 m high escarpment or cliff (Fig. 1: B). The stream is currently weak and appears only temporary, after the early spring meltout of snow and after the strongest summer thunderstorms. The stream bed is quite narrow, being only as wide as around 50-60 m near the site (Fig. 2: B). The bed comprises of at least two alluvial terraces and a narrow floodplain. Terraces are built mostly of silts, and the alluvia of floodplain and current channel are composed of limestone and chert gravel, and silts.

The mining field is situated around 4 m up to 25 m above the stream bed, right above the erosional escarpment of the Udorka stream, on a lower part of an eastern denuded slope (Fig. 2). This slope is built of well-bedded Upper Jurassic (Upper Oxfordian-Kimmeridgian) limestones with chert, covered with regolith consisting of reddish loam with weathered limestone and chert blocks, and covered with loess-like sediments. On the slope, limestones occur at least 1 m below the modern terrain surface. Only a few outcrops of these limestones are currently available and they all have extremely limited spatial

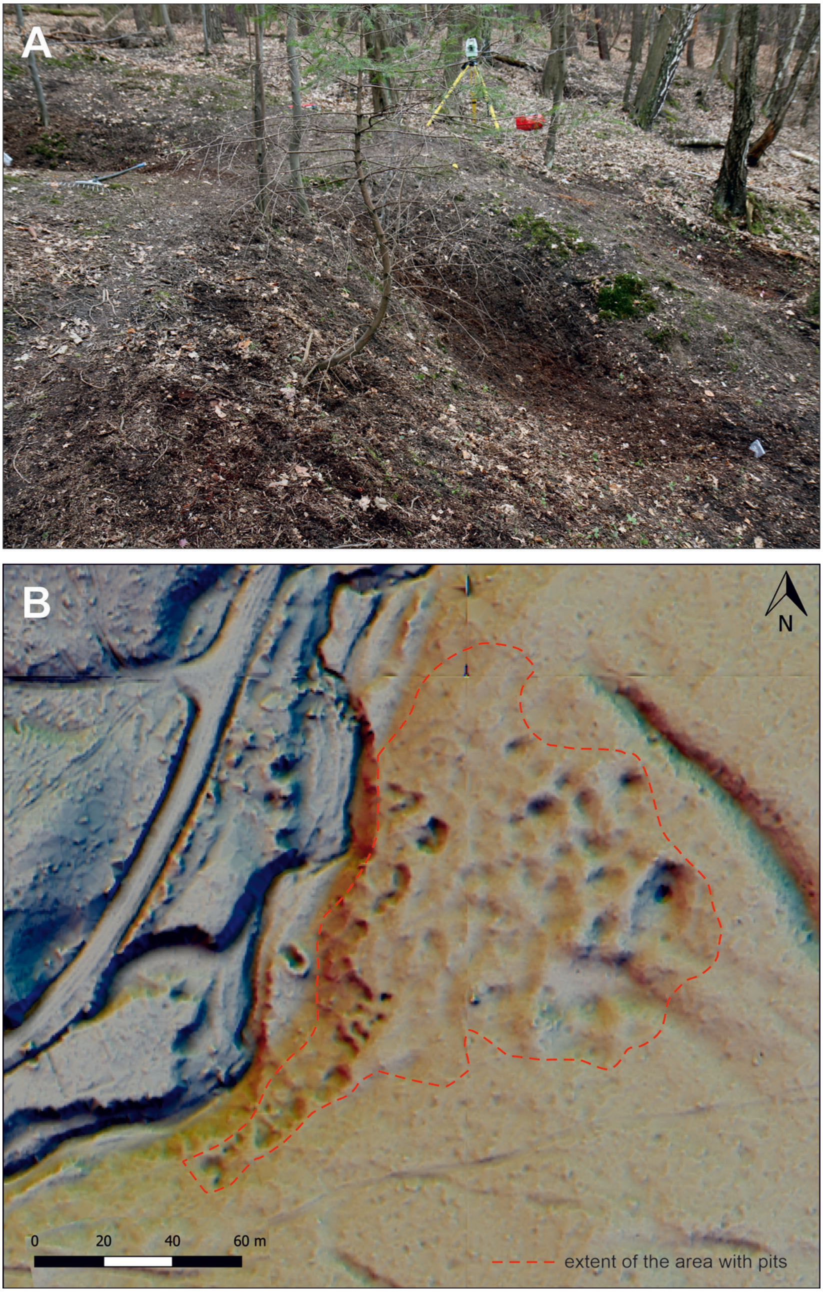

Fig. 2. Anthropogenic transformations of the terrain at the site.
A – the area of the site before excavation (photo M. Sudoł-Procyk), B – digital terrain model of the site (after Sudoł-Procyk *et al.* 2018a, with authors' changes)

range. They are uncovered at several points at the Udorka's erosional escarpment, where they form cliffs up to 2 metres high, and are also visible locally at the bottom of the stream bed. The Jurassic rocks form an anticline in the area of the site, whose crest is crossing the site, probably along WNW-ESE direction. The chocolate flint-bearing bedded limestones occur within the crest. On the limbs of this anticline, the flint-bearing limestones are covered by younger massive and talus limestones without chert.

The sources of Kraków-Częstochowa chocolate flint at the site and in its vicinities include: the limestone bedrock, the regolith, the valley's alluvia, and the colluvial fills of some gullies cutting the slope. This local variety of chocolate flint is similar to some varieties of the classic chocolate flint known from the north-eastern margin of Holy Cross Mountains (Polish: Góry Świętokrzyskie; Krukowski 1923; Schild 1976) and has the same stratigraphic position. The monoclinal structure of the Kraków-Częstochowa Upland suggests that one should expect the occurrence of chocolate flint-bearing facies along the entire eastern edge of the Upland. However, the Udorka Valley is the only spot where their occurrence has been demonstrated so far (Krajcarz *et al.* 2012, 420).

The macroscopic characteristics of the Kraków-Częstochowa chocolate flint have been presented by Krajcarz *et al.* (2012, 418) and Sudoł-Procyk *et al.* (2018a, 93). Nodules are flat with parallel upper and lower surfaces. The thickness of these nodules is 2-10 cm and their diameter ranges from several to several dozens centimetres. The cortex is thin (about 0.5-5 mm, average 1-2 mm), white, smooth but with numerous fossils and grains on the surface, clearly separated from an outside rock. Below the cortex, a several-millimetres thick white dull non-transparent zone occurs, distinctly separated from the inner silica substance. The silica mass is dark, from dark brown to yellowish brown, greyish brown, and milky white. It is fine-crystalline, dull, slightly transparent, with a fatty or pearly lustre. In some specimens, horizontal bands of coarse-crystalline silica occur inside the mass. The weathered cortex is orange. The weathered silica mass is dull, nontransparent, grey to yellowish grey or bluish grey, in some specimens striped. The knapping properties are very good. When knapped, this silicite gives a subconchoidal fracture (Krajcarz *et al.* 2012, 418).

4. THE MINING FIELD: TOPOGRAPHY AND ARCHAEOLOGY OF THE SURFACE RELIEF

The mining field is easily identifiable by its characteristic anthropogenic relief: numerous quite regular oval pits, usually surrounded by low banks of earth containing limestone blocks and sparse products of flint knapping (Fig. 2: A). Morphology and spatial relationships between these structures were analysed by airborne laser scanning (LiDAR-ALS) (Fig. 2: B; Sudoł-Procyk *et al.* 2018a, 93). Based on this, we distinguish four zones of slightly different topography (called Zones 1, 2, 3, and 4 in the further text) within the mining field (Fig. 3).

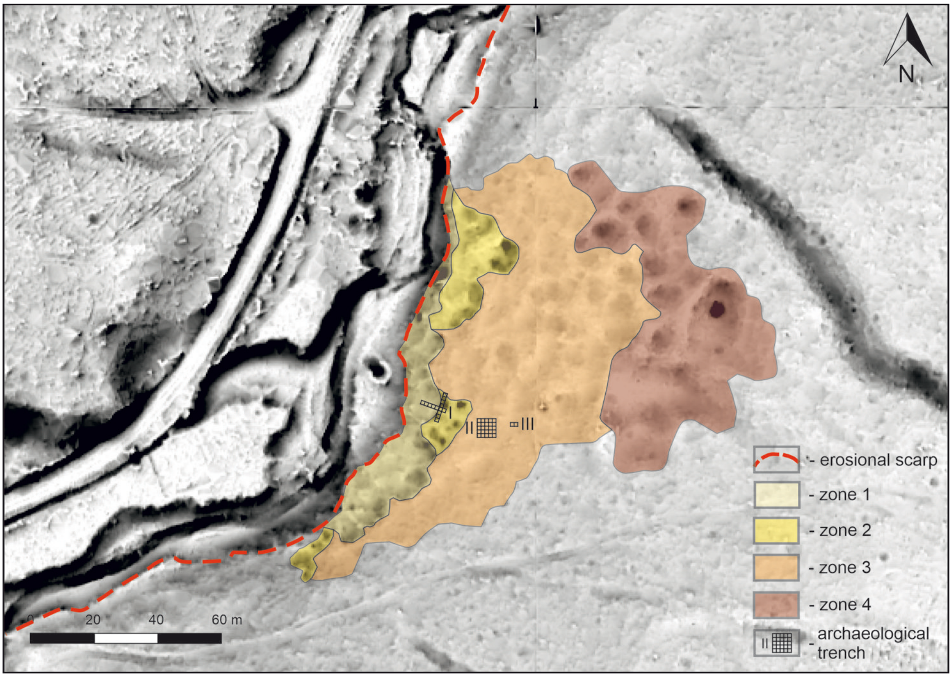

Fig. 3. Range of the site with various zones of relief and location of archaeological trenches (drawn by M. Sudoł-Procyk)

The most elevated part of the site is a vast area of relatively large pits of various depths and shapes (Zone 4 – Fig. 3). It extends for a distance of over 100 m from the valley bottom. The pits in this zone are deep and are surrounded by large and distinct spoil heaps. The largest of the pits measures 13 m by 25 m across. This is also one of the highest elevated pits. Features located lower on the slope (*i.e.*, in Zone 3 – Fig. 3) often have a diameter of only a few metres. The surface area in Zone 3 is flatter. The surface relief is so blurred that it is impossible to clearly define the number of features. Despite this, around almost every one of the identified pits the faintly marked relics of heaps can be observed. To the south of them, there is a sizeable zone of niches dug into the top part of the erosional scarp of the Udorka stream, extending over a distance of almost 100 m (Zone 1 – Fig. 3). Between Zone 1 and Zone 3, in some localized places on the slope, there are quite deep pits, but not exceeding 3 meters in diameter (Zone 2 – Fig. 3). In contrast, in Zone 1 there are many slight pits with a diameter of up to several metres that have the form of niches open towards the stream. This suggests that they were created by repeated exploitation activities. These niches are surrounded by small spoil heaps, usually with a few flint products. The heaps are typically located at the north, east and south sides of each niche, *i.e.*, are situated higher on the slope than a niche itself. The lack of distinct spoil heaps from the edge situated toward the stream may suggest that most of the waste material in this part was thrown down the escarpment into the stream, and was periodically washed away by the stream. At the lowest section of the slope, at the very edge of the stream bed, there are two large erosional niches undercutting the slope and possibly cutting off a part of Zone 1 (Fig. 2: B, Fig. 3; Sudoł-Procyk *et al.* 2018a, 94).

Detailed archaeological survey was conducted over the whole area of the chocolate flint outcrop, where the anthropogenic relief with the pits described above was identified. Only a relatively sparse amount of archaeological material came from the surface, found primarily in the depressions and niches located in the immediate vicinity of the valley edge. It was not easy to detect the archaeological material because it is covered by thick forest litter. Among the surface finds, however, natural blocks, test-flaked pieces, incipient cores, and semi-products were successfully documented. The flint is quite heavily patinated, which means that it has remained on the surface for a long time. The material exposed on the surface is associated with the knapping of the raw material with a hard hammerstone. The flint finds were accompanied by a few limestone flakes. Some of them are heavily weathered, which proves that at least some knapping activity was focused on the raw material dug from the topsoil or regolith, and not from the underlying limestone (Sudoł-Procyk *et al.* 2018a, 94).

5. STRATIGRAPHY

The excavations have so far covered two parts of the site. The first includes the steep lower section of the slope – in the Zones 1 and 2, the second is located on the more elevated and flatter section of the slope – in the Zone 3 (Fig. 3).

In the first case, in order to obtain the most accurate information about the structure of the pits, two trenches, 1 m wide, were laid out along and across the slope and intersecting at right angles (Trench No. I; Fig. 3). The excavations revealed a complex of archaeological features: step-like cuts in the regolith, a shaft dug in the limestone, and heaps of limestone blocks and limestone dust. The stratigraphy allows reconstructing the prehistoric activity as carried out by exploring the sediments of the regolith (layer 2; Fig. 4: A), usually to a depth of about 1 m. In the zone located lowest on the slope, the exploration was carried out much deeper, until reaching the flint beds within the limestone bedrock, *i.e.* to a depth of about 2 m (Fig. 4: A). The stratigraphy at this point turned out to be extremely interesting, the sediments on the slope were the remains of mining heaps and loess sediments, in which flint finds have been documented. The shaft was cutting all these deposits, and was filled with another series of colluvial sediments (layers 2a, 11a and 12a; Fig. 4: A).

Analysis of the cross-sections (Fig. 4: A) indicates that the stratigraphy of sediments and the presence of anthropogenic structures clearly differ the backfill of the pits from the

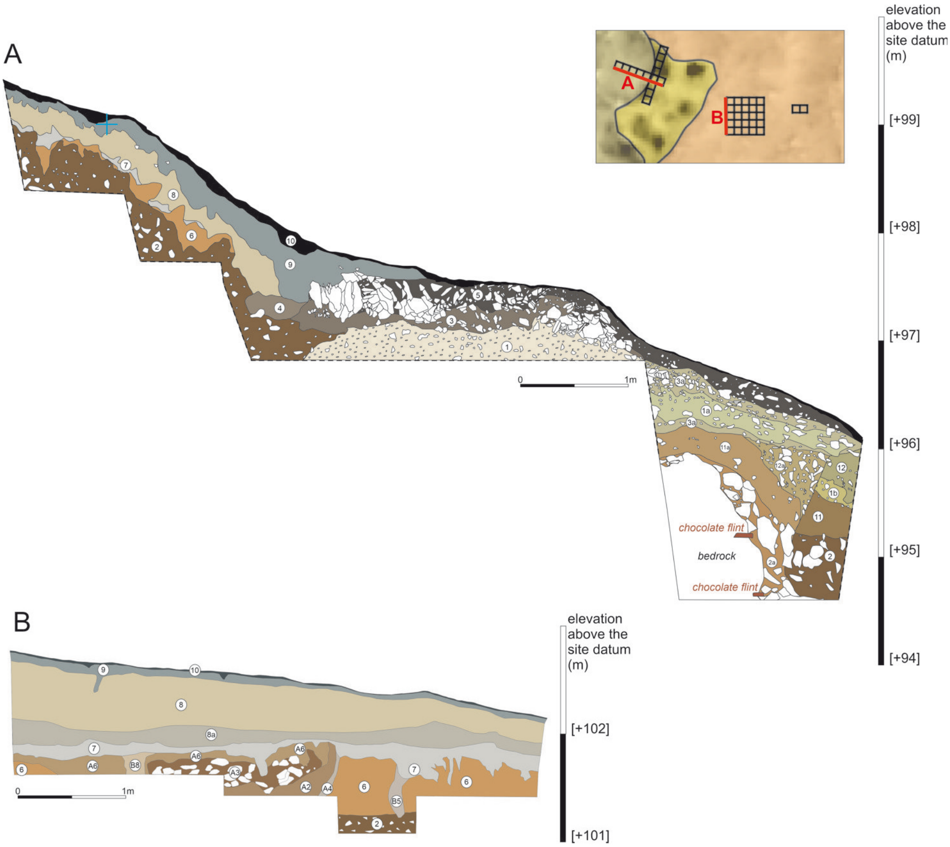

Fig. 4. Cross-section S (along the slope) in Trench No. I (A) and cross-section W in Trench No. II (B); the location of cross-sections is marked with a red line (drawn by M. Sudoł-Procyk).
Description of layers: 1 – light gray loam with large amount of weathered fine limestone debris; 1a, 1b – light gray loam with large amount of weathered fine limestone debris (re-deposited material of layer 1?); 2 – orange clay loam with a natural weathered flint concretions (a regolith); 2a – orange clay (re-deposited material of layer 2, possibly mixed with material of layer 11a); 3 – dark grayish brown loess with fine limestone debris; 4 – gray loess; 5 – black humiferous sediment with large amount of limestone stabs and limestone debris; 6 – orange loess (Bt horizon of a paleosol with single flint artifacts); 7 – whitish loess (Et horizon of a paleosol); 8 – yellowish loess (BC horizon of a modern luvisol – a layer with flint artifacts); 8a – yellowish loess similar to layer 8, darker; 9 – black humiferous silt (AE horizon of a modern luvisol, possibly partially re-deposited by colluvial processes); 10 – contemporary litter (O horizon of a modern luvisol); 11 – orange-brown silt with fine limestone debris – a layer with flint artifacts; 11a – orange-brown silt with fine and coarse limestone debris (re-deposited material of layer 11, a backfill of the pit) – single flint products; 12 – gray-brown silty sand with large amount of limestone debris; 12a – gray-brown silty sand strongly with numerous intercalations of light gray silt (similar to layer 1) with large amount of limestone debris, possibly composed of mixed material of layers 12, 3a and 1a (re-deposed layer 12?, a backfill of the pit); A2, A3, A4, A6 – a backfill of a large archaeological feature, possibly of anthropogenic and/or colluvial origin (A2 – orange clayey silt with large amount of lithics, A3 – brown loam with limestone clasts, with sparse lithics, A4 – gray silt, A6 – orange clayey silt with large amount of lithics); B5, B8 – probably backfills of small archaeological features (whitish silt, horizontally laminated, with lithics and charcoals)

Fig. 5. Archaeological feature in Trench No. II. A – flint products in situ, B – large feature, C – small features (post-holes?) (photo by T. Wiśniewski)

area outside of the pits. It seems that after their exploitation was finished, the pits were filled with pieces of limestone probably coming from nearby niches. A few flint products were registered in the fillings of these features.

The layout of sediments registered in the same cross-section in the higher parts of the slope is different (Fig. 4: A). Here, the loess-like stratum occurs (layer 8), composed of the material redeposited from the areas of the slope above. Large amount of flint finds was documented within this stratum. The cross-section taken across the slope showed the activity of erosive processes and the presence of erosional structures (rills or paleochannels) filled with colluvial loess containing flint finds that had originally been deposited on the higher parts of the slope. Several small pseudomorphs after frost wedges occur in the loess. Some flint artefacts were found within the fills of these structures. Because the frost wedges are typical periglacial structures connected to the cold climate of Pleistocene stadials, this allows to date at least a part of the flint assemblage to the Pleistocene.

Trench No. II located in the Zone 3 (Fig. 3) also showed the presence of redeposited loess sediments with a large amount of flint finds. Underneath there are preserved the remains of a semi-circular feature, with a diameter estimated to around 3 m (Fig. 4: B). The feature was filled with silty-clay stratified sediments. So far, almost 7,000 flint finds have been registered within. These are the remains of the pre-treatment of the raw material (Fig. 5: A). The feature cuts through the layers of barren loess and further the regolith. The bottom of this structure has not been reached yet, so currently we can only hypothesize that this feature is a remain of a shaft and goes deeper down through the rock to reach the flint layers. Several smaller features have been found around this large feature (Fig. 5: B). These are circular or oval pits of around 20 up to 30 cm diameter, up to 60 cm deep, backfilled with laminated silty sediment with abundant charcoal fragments. The shape and location of these features suggest that they could be post-holes (Fig. 5: C), maybe remains of a structure that served as a roof over the large feature. However, we cannot exclude at the current state of recognition that these small structures have a natural origin. From these structures, numerous charcoal samples were collected for anthracological identification and radiocarbon dating (currently still being analysed). Excavations in this area will be continued in the following seasons.

6. MINING STRATEGY

Due to the current preliminary stage of research on site 24 at Poręba Dzierżna, little can be said about the methods of work of the prehistoric miners. Observing the various relief forms visible in the terrain and based on the first results of fieldworks, we can assume that different methods of exploitation were applied depending on the distance from the valley bottom and the steepness of the slope, and most probably, also the depth of the flint stratum.

Extensive niches located in the lowest part of the site, formed in the immediate vicinity of the stream's erosional scarp, probably as a result of repeated use of small pits open towards the riverbed (Zone 1 – Fig. 3). Flint layers may have been exploited by horizontal workings or shallow open-cast mines. A similar situation was observed for example at the Neolithic mines at Rijckholt-St. Geertruid (Nederlands) and the Defensola mine (Gargano,

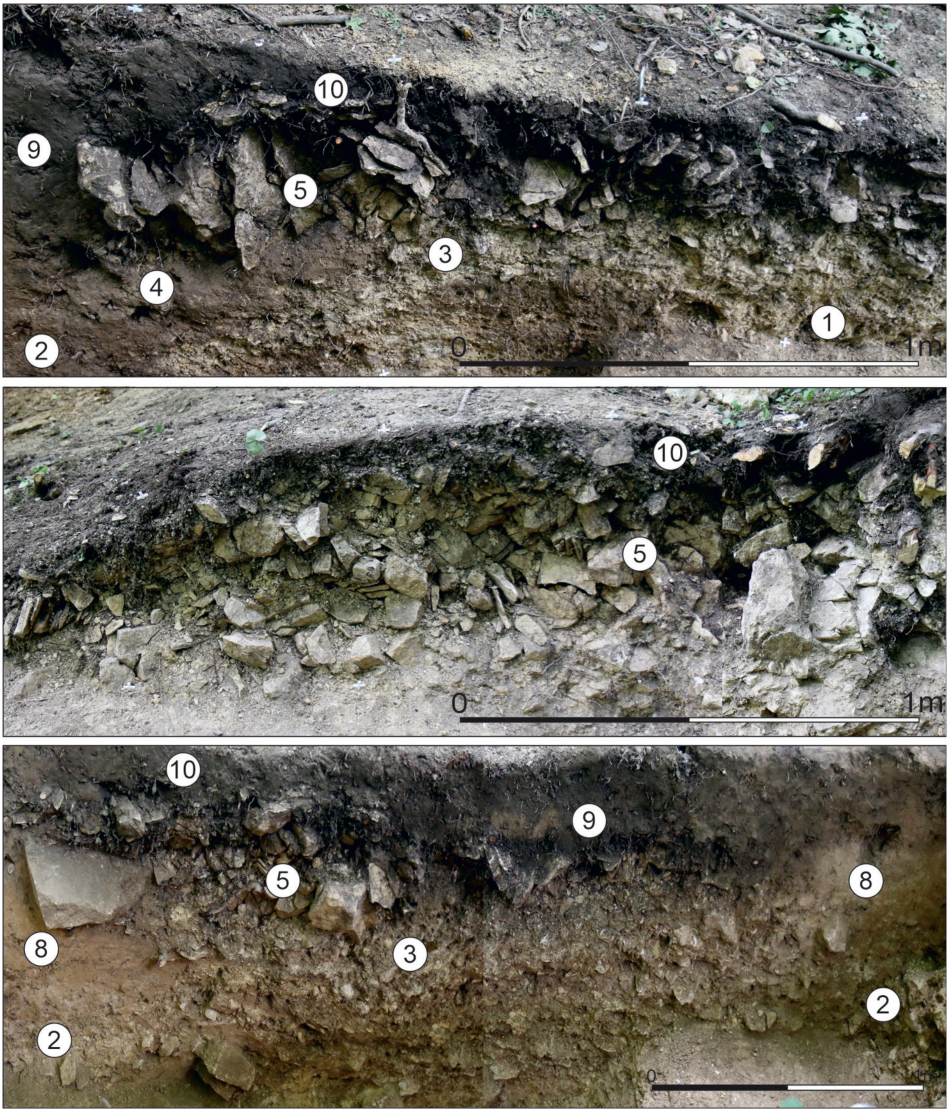

Fig. 6. Backfills of the pits (photo by M. Sudoł-Procyk); for the description of layers see Fig. 4

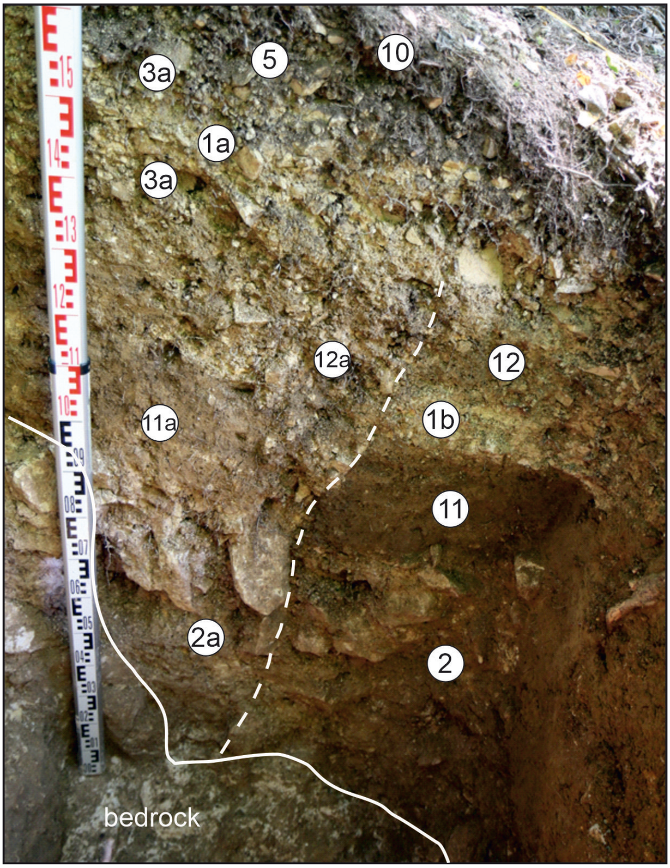

Fig. 7. The edge of a feature (a shaft?) (photo by M. Sudoł-Procyk); for the description of layers see Fig. 4

Italy; Felder *et al.* 1998, 73; Tarantini *et al.* 2016, 252, 253). This is the simplest method of raw material exploitation, apart from the simple collection of the raw material from the surface, which in the case of outcrops located on a slope should ever be expected.

In a more elevated part of the slope (Zone 2 – Fig. 3), remains of pits have been found in the Trench No. I located in the lower part of the slope. Their fillings are heterogeneous: the floor is filled with fine rock rubble with a silty sediment washed in from above, while in the upper part there are large slabby limestone blocks, with empty voids still preserved between them (Fig. 6), giving the impression of being arranged in a tile-like manner (also vertically). The limestone blocks had probably come from adjacent niches. Flint finds were only rarely found in the fillings of these features.

In the Trench No. I, it was possible to document the edge of a feature (a shaft?), the depth of which reaches 150 cm (Fig. 4: A, Fig. 7). This feature cuts through redeposited colluvial

Fig. 8. Two beds of chocolate flint visible in situ in the limestone bedrock (photo by M. Sudoł-Procyk)

sediments that are the remains of mining heaps, loess containing flint finds, and regolith with small fragments of tabular flint nodules and fragments of rock, and finally it cuts the limestone bedrock and reaches two flint layers. The exposed limestone wall is not weathered; its fresh condition and lack of a regolith, usually covering the limestones in the region, suggests that it had been exploited by prehistoric miners. Due to the small area of the archaeological excavation, little can be said about the methods and tools used in the exploitation of the raw material. Certainly, some efforts were made to keep the wall vertical, possibly in order to obtain as much raw material as possible, but maybe also due to technical purposes. No traces of tools were found on the rock walls in this place. However, observing the shape of the rock blocks that are part of the filling of the adjacent pits, we can assume with high probability that the rock was removed in the form of horizontal plate-like fragments. This exploitation continued until the desired flint deposit was achieved.

The bottom part of the excavation corresponds with two levels of the chocolate flint found *in situ* within the limestone. They are separated by about 0.5 m limestone stratum (Fig. 4: A, Fig. 8). The first (upper) level consists of small, irregular, bulky concretions, the size of which, as a rule, does not exceed 10 cm. The second (lower) level, on the other hand, is composed of large regular tabular nodules of more than 60 cm in length and 10 cm in thickness. We suspect that the lower flint level (at least in this area of the site) was the desired target of exploitation, because the shaft bottom is situated just below it. In the backfill of this feature, several triangular flint forms were found, with flake scars formed under the influence of pressure and crushing, suggesting their functional nature. They were most likely used as wedges.

Trench No. II dug in the higher parts of the slope, where the terrain slightly flattens out (Zone 3 – Fig. 3), revealed the presence of numerous cultural features under the redeposited loess colluvium. Currently, the excavations are being carried out within one of them. So far, only the uppermost parts of the fill of this feature have been explored, therefore it is not possible to clearly define its character. However, already at this stage of the research, the structures observed within it indicate that we are probably dealing with the remains of a shaft with a diameter of about 3 m.

A large amount of charcoal (under analysis) and burnt flint objects were documented in all features. Perhaps some of them may be associated with traces of the re-use of the top parts of the remains of shafts (which could have been used as a natural shelters) as the locations of the workshops (Bąbel 2014, 77).

7. CHRONOLOGY OF THE SITE

Stratigraphic premises, absolute dating (^{14}C and OSL), and techno-typological features of the flint material indicate the presence of human activity at the end of the Pleistocene and the beginning of the Holocene.

The dates obtained so far (Table 1) relate to several groups of deposits: the natural loess deposits that were dug through during prehistoric mining, the colluvial material covering the archaeological features, and the infill of an archaeological feature that was probably related to the workshop activity. The dates for the loess (GdTL-3540 and GdTL-3541, around 18-10 ky BP) indicate that mining activity happened after around 10 ky BP. The dates for the infill of the feature (Poz-124476 and GdTL-3538, around 10-9 ky BP) are probably close to the chronology of one of the activity phases at the site. The dates for the covering colluvium (GdTL-3537 and GdTL-3539, around 6-3 ky BP) suggest that the mining activity had ceased some time before around 6 ky BP.

Table 1. List of radiocarbon and OSL dates

Lab No.	Dating technique	Date	Layer	Context
GdTL-3539	OSL	3.13 ± 0.21 ky BP	8	Colluvial sediments covering the archaeological features
GdTL-3537	OSL	5.99 ± 0.36 ky BP	8	Colluvial sediments covering the archaeological features
GdTL-3538	OSL	9.07 ± 0.48 ky BP	A3/A4	Wall of the archaeological feature
Poz-124476	radiocarbon	9150 ±50 BP (uncalibrated)	A4	Wall of the archaeological feature
GdTL-3540	OSL	10.38 ± 0.62 ky BP	7	Loess cut by the archaeological feature
GdTL-3541	OSL	18.7 ± 0.11 ky BP	6	Loess cut by the archaeological feature

8. FLINT WORKING

The largest number of flint finds came from excavations located on the higher parts of the slope. The most representative structure of the flint items is provided by the assemblage from Trench No. II (Fig. 9), where 6,932 finds have been documented in an area of 21 m^2 (the depth of the Trench No. II ranged from 50 to 140 cm from the ground surface). It should be noted that about a quarter of them came from the upper group of redeposited sediments, the layer 8 (see Fig. 4: B), and the remaining ones were documented in the topmost layers of the feature. Considering that further exploration of this feature will take place in further seasons of the project, it may be expected that this number will surely increase.

The most numerous category comprises industrial waste: fragments of flakes showing even a very small amount of working (48.7%). It is a very diverse collection, containing large specimens, several centimetres and several dozen centimetres across, heavily patinated and covered with cortex, and small items, mostly unpatinated, with traces of fire.

The second largest group of artefacts consists of flakes and their fragments (Fig. 10) – these comprise 36.5% of the finds. Most (69%) are covered with cortex to a greater or lesser extent. There are 7% of fully cortical flakes, while 31% are devoid of natural surfaces. The butts of the flakes are generally large, mostly cortical or utilizing a convenient natural nodule surface. There are also visible bulbs of percussion, indicating the use of a hard hammerstone. Initial observations indicate that the prevailing form comprises irregular, massive flakes from the initial phases of the core shaping, sometimes bearing traces of part of the pre-core preparation, or part of the precore and striking platform (*i.e.* technical flakes). Smaller, more regular flakes from more advanced later stages of treatment are also encountered. A significant category of the finds (8%) is comprised of chips.

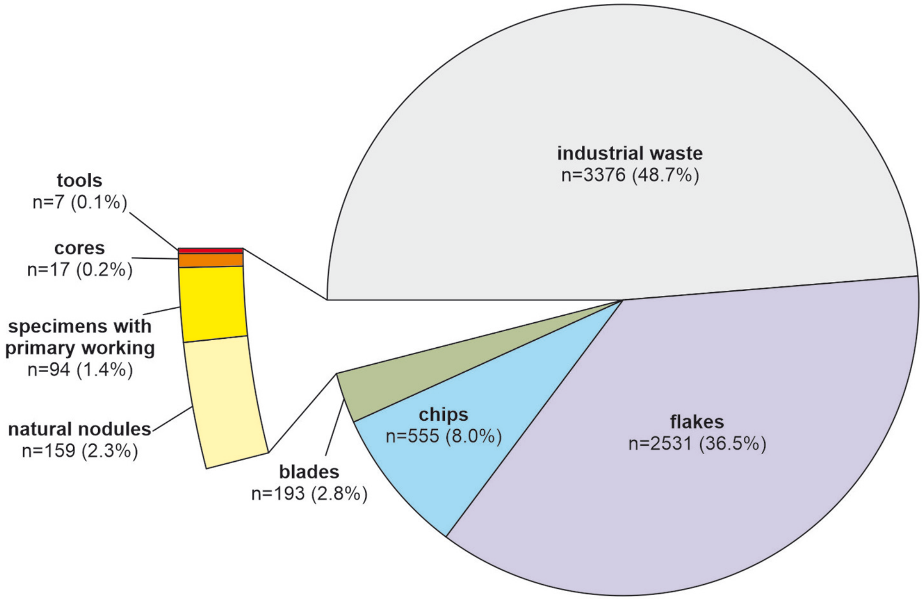

Fig. 9. Quantitative structure of flint products in Trench No. II

Natural nodule fragments (2.3%) and specimens with traces of initial working (1.4%) are present in a smaller percentage (Fig. 11). The former are mostly strongly patinated, cortical, sometimes with burn marks. Nodules with single detached flakes show similar features.

A small category are cores (Fig. 12), which consists of 17 specimens and their fragments. All of them can be included in the category of incipient cores. Three fragments derive from the distal parts of cores, and include part of the flaking surface and striking platform that are natural or prepared by a single flake.

Blades and bladelets, as well as their fragments (Fig. 13) constitute 2.8% of all the finds. There are large, regular, trapezoidal specimens, without cortex, sometimes burned. Also present are small, sometimes cortical, less regular bladelets, often triangular in cross-section. Several technical blades were also distinguished.

The least numerous group consists of tools (Fig. 14) and they comprise: an end-scraper made of a fragment of a nodule (Fig. 14: 1), a truncated blade with the truncation on the apex (Fig. 14: 2) and a burin made on a spall. Two flakes with retouched edges complete the assemblage. It is worth mentioning that also found in the trench were two flint hammerstones (Fig. 14: 3) that had been adapted from previously used cores.

Looking at the state of preservation of the finds, it is noticeable that more than half of them (57%) are covered with patina, usually to a moderate and strong degree, and more

Fig. 10. Selection of flint products: 1-6 – flakes (photo by T. Wiśniewski)

than a quarter of them (28.2%) show traces of contact with fire. As far as the degree of burning is concerned, virtually all its stages were observed: from very strong (cracked, grey or white surface; Fig. 13: 8, 10, 11), through overheating, changing the surface colour to reddish-brown, to very weak, without a clearly visible transformation of the flint structure (Fig. 10: 3; 14: 2).

The analysis of flint products is only at a preliminary stage. The percentages of the individual technological groups undoubtedly prove the existence of a mining workshop (see

Fig. 11. Selection of flint products: 1-3 – natural nodule fragments with traces of initial working (photo by T. Wiśniewski)

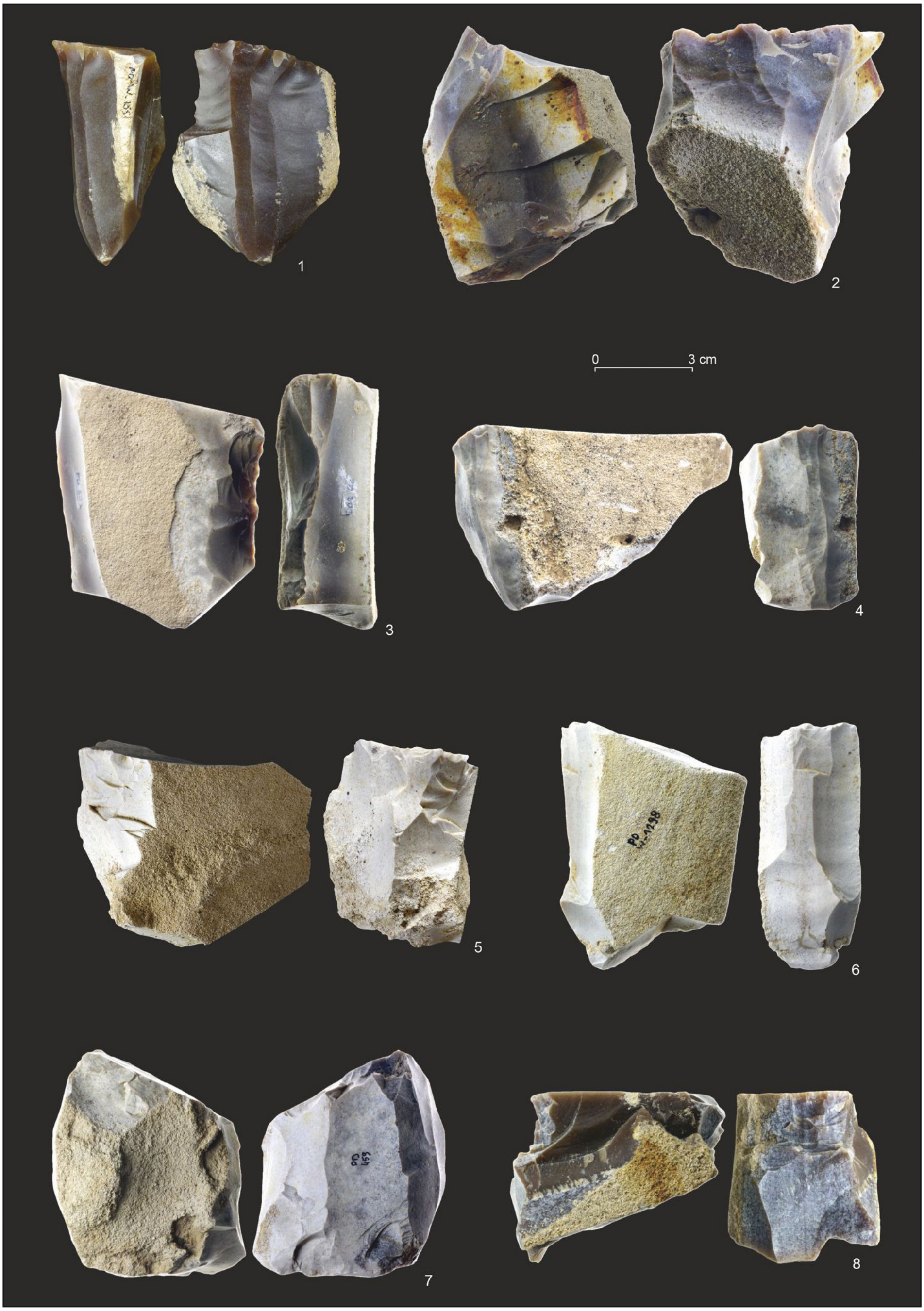

Fig. 12. Selection of flint products: 1-8 – cores (photo by T. Wiśniewski)

Fig. 13. Selection of flint products: 1-11 – blades (photo by T. Wiśniewski)

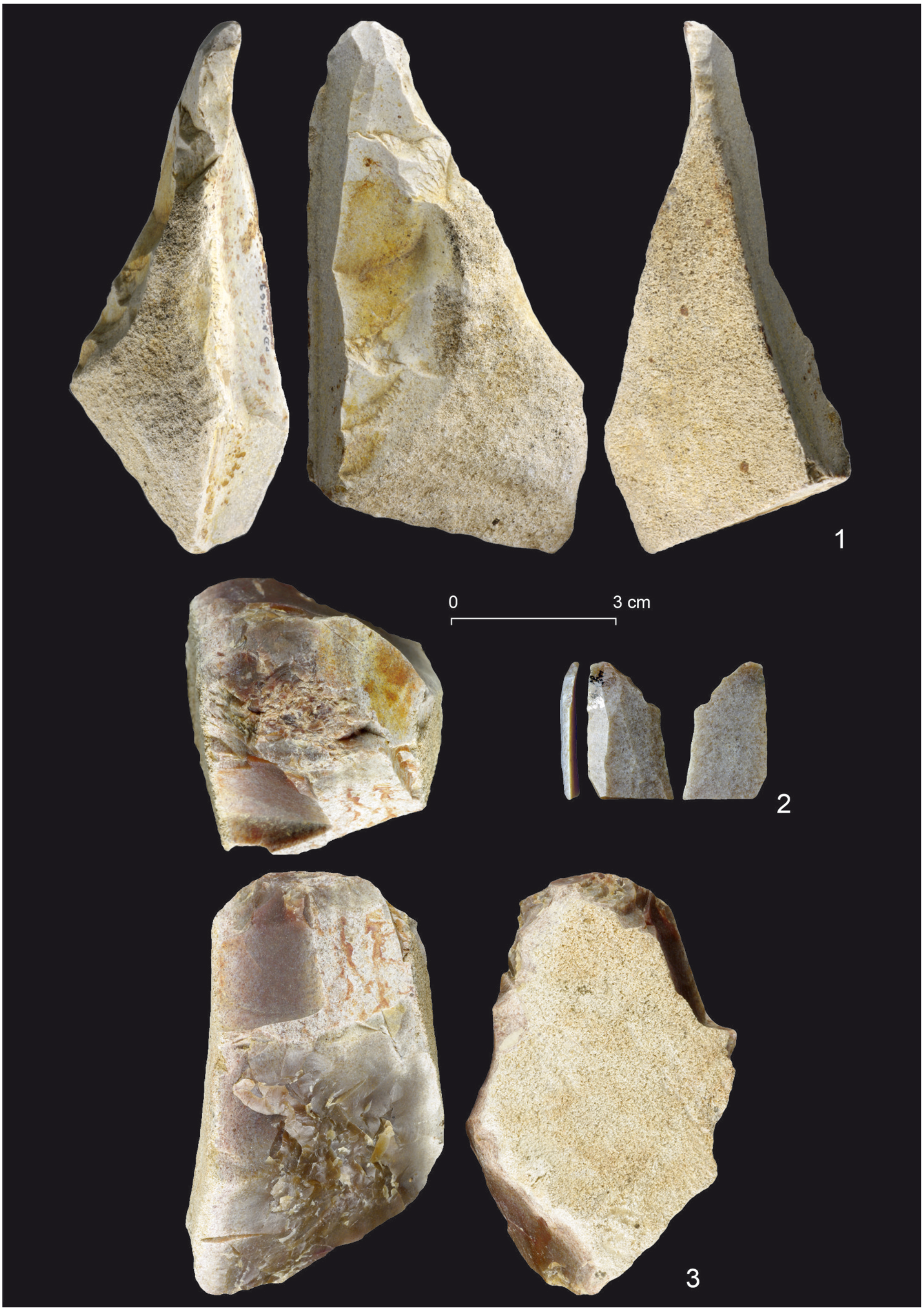

Fig. 14. Selection of flint products: 1-3 – tools (photo by T. Wiśniewski)

e.g. Dzieduszycka-Machnikowa and Lech 1976, 39; Schild *et al.* 1985, 54ff; Lech 2012, 93; Lech and Werra 2019, 94, 95). The results of the stratigraphic analysis and absolute dating indicate that we are dealing with more than one chronological episode of use of the site. More precise conclusions will be possible only after carrying out detailed planigraphic analyses of material from different cultural layers.

9. DISTRIBUTION OF FLINT PRODUCTS AND RAW MATERIAL FROM THE MINE: THE IMPORTANCE OF THE RAW MATERIAL

Chocolate flint stands out among the varieties of siliceous raw materials from Poland, both in terms of technical and visual values. Its very good quality was known and appreciated by prehistoric communities since the Middle Palaeolithic (see Ginter 1974, 9, 10, 63ff). Products made of this raw material are known from almost all regions of Poland, as well as neighbouring countries (Sudoł-Procyk 2021).

When the only known outcrops of the chocolate flint were on the north-eastern margin of the Holy Cross Mountains, earlier interpretations had assumed that all the chocolate flint that was present in the inventories of prehistoric sites from the Kraków-Częstochowa Upland was brought to the area from there. The discovery of a new chocolate flint outcrop and the site of its exploitation by mining sheds interesting light on the issues of the origin and use of this raw material by prehistoric communities, mainly those living in the immediate areas.

Traces of the use of chocolate flint coming most probably from the mines at Poręba Dzierżna site 24 are known currently from sites located up to 3 km away. The most numerous inventories, largely utilising chocolate flint, were documented in the Perspektywiczna Cave (approx. 300 m from the outcrop) and in the open-air site in Kleszczowa (about 3 km from the outcrop; Fig. 1: B; Sudoł-Procyk 2020, 294). The character of these Late Palaeolithic and Mesolithic workshop inventories confirms the knappers had a good knowledge of the raw material and its exploitation. The location of workshops in open-air and cave sites in the vicinity of the outcrops is an important evidence for the exploitation of local deposits of chocolate flint and the methods of its use.

As a result of the discovery of the chocolate flint outcrop in the Udorka Valley and the Poręba Dzierżna 24 site mine, it is necessary to determine the scale of use of this raw material by prehistoric communities. An important issue is the question of what role this newly-discovered mine played in terms of the exploration and distribution of chocolate flint in general. This is particularly important in order to understand the presence of chocolate flint in prehistoric Polish and foreign inventories. The existence of a second source raises the question of whether the raw material on any given site came from the Holy Cross Mountains or Kraków-Częstochowa Upland regions may put the issue of distribution of this raw material in a completely new light (Sudoł-Procyk and Krajcarz 2021). Until methods are developed to distinguish chocolate flint from these two regions, it will be difficult to indicate what the real distribution range of this raw material. Further research should provide answers to these questions.

10. CONCLUSIONS

Chocolate flint was one of the most important raw materials used by prehistoric communities from the Paleolithic through to the Late Bronze Age times in Central Europe. It has been identified at archaeological sites in Poland (almost all over the country), Belarus, Latvia, Lithuania, Ukraine, Czechia, Slovakia, Hungary, and Austria. Its prehistoric procurement was well recognized in archaeology for the Holy Cross Mountains region, but we prove that it was also known and exploited by prehistoric societies in another region, namely central part of the Kraków-Częstochowa Upland.

The newly-discovered chocolate flint deposit, which was exploited by mining and connected with further processing of the raw material at the spot, is the first site of this type in the Kraków-Częstochowa Upland. The flint mine in Poręba Dzierżna changes our knowledge of the prehistoric network of chocolate flint procurement and distribution at the end of the Pleistocene and at the beginning of the Holocene.

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