

KEEP IT OR DISCARD IT?

Why the Neanderthals made tools from some rocks

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Abstract: The adjustability of stone processing techniques to the kind and quality of accessible stone raw materials is an important factor of Middle Palaeolithic stone tool production. Middle Palaeolithic people mostly exploited local rocks, preferably of good quality, and yet in some sites, even located in flint-rich areas (like the Obłazowa Cave site discussed in the text), Neanderthals used rocks they found elsewhere, alongside locally sourced but quite unusual raw materials. These are rocks that are likely to crack or that are very soft, unsuitable for knapping and for later use as tools. The question that arises is, to what end were these rocks even processed? In the paper, the typological character of those artefacts, prepared from a variety of raw material (high-quality foreign rocks and low-quality local ones), and their place in the *chaîne opératoire* will be discussed.

Studying the subject of Neanderthal raw materials use has brought us a better and fuller understanding of the past land-use patterns, foundations of raw material economics and in some cases, a better understanding of the connection between the land-use and seasonal change of the subsistence strategy. Analysing the strategies for the procurement of knappable rocks, together with the techno-typological research, provides an insight into the logic of Neanderthal economy.

The above holds true as long as the rock type is relevant in some way to the form and technique implemented in the production process. It is widely acknowledged that in most cases, Neanderthal communities based their raw material economy on local rocks. Local extraction of raw materials, or hauling good-quality fine-grained raw material into sites located in areas with poor supply of rocks is understandable. Similarly comprehensible is the local use of low-quality rocks in the face of no other raw material sources in close proximity of the archaeological site.

However, in archaeological records, there are exceptions to this seemingly logical behavior. Examples include the processing of low-quality stones alongside (or instead of) local fine-grained rocks (e.g. Márquez *et al.* 2013); long-distance transport of low-quality rocks; transport of unprocessed or seemingly unprocessable (i.e. too small or extensively cracked) pieces of raw material to the site. Transporting rocks across distances that in some cases exceed 100 km, although not unique (Cieřla 2018; Féblot-Augustins 1993; 1999; Turq *et al.* 2017; Valde-Nowak/Cieřla 2020, etc.), must therefore be considered at least unusual. This article aims to present those unusual situations on an example of the Obłazowa Cave archaeological site. It is a case study of the site inventories. In the cave located in a flint-rich area, Neanderthals exploited some poor-quality rocks. Also, some stones from a very distant transport (like obsidian) can be found, in the form of microlithic artefacts, among them tools.

When attempting an explanation of these phenomena, raw material provisioning options should be taken into account. This concerns both local raw material available for exploitation by Neanderthals and transport possibilities on a regional scale.

Additionally, as shown by several studies, we should take into account the possibilities and necessity for stone artefacts recycling (Vaquero *et al.* 2015), or instances of ramification (branched production or cores-on-flakes as a pre-planned element of production process; Mathias/Bourguignon 2020; Romagnoli *et al.* 2018); these phenomena can also factor in the pre- and postdepositional character of an archaeological deposit.

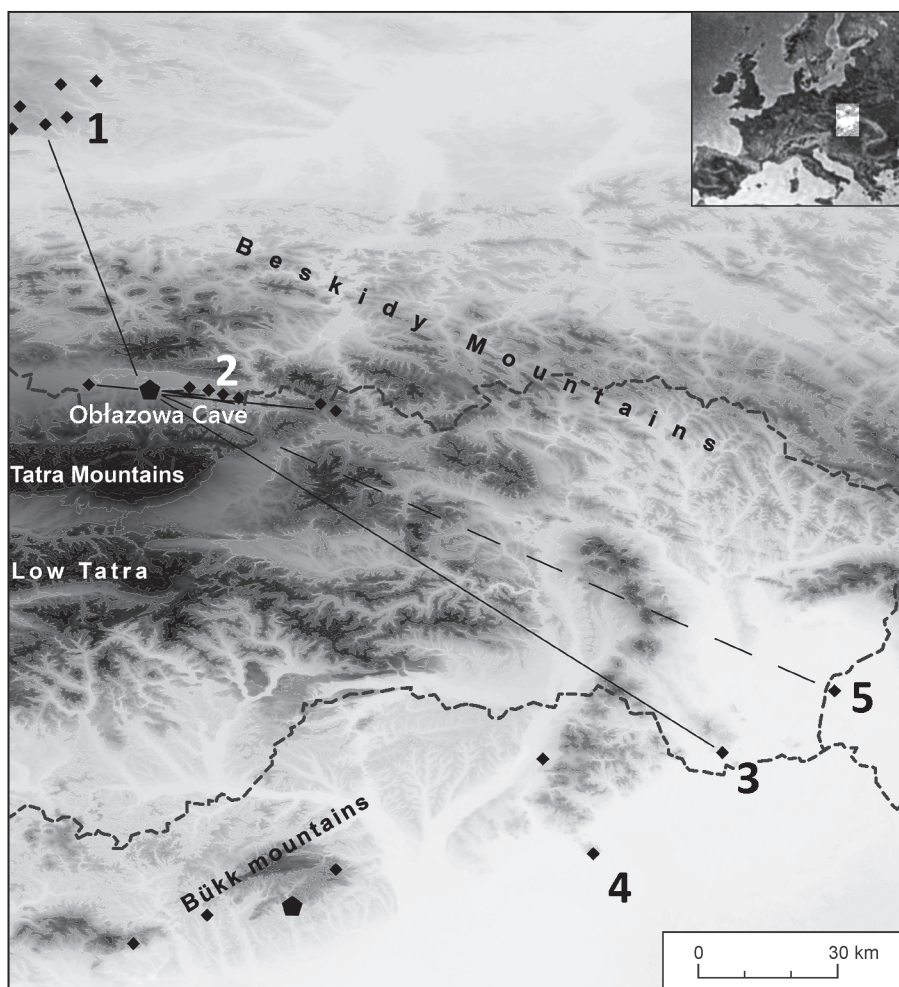


Fig. 1. Carpathian stone raw materials. Materials exploited at the site of Oblazowa Cave. 1 – Kraków Jurassic flint; 2 – Pieniny radiolarite; 3, 4 – Slovak obsidian; 5 – possible location of the sources of silicified sandstone from layer XIII (drawing by M. Cieśła).

OBŁAZOWA CAVE SITE, RAW MATERIAL BASE AND MIDDLE PALAEOOLITHIC ARCHAEOLOGICAL RECORD

The archaeological site of Oblazowa Cave, located in Southern Poland, in the highland plateau of Eastern Podhale (or, more precisely, on the border of this plateau and the Pieniny mountain range), has yielded numerous finds connected with Middle, Upper and Late Palaeolithic. The richest series of artefacts come from the Neanderthal layers. In the latest excavations, the overall number of Middle Palaeolithic artefacts from the site has reached several thousand pieces.

The site is located in a zone with outcrops of local silica rock, a fine-quality Carpathian radiolarite. The outcrops of this raw material are known primarily from limestone geological formations of the Pieniny Klippen Belt and also from Tatra Mountains (*Sujkowski 1932*) but that fact alone does not answer the question of the radiolarite provenience in the Oblazowa Cave. Nowadays, good-quality radiolarites can be found at a distance of 7 km from the site, in the riverbed of a small stream called Branisko. Some lower-quality radiolarites can be found closer to the site, but their use was not extensive, or at least, it is not documented at the site.

In close vicinity of the site (ca. 100 m), the Białka River flows. Its bed is made of pebbles, cobbles and boulders of various rock types, mostly granites. Some water-formed sedimentary rocks, such as sandstones, brought by the watercourse from the flysch zone of the Magura Spiska range can be found

there. Initially, the river flowed through the cave itself, leaving inside a thick deposit of sands, gravels and river cobbles (Valde-Nowak/Nadachowski/Madeyska 2003). With the developing erosion of the riverbed, at the time of the Neanderthals' first settlement at the site the river had already changed its course and flowed beside the cave.

As can be seen, good-quality raw material was relatively easily accessible from the site, and low-quality rocks could be found in direct proximity of the cave (Fig. 1).

The local raw material used at the site constitutes a large majority of all the Neanderthal occupation levels in the cave (Table 1), which coincides with the standard of Neanderthal sites from central Europe. Although this holds true for all of the MP inventories, in a number of them some rather exotic rocks were also found. As already discussed in previous articles (Cieřła 2018; Valde-Nowak/Cieřła 2020), the presence of such raw materials probably reflects the range of Neanderthal mobility or at least the range of their familiarity with neighbouring lands. The currently known trails of raw material transportation show that the Obłazowa Cave Neanderthals knew and used rocks from the borders of the Hungarian Plain as well as those from the Kraków-Częstochowa Upland. Although it seems clear that the site witnessed an increased mobility of Neanderthal groups towards the end of Middle Palaeolithic, and the archaeological records could likely support a hypothesis of a Carpathians crossing in late Middle Palaeolithic (in some of the archaeological levels, raw material from both south and north of the mountain range can be found; Cieřła 2018), the majority of preserved raw material is nevertheless of local provenience.

MATERIALS AND METHODS

The material studied for this paper was the Middle Palaeolithic inventory of stone artefacts discovered at the site of the Obłazowa Cave. The artefacts discussed include specimens found *in situ*, in a clearly defined stratigraphic position. They belong to various archaeological units connected with the Obłazowa Cave Middle Palaeolithic series: layers XXb, XIX, XVIIIb, XVII, XVI, XVb or XIII (listed here in chronological order, starting with the oldest; see Alex *et al.* 2017; Valde-Nowak/Nadachowski/Madeyska 2003).

The radiocarbon dates obtained for the site suggest a late chronology of its Middle Palaeolithic inventories – they can be positioned at the beginning of MIS 3 (Alex *et al.* 2017).

The current analysis only includes material excavated before the year 2018, and therefore the statistics presented in this article (see Table 1–3) may change in the years to come, when new material will have been excavated and analysed.

The use-wear analysis of the Middle Palaeolithic artefacts from the site has proved inconclusive in distinguishing between intentional and unintentional changes to the artefacts surface (Valde-Nowak/Nadachowski/Madeyska 2003). As a result, the distinction between intentional and unintentional modifications of stone implements was based on their macroscopic overview, in some cases aided by use of an optical microscope.

Additionally, the subject of manuports was approached with special care. Since sandstone pebbles could have occurred at the site naturally as a water sediment, only pieces with evident traces of processing were considered in this work. Several limestone flakes that were documented during the excavations were also ignored in this compilation, as the intentional character of their presence inside a limestone cave cannot be confirmed beyond reasonable doubt.

ANALYSIS

In all of the archaeological units in this time frame, local raw material dominates. Some 98% of all of the artefacts from the Neanderthal layers were made of radiolarite (Table 1).

Although their number is relatively low, the artefacts made of different rock types form an interesting collection.

Obsidian artefacts can be found in the older set of layers from Obłazowa (layers XIX, XVIIIb and XVII), in the form of small flakes and chips (in most cases less than 1 cm in diameter). In comparison with the overall number of artefacts, they are fairly insignificant (see Table 1; 2).

Table 1. Obłazowa Cave. Raw materials in MP layers. Legend: R – radiolarite; Q – quartz; QZ – quartzite; G – granite; F – flint; O – obsidian; C – conglomerate; S – sandstone; HS – hornstone; L – limestone; UR – undetermined rock; SSA – undetermined silicified sandstone.

Layer		R	Q	QZ	G	F	O	C	S	HS	L	UR	SSA
XXb	Tools	39	–	1	–	–	–	–	–	–	–	–	–
	Unretouched forms	124	1	1	–	–	–	–	–	–	–	–	–
	Cores	5	–	–	–	–	–	–	–	–	–	–	–
XIX	Tools	314	–	–	–	–	4	–	–	–	–	–	–
	Unretouched forms	1957	1	7	–	1	19	–	–	2	–	3	–
	Cores	34	–	–	–	–	–	–	–	–	–	–	–
	Other	1	–	–	1	–	–	1	4	–	2	–	–
XVIIIb	Tools	34	–	–	–	–	–	–	–	–	–	–	–
	Unretouched forms	109	–	–	–	–	1	–	–	–	–	1	–
	Cores	6	–	–	–	–	–	–	–	–	–	–	–
XVII	Tools	53	–	–	–	–	–	–	–	–	–	–	–
	Unretouched forms	173	–	3	–	–	2	–	–	–	1	–	–
	Cores	3	–	1	–	–	–	–	–	–	–	–	–
	Other	–	–	1	–	–	–	–	–	–	–	–	–
XVI	Tools	4	–	–	–	–	–	–	–	–	–	–	–
	Unretouched forms	53	–	1	–	–	–	–	2	–	–	–	–
	Cores	3	–	–	–	–	–	–	1	–	–	–	–
XVb	Tools	35	–	1	–	1	–	–	–	–	–	–	–
	Unretouched forms	98	–	1	–	4	–	–	–	–	1	–	–
	Cores	4	–	–	–	–	–	–	–	–	–	–	–
XIII	Tools	16	–	1	–	3	–	–	–	–	–	–	1
	Unretouched forms	139	–	–	–	2	–	–	–	–	1	–	2
	Cores	2	–	–	–	–	–	–	–	–	–	–	–
	Other	–	–	–	–	–	–	–	4	–	–	–	–

Table 2. Obsidian in Obłazowa Cave. Number of artefacts and their weight per layer.

Number of layer	XIX	XIX: Obsidian	XVIIIb	XVIIIb: Obsidian	XVII	XVII: Obsidian
Number of pieces	2352	23	151	1	237	2
Weight (g)	14845.5	32	1574	0.2	1299.6	10.2

The largest collection so far comes from the layer XIX (Fig. 2), which is the level that supposedly can be interpreted as a palimpsest of several Neanderthal visits to the site¹.

The character of most obsidian artefacts, as described below, is similar in the inventories from all of the archaeological layers: they are small and in many cases visibly damaged. Although the postdepositional abrasion of pieces has to be considered as an important factor, it also needs to be emphasised that the abrasive processes did not seriously alter the form and size of artefacts. The intentional character of the average of 70% of outer surfaces is clearly visible in their form – they show all the traits of intentionally prepared negatives. What is more, in the cases where the dorsal side of a flake is well preserved, the width of earlier flake negatives varies between 0.6 cm to 1 cm. All this suggests that the artefact size does not result only from destructive postdepositional processes, but mostly from intentional actions of their makers.

¹ In case of the discussed site the sedimentation rate in the beginning of MIS 3, when most of the inventories were formed was rather high. The thickness of MP-connected sediment reaches approx. 1.5 m, while the radiocarbon dates for most of the inventories are similar (see ex. *Alex et al. 2017; Valde-Nowak/Nadachowski/Madeyska 2003*). Also, in layer XIX there are visible dissimilarities in the state of preservation of different artefacts, there are no (or close to none) refittings, and the saturation of artefacts in layer XIX is unusually high: sometimes the number of artefacts is larger than the amount of sediment. All this points at the probability of the layer being a palimpsest of different occupation episodes.

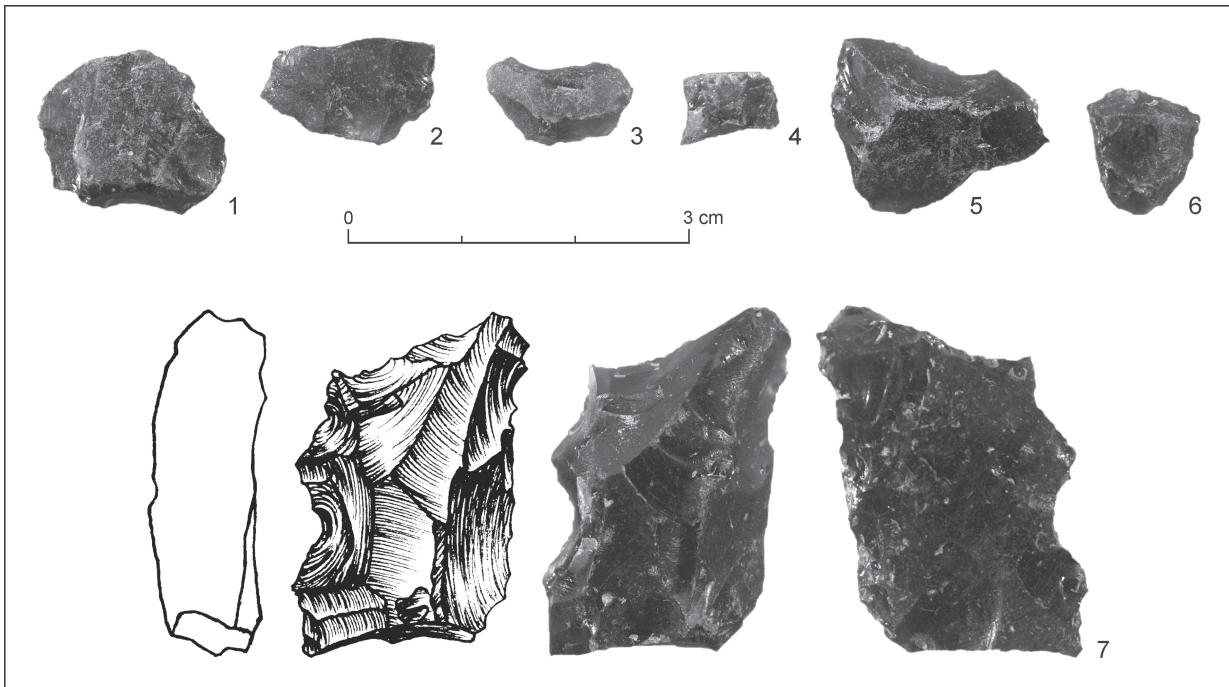


Fig. 2. Obłazowa Cave, layer XIX. Selection of Middle Palaeolithic obsidian artefacts (photo by M. Cieśla).

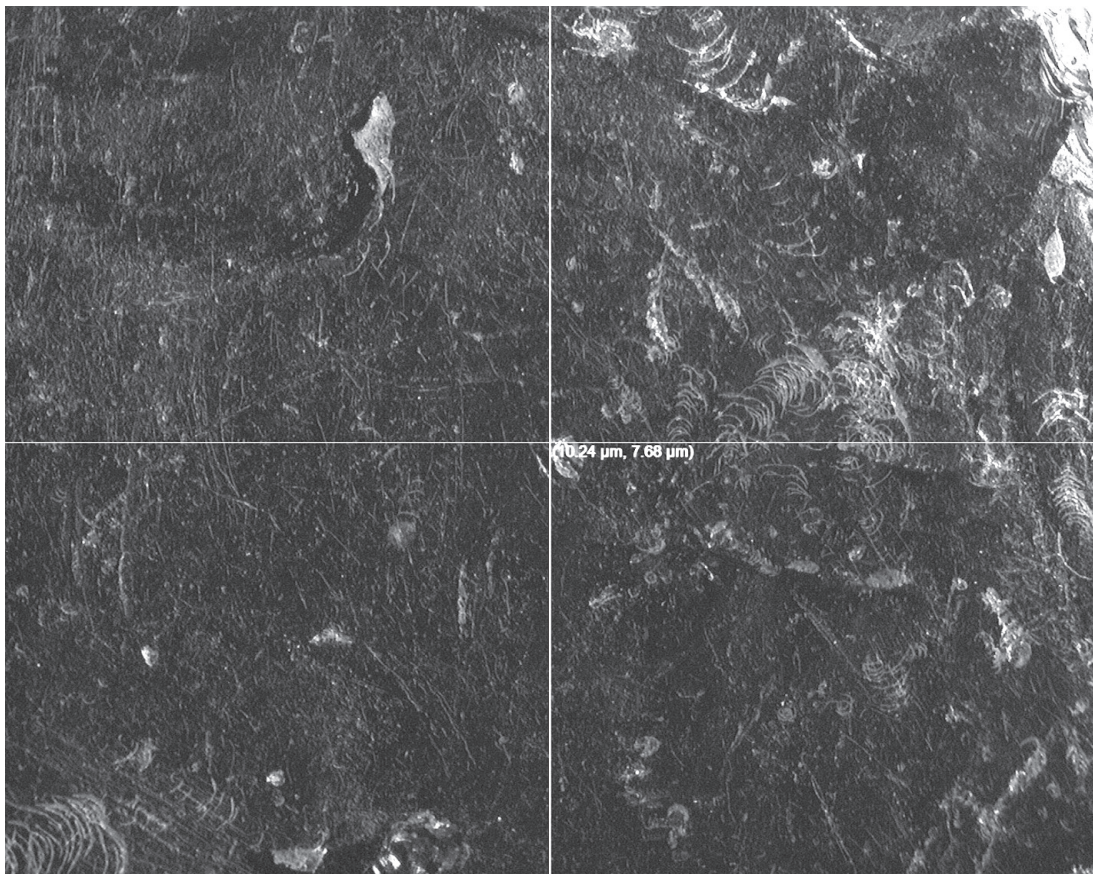


Fig. 3. Obłazowa Cave, layer XIX. View of obsidian artefact surface abrasion (photo by M. Cieśla).

Table 3. Jurassic flint in Obłazowa Cave. Number of artefacts and their weight per layer.

Number of layer	XIX	XIX: Jurassic flint	XVB	XVB: Jurassic flint	XIII	XIII: Jurassic flint
Number of pieces	2352	1	145	5	171	5
Weight (g)	14845	18	772	34.2	657.6	4.2

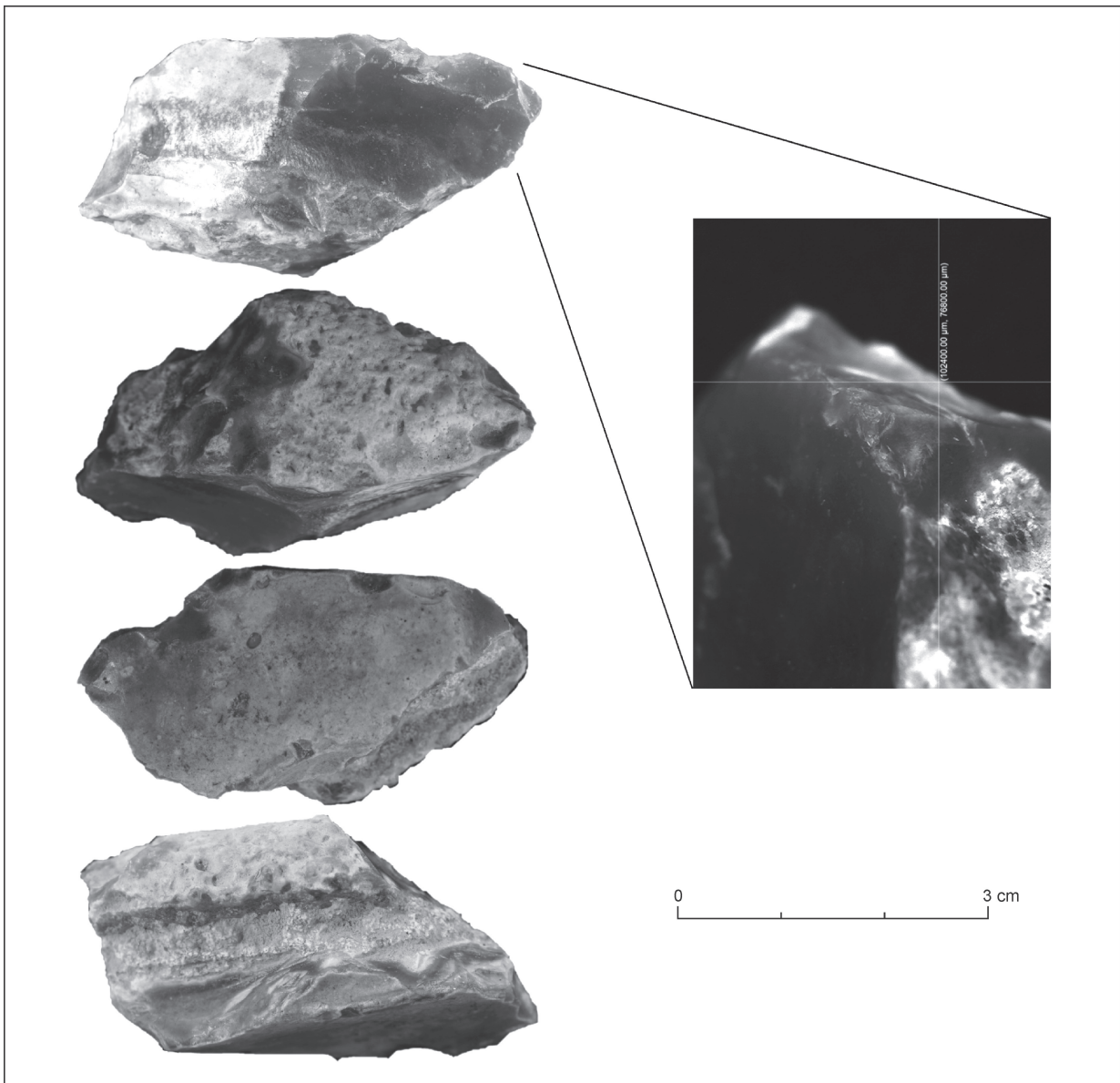


Fig. 4. Obłazowa Cave, layer XIX. Artefact made of Kraków Jurassic flint (photo by M. Cieśla).

The outer surface of the specimens is visibly abraded (Fig. 3), unlike the surface of the radiolarite or flint artefacts. On average, obsidian in archaeological contexts is considered as more brittle and prone to damage than other knappable rocks (Dobosi 2011). It reaches only 5 to 5.5 points on Mohs scale of hardness, as compared with good-quality silicites and quartz reaching 7 points (Brandl 2014; 2016).

The majority of flint artefacts can be found in the context of the youngest Middle Palaeolithic layers at the site: XVb and XIII (Table 1; 3). The only exception to this chronological rule is a chunk of a Kraków Jurassic type flint found as an element of a layer XIX (Fig. 4).

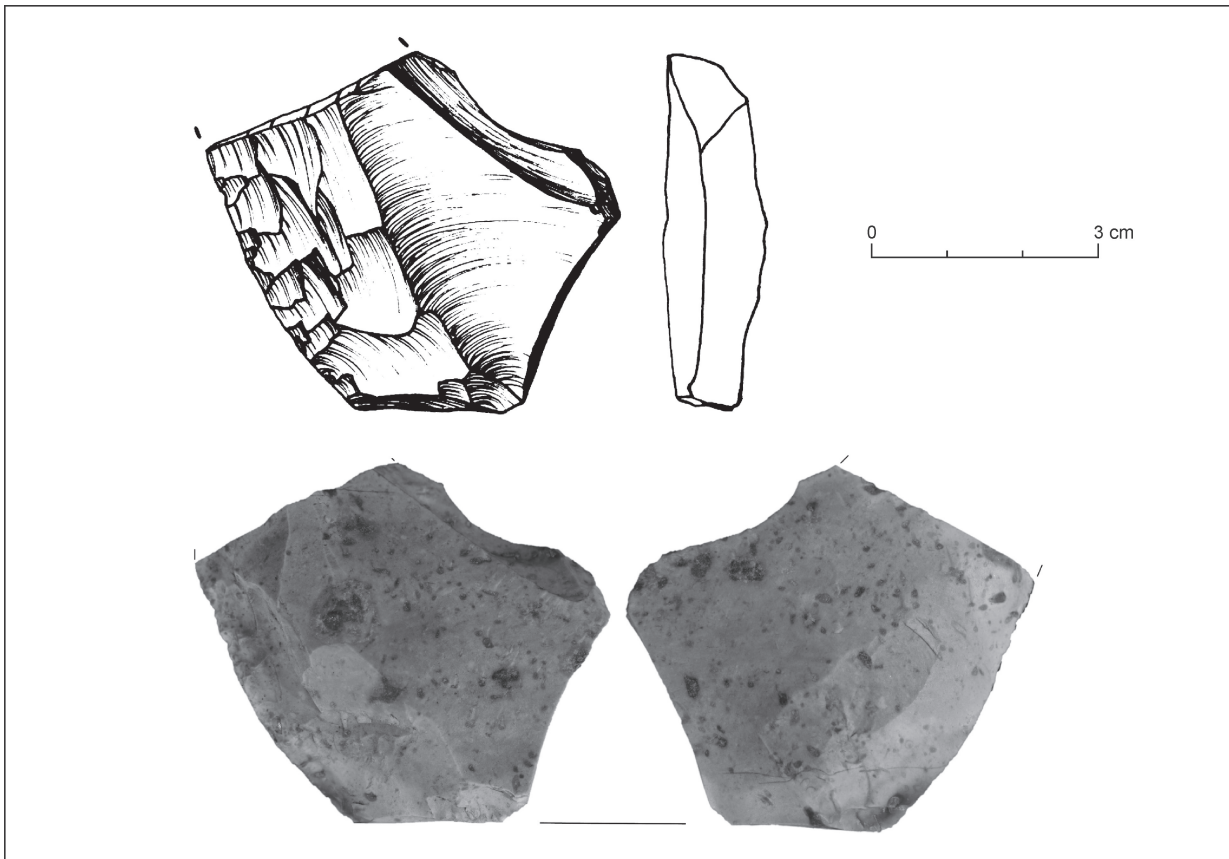


Fig. 5. Obłazowa Cave, layer XVb. Artefact made of Kraków Jurassic flint (drawing and photo by M. Cieśla).

Mostly, flint artefacts are small flakes or chips and chunks. The exception to this rule are a middle sized (4.7 x 2.3 cm) chunk of flint from layer XIX and a broken sidescraper from layer XVb (Fig. 5).

In most cases, no macroscopically visible damage could be observed on the surface of the artefacts and all intentional negatives are completely preserved. The breakage of the sidescraper from layer XVb could be pre-depositional in character (so far, no other part of this specimen was discovered).

The analysis of the flint artefact from layer XIX (Fig. 4) is more challenging. The outer surfaces of the specimen are intensively polished. The macroscopically visible polishing can also be spotted on the surface of the negatives on the edge of the artefact (where it is less intensive). Both types of polishing (more and less intensive) could be resulting from the rubbing of the sediment on the surface of a deposited artefact, which was already mentioned for the discussed site (use-wear analysis, as described by *Valde-Nowak/Nadachowski/Madeyska 2003, 73*). However, it has to be emphasised that the typical polish of flints from the site is less intensive; it usually fits what can be seen in the negatives of described specimen, therefore the polishing of all its other surfaces most probably originates from the phase before its deposition.

Sandstone use at the site is limited to one layer only, XVb. In some other layers, natural sandstone pebbles occur, but as they do not show any traces of intentional processing, they will not be discussed here.

The two sandstone specimens with visible intentional negatives on their surface are middle-sized sandstone plate and pebble (Fig. 6). The plate (Fig. 6: 2) has only one negative and its intentional character is questionable. The other artefact, however, was processed with several uni-directional strokes, forming a clear flaking platform on one side (Fig. 6: 1).

A double sidescraper (*limace*) of undetermined rock type (Fig. 7) was found in the youngest Middle Palaeolithic layer of the site (layer XIII). The raw material is most probably not a local one; however, there is no consensus as to the geographic attribution of its outcrops. It is most likely some kind of highly silicified sandstone, similar to that which can be found in Transcarpathian Ukraine

(Rácz 2013, 133, 134, 144), in the distance of approximately 180 km as the crow flies from the Obłazowa Cave. Although there can be no certainty as to the location of its sources, the character of the artefact suggests that it might have been brought in from a considerable distance. The intensively retouched edges and slightly rounded arrises between some of the negatives on the dorsal side point to a prolonged use and probably to the transport of the specimen. Additionally, despite its fine quality, this kind of rock does not appear in any other assemblage at the site. In layer XIII, where it was found, it is accompanied by three small chips made of the same material (which do not refit with this specimen). Finally, the form of the artefact should be considered of vital importance – *limace* scrapers are not a common feature in Eastern Central European Middle Palaeolithic inventories.

DISCUSSION

The examples listed above seem disjointed but they are all parts of a group of non-typical artefacts among Middle Palaeolithic materials of the Obłazowa Cave.

In the case of obsidian, its use in Middle Palaeolithic is well described, at least in Hungarian archaeological sites (e.g. Biró 1984; Biró/Dobosi 1991; Biró/Dobosi/Schléder 2000). The exotic character of this rock in the context of Obłazowa (minimal transport distance: 140 km as the crow flies; Fig. 1) is combined with its relative popularity at this site (expressed in its repeated occurrence in subsequent chronological units rather than the quantity of artefacts). There are several possible explanations for the presence of this raw material at the site.

The physical characteristics of this stone type (i.e. lack of fissures or internal cracks, homogeneity) suggest that it could have been treated as a supply of fine-quality raw material for long distance journeys. Some smaller chips can supposedly be interpreted as remains of “missing artefacts” – larger tools retouched on-site and then transported off-site (as proposed by Neruda/Kaminská 2015). This

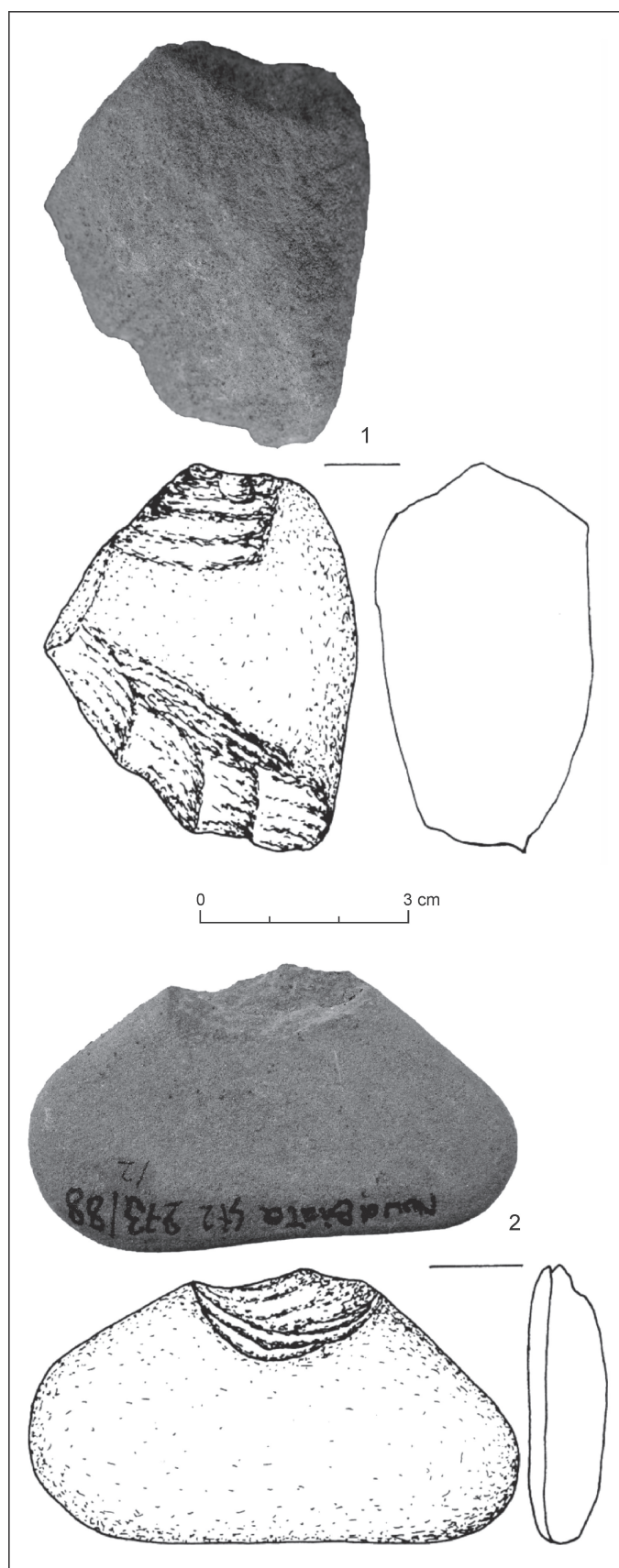


Fig. 6. Obłazowa Cave, layer XVb. Artefact made of local sandstone (drawing by E. Osipowa, photo by M. Cieśła).

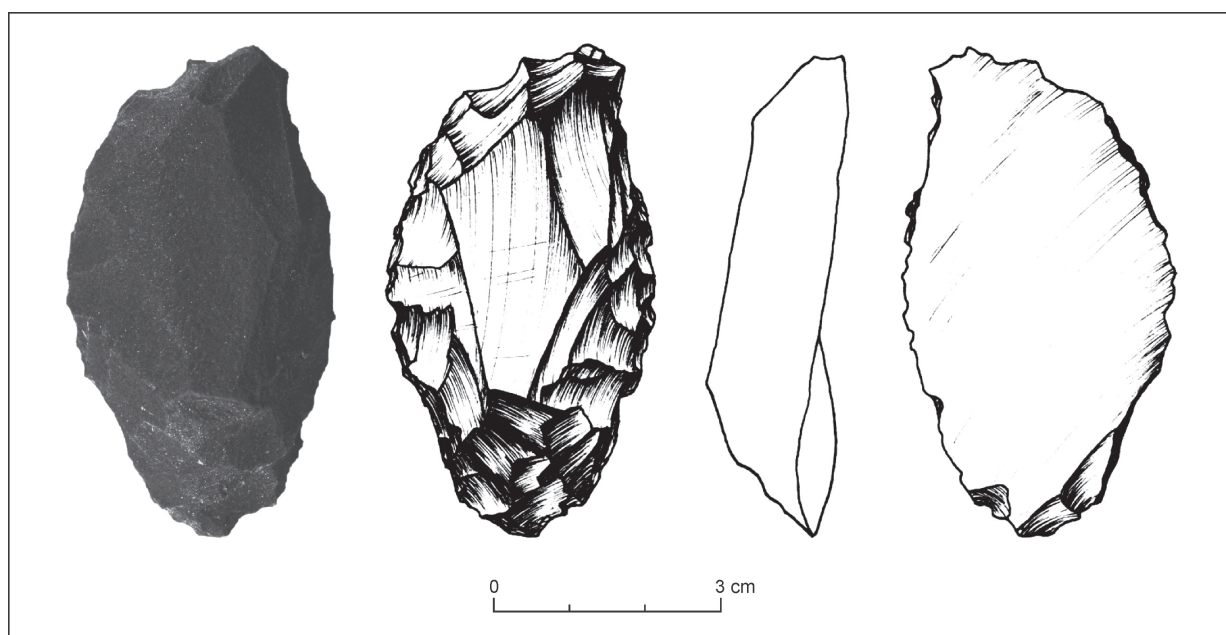


Fig. 7. Oblazowa Cave, layer XIII. Artefact made of undetermined rock (silicified sandstone?; drawing and photo by M. Cieřla).

however, does not explain the presence of microlithic tools made of obsidian (e.g. Fig. 2) at the site. Also, the small size of tools might be interpreted as an adaptation to the conditions of transport – for example, the use of microlithic flakes in hafts could allow transport of smaller amounts of raw material.

Ramification (e.g. *Mathias/Bourguignon 2020*), defined as the branching of the production strategy, here expressed in pre-planned use of cores-on-flakes as a part of raw material transport strategy, can be taken into account in the case of this raw material. However, no direct evidence of this strategy being used for obsidian has been found so far. No core-on-flake of obsidian has been discovered, nor any obsidian artefacts are found among the modest representation of flakes with double ventral sides from the Oblazowa Cave. The procurement of small flakes from bifacial pieces can probably be ruled out for this material among the obsidian flakes – none of them meets the formal requirements for such pieces. In the diachronic perspective, the occurrence of this rock in the older set of layers suggests the southern origins of settlement in this mountainous region in the first stages of MIS3.

The concept of branched production can be observed in the case of two artefacts described above. The first one is the flint scraper, with visible Quina retouch (layer XVb; Fig. 5). The other is the silicified sandstone double scraper (*limace*, layer XIII; Fig. 7), prepared for use both as a tool and a source of small, sharp flakes.

In this context, the Jurassic flint from layer XIX (Fig. 4) appears to be out of place. Even so, in the context of this layer, which can possibly be interpreted as a palimpsest of occupation episodes formed in relatively favorable climatic conditions (see *Valde-Nowak/Nadachowski 2014*), arrivals from south and north or contacts with populations living on both sides of the Carpathians happening in the same climatic phase cannot be excluded. The fact that among so many artefacts (see Table 1), only one specimen demonstrates links with the north suggests a relatively low recognition (typical for the initial phase of migration and settlement) of septentrional raw material resources.

The explanation of the origins of this specimens typological classification (it can be described as an unretouched chunk of raw material, with some dubious retouch negatives) is more complicated. As demonstrated for most of the exotic raw materials at the site (save for obsidian, as discussed above) and generally in Middle Palaeolithic contexts (see e.g. *Delagnes/Rendu 2011*), good-quality rocks were processed in a way that allowed them to be easily reworkable tools, or to be used as tools and cores at the same time. In this case, the obviously non-local rock was transported, probably kept for a long time – hence the intensive polish of the surfaces – and finally discarded in an almost unchanged form. Of course, it is possible that for some reason, the specimen was kept as a curiosity; it is also possible that

it had some practical use. It has been suggested that it could have been used as a fire striker² – but so far, this hypothesis has remained an unsubstantiated speculation, and the question still stands. Examples of fire strikers this old admittedly feature in archaeological records but their typological form is quite different (Sorensen/Claud/Soressi 2018).

The original purpose of the sandstone artefacts is probably the most obscure. It has to be stressed that the sandstone in question was not silicified and was therefore soft and prone to cracking; in short, completely unsuitable for the production of cutting or scraping tools. The use of sandstone in archaeological contexts is well documented in many archaeological sites but it concerns unprocessed pieces (see e.g. Pacheco *et al.* 2012). The situations where despite abundance of raw material of better quality (as we would understand it), sandstone is still used are rare but they do exist (see e.g. Márquez *et al.* 2013). Mostly, however, sandstone nodules are interpreted *a priori* as hammerstones. It is possible in this case that we are dealing with a specific hammerstone prepared for some knapping action, or with a core for flakes that could have served as such hammerstones (retouchers). Due to intensive surface abrasion, which precludes a study of this artefact for traces of such use, this hypothesis will have to remain in the realm of speculation.

CONCLUSIONS

The subject of seemingly incomprehensible use of various raw materials and their place in the *chaîne opératoire* of Neanderthal tool production definitely requires more room in the scientific literature. Extensively described use of local raw materials that are characteristic for a particular site and their techno-typological characteristics, together with a wide-range analysis of the site context is a basis of any archaeological analysis. Even so, when studying the Middle Palaeolithic, research into less usual types of artefacts, or simply those that are in some way surprising in their context, can yield otherwise unobtainable findings.

Translated by author

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² I would like to thank Małgorzata Kot, PhD., from the Institute of Archaeology of the University of Warsaw for suggesting this hypothesis to me.

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Zachować czy wyrzucić?

Dlaczego neandertalczycy wykorzystywali niektóre typy skał w produkcji narzędzi

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Streszczenie

W badaniach nad paleolitem środkowym zagadnienie wykorzystania różnorodnych skał przez neandertalczyków podsumowywane jest zazwyczaj stwierdzeniem o dominującym znaczeniu surowców lokalnych. Badania z ostatnich lat potwierdzają wprawdzie użytkowanie w paleolicie środkowym Europy surowców transportowanych nawet z relatywnie dużych odległości, jednak ich znaczenie dla podstaw gospodarki surowcowej można uznać za marginalne.

Zadokumentowane są jednak też sytuacje, gdy w inwentarzach pojawiają się skały nietypowe, lub też niektóre skały są nietypowe dla zastosowanego celu. Są to sytuacje gdy obok dobrej jakości łatwo dostępnych skał lokalnych opracowywane były również skały złej jakości; gdy transport z większych odległości obejmował skały nie nadające się do obróbki – zbyt małe lub zbyt spękane, lub nieodpowiednie do opracowania. Wreszcie, do sytuacji nietypowych należy zaliczyć transport skał z dużych odległości, np. przekraczających odległość 100 km w linii prostej.

Analiza tych sytuacji wymaga uwzględnienia całej gamy zjawisk: dostępności surowca w różnych warunkach środowiska, możliwego wielokrotnego przerabiania narzędzi kamiennych, rozgałęziania procesu produkcji a także charakteru i stanu zachowania artefaktów w danym inwentarzu.

Wymienione powyżej zagadnienia zostały omówione w oparciu o analizę materiałów z sekwencji środkowo paleolitycznej z Jaskini w Obłazowej (gm. Nowy Targ, Polska) odkrytych przed rokiem 2018. Dostępne w relatywnie niewielkiej odległości od stanowiska były wychodnie dobrej jakości surowca: radiolarytu. Bezpośrednio przy stanowisku, w dolinie rzeki dostępne były w dużych ilościach skały gorszej jakości.

Wśród przedmiotów ze skał importowanych warto wymienić pojedyncze, niewielkie artefakty obsydianowe. Ich obecność na stanowisku dokumentuje transport surowca z południowych obrzeży Karpat Zachodnich. Inny typ skały importowanej na stanowisko to pojawiający się przeważnie w młodszych poziomach osadniczych krzemień jurajski. Występuje on w formie odłupków i łusek, odkryto jednak również zgrzebło wykonane z niego i silnie wyświecony, być może naturalny fragment krzemienia. Do importów zaliczyć należy prawdopodobnie również *limace* z najmłodszego poziomu środkowo paleolitycznego. Nie udało się nadal ustalić z jakim rodzajem surowca mamy do czynienia, co utrudnia interpretację.

Jednocześnie na stanowisku zadokumentowana jest obróbka lokalnych piaskowców, skał pozbawionych cech odpowiednich dla produkcji narzędzi kamiennych.

Określenie roli takich artefaktów w *chaîne opératoire* danego stanowiska jest zadaniem utrudnionym m. in. ze względu na wpływ czynników podepozycyjnych. Dodatkowo, zrozumienie ich roli wymagałoby dostępu do licznych materiałów porównawczych, co w kontekście małej ilości takich opracowań bywa utrudnione. Można rozważać wykorzystanie poszczególnych opisanych elementów w specjalistycznych zadaniach typu krzesanie ognia lub wykorzystanie jako specjalnie przygotowane tłuczki. Szczególnie w przypadku zabytków z importowanych surowców, można rozważać ich wykorzystanie w ramach tzw. rozgałęzionej produkcji (ramifikacji). Wszelkie tego typu sugestie wymagają jednak dalszych badań.

Ryc. 1. Karpackie surowce kamienne. Typy skał wykorzystywane na stanowisku w Jaskini w Obłazowej. 1 – krzemień jurajski podkrakowski; 2 – radiolaryt pieniński; 3, 4 – obsydian słowacki; 5 – prawdopodobna lokalizacja złóż skrzemienionego piaskowca znalezionej w warstwie XIII (rysunek M. Cieśla).

Ryc. 2. Jaskinia w Obłazowej, warstwa XIX. Wybrane artefakty z obsydianu z inwentarzy środkowopaleolitycznych (foto M. Cieśla).

Ryc. 3. Jaskinia w Obłazowej, warstwa XIX. Widok przetartej powierzchni artefaktu z obsydianu (foto M. Cieśla).

Ryc. 4. Jaskinia w Obłazowej, warstwa XIX. Artefakt wykonany z krzemienia jurajskiego podkrakowskiego (foto M. Cieśla).

Ryc. 5. Jaskinia w Obłazowej, warstwa XVb. Artefakt wykonany z krzemienia jurajskiego podkrakowskiego (rysunek i foto M. Cieśla).

Ryc. 6. Jaskinia w Obłazowej, warstwa XVb. Artefakt wykonany z lokalnego piaskowca (rysunek E. Osipowa, foto M. Cieśla).

Ryc. 7. Jaskinia w Obłazowej, warstwa XIII. Artefakt wykonany z nieokreślonego surowca (skrzemieniony piaskowiec?; rysunek i foto M. Cieśla).

Tabela 1. Jaskinia w Obłazowej. Surowce kamienne w inwentarzach środkowopaleolitycznych. Legenda: R – radiolaryt; Q – kwarc; QZ – kwarcyt; G – granit; F – krzemień; O – obsydian; C – zlepienie; S – piaskowiec; HS – rogowiec; L – wapień; UR – surowiec nieokreślony; SSA – nieokreślony skrzemieniony piaskowiec.

Tabela 2. Obsydian w Jaskini w Obłazowej. Liczba artefaktów i ich waga w poszczególnych warstwach.

Tabela 3. Krzemień jurajski z Jaskini w Obłazowej. Liczba artefaktów i ich waga w poszczególnych warstwach.