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THREE SEASONS OF RESEARCH IN THE HUČIVÁ DIERA CAVE IN THE SLOVAK TATRA MOUNTAINS[1]

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This paper presents the results of a research project addressing the hitherto mysterious absence of Palaeolithic traces within the Tatra Mountains. Preliminary investigations conducted in 2019 at Hučivá diera Cave, located in the Slovak portion of the Tatras (the Belianske Tatras), successfully identified distinct evidence of occupation by the Magdalenian culture. In 2022 and 2024, interdisciplinary research at the site continued. The findings have significantly expanded the archaeological dataset and facilitated a more precise definition of paleoenvironmental aspects, such as the Late Pleistocene fauna and flora within this high-altitude environment. Discoveries from Hučivá diera Cave suggest that during the Bölling warming period at the end of the Pleistocene, the cave was utilised by hunters who primarily targeted the Alpine ibex, processing the carcasses and hides *in situ*.

Keywords: High Tatras, Hučivá diera Cave, Magdalenian, Bölling, hide processing.

INTRODUCTION

The abundance of caves in various physical and geographical units in Slovakia encourages their exploration in the speleological, palaeozoological, and archaeological sense (*Bella/Hlaváčová/Holúbek 2007*; *Soják 2024*). Although this research has a long tradition and has often resulted in important discoveries, it has only to a small extent covered the cave objects of the Tatra region. In this context, it is worth mentioning the work undertaken a decade ago by paleozoologists in two caves of the Belianske Tatras: Muránska Cave (1559 m a.s.l.) and Nový 3 Cave (1791 m a.s.l.; *Horáček et al. 2015*). The results of these studies suggest that in the High Tatras, the surfaces of the Vistulian glacier were colonized by a diverse community of small vertebrates, including highly demanding, endemic, and even forest elements. The authors believe that such relatively optimal conditions occurred there not only in the mild part of the Vistula glaciation (MIS 3), but also during the LGM (MIS 2). These hidden refugia for many Central European taxa could, as the authors suggested, also have attracted human interest (*Horáček et al. 2015*, 375, 376). However, the studies in question did not provide any evidence information about larger animals.

From a purely archaeological perspective, it is difficult to say today about the role of the Tatra massif in ancient human penetration. In the Slovak Tatras, we know one cave archaeological site, but without traces dating back to the Stone Age. In the Dúpnica Cave, located in the Western Tatras, in the Sielnicka Valley, pottery, bronze, and iron items were found. They date back to the younger Bronze Age, Hallstatt period and the Early Iron Age (*Šimková 2006*; *2014*). A Celtic silver coin was also found (*Soják/Struhár 2014*). The cave was also inhabited in the Middle Ages and was used by the population as a shelter during World War II (*Bella/Hlaváčová/Holúbek 2007*; *2018*).

For the Polish Tatras, the situation is different. The main 19th-c. cave researcher, G. Ossowski, tried to include also the Tatra caves in the then research. Both for him and his archaeological successors in the 1930s, these attempts ended with negative results (*Jura 1955*; *Zwoliński 1955*). For almost a hundred years, from the mid-19th c., the object with which great hopes were placed to discover traces of human presence was the Magura Cave in Polish Tatra (*Jura 1955*; *Zwoliński 1955*). Despite referring to the scientific authorities of the time, the alleged bone and stone artefacts from the excavations undertaken over time in the Magura Cave were ultimately not confirmed. Thus, the topic of prehistoric settlement in the Polish Tatras has been practically closed to this day. The first steps in the recent attempt to undertake archaeological research in both the Polish and Slovak Tatras were discussed in an article from 2024, in which the results of the first discoveries in Hučivá diera Cave were also briefly summarised (*Valde-Nowak et al. 2024*). This article is an update and enrichment of the results of the previous research in Hučivá diera Cave.

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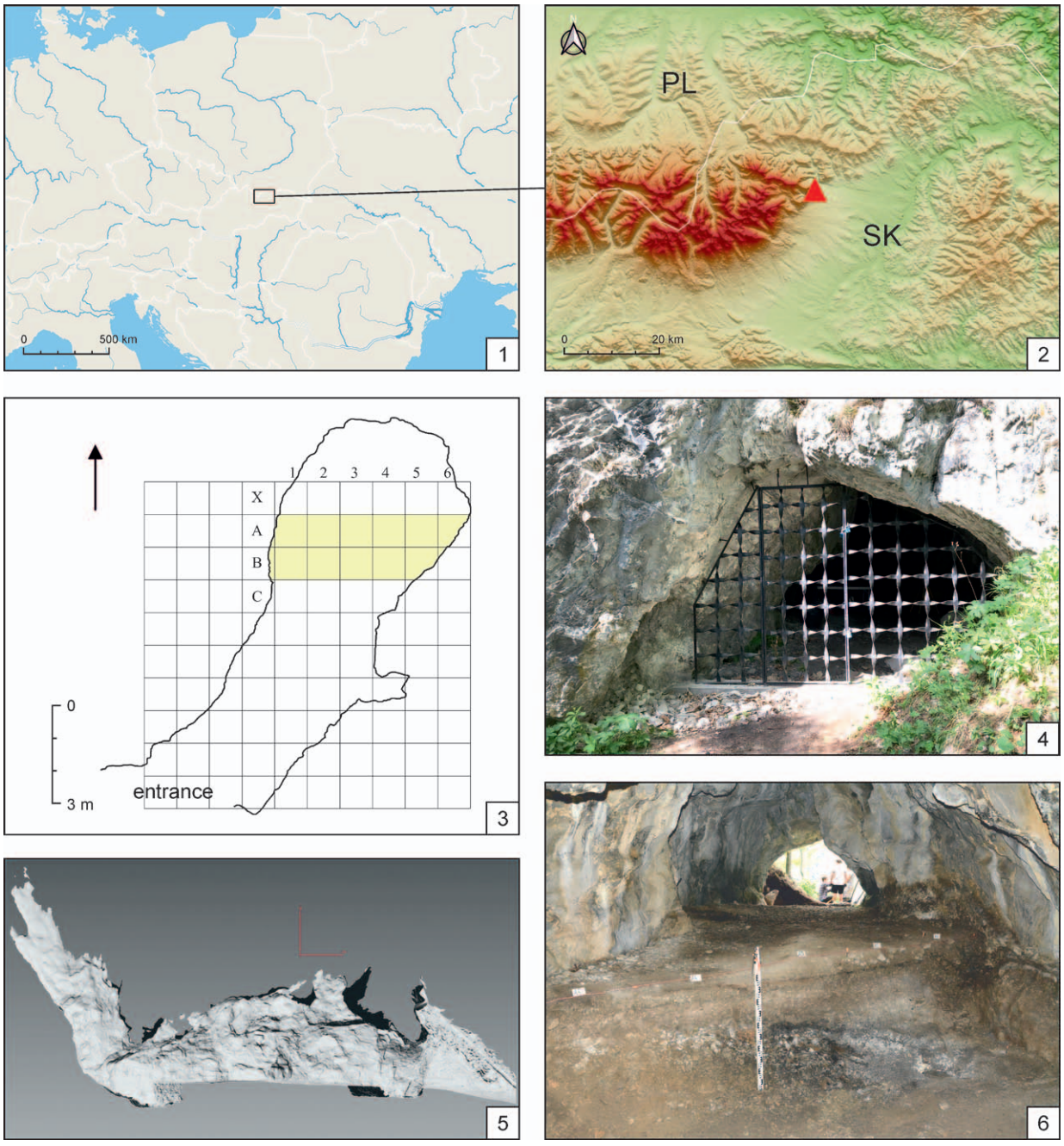

Fig. 1. Hučivá diera cave. 1 – the general location; 2 – location on the map of Slovakia; 3 – plan of the cave chamber with the excavation marked in yellow against the background of a meter grid; 4 – entrance to the cave; 5 – general view of the excavations trench in 2022 season; 6 – longitudinal cross-section of the cave as an effect of 3D scan. Drawing J. Skłucki, scan M. Cheben.

THE HUČIVÁ DIERA CAVE AS AN ARCHAEOLOGICAL SITE

As we know, cave structures constitute a natural monument and are usually under the protection of scientific and speleological communities. If traces of former settlements are discovered in a cave, the significance of such an object increases further, becoming an archaeological site. It is precisely the probability of preserving archaeologically significant traces in the cave that means that archaeologists are authorized to conduct an exploration of cave sediments in the first place. The optimal situation is when speleologists remain in contact with archaeologists when exploring caves. To some extent, such a situation took place at the end of 2018 in the Belianske Tatras, in the Hučivá diera Cave in Slovakia, when an important episode occurred,

which today allows us to look differently at the possibility of using Tatra caves in the Stone Age, and specifically in the Palaeolithic period.

During a visit, M. Soják to the Hučivá diera Cave for photo documentation at the end of 2018, in its back premises found significant damage to the cave sediments. This amateur pit was probably made by the speleologists. Through a detailed study of the superimposed heaps of cave sediments, it was possible to discover at the time the first stone artefacts (*Soják/Valde-Nowak 2019*; *2021*). After completing their amateur excavation of its rear spaces, the length of the cave was increased from 13 to 16 m (*Bella/Hlaváčová/Holúbek 2018*, 270). Several stone artefacts collected from the heap by speleologists were provisionally classified as Magdalenian technocomplex (*Valde-Nowak/Soják 2018*, 45). At that point, Hučivá diera Cave became an archaeological site.

The Hučivá diera Cave in the Belianske Tatras in Slovakia lies in the cadastre of the High Tatras-Tatranská Lomnica (Poprad district) in the Prešov region in Slovakia (Fig. 1: 1, 2).[2]

The cave with a total length of 16 m is located at an altitude of 936 m in a rock cliff on the Southern slope of Kobylí vrch (1109 m) in the Belianske Tatry Mountains near the 'Sparkling Spring' (*Rausch Quelle*; Fig. 2: 1). It developed in the Ramsau dolomites (Triassic, Fatricum) on a fault discontinuity, which predisposes the formation of the horizontal cave passage with a high ceiling. A portal entrance of a triangular shape with a base of approximately 4 m and more than 2 m in height is a relic of a horizontal (phreatic) cave passage with a length of 10 m (Fig. 1: 3–5). At the cave passage end, where the site of the excavated archaeological profile is located, the cave ceiling sharply rises becoming a vertical chimney (Fig. 1: 6). The narrow chimney is blocked by rocks and soil in its upper parts, which prevents it from opening to the surface. The signs of frost weathering are documented by rock debris and gravitational breakdown, accumulated at and near the archaeological site. The detachment surfaces of the rock breakdown are currently obliterated by weathering, and dissolution by seepage water. If it was open at the time of human use of the cave, it could have ventilated the smoke of the fireplace.

The Institute of Archaeology of the Slovak Academy of Sciences in Nitra and the Institute of Archaeology of the Jagiellonian University in Krakow undertook the first rescue works in 2019, which were continued as systematic works in 2022 (*Soják et al. 2019*; *Soják/Valde-Nowak 2019*; *2021*; *Valde-Nowak et al. 2022*) and in July 2024. Stone and other artefacts, bones, and plant microfossils are collected during the research after they have been precisely tracked. The sediment was exposed in arbitrary layers (0.05 m), maintaining a grid of quarters of meters (0.25 m^2), which forms the basic excavation unit. The whole sediment is wet-screened on sieves with less than 1 mm mesh size (Fig. 2: 2). Sediments were examined in two excavations. One of them was located in the entrance opening – where the entrance grate was planned to be installed, which took place in 2020. So far, sediments have been examined on an area of approximately 20 m^2 to a depth of 250 cm. The rock floor was not reached in any part of the excavation.

MAIN RESULTS OF EXCAVATIONS

The work to date has allowed us to recognize the stratigraphy. The profile has nine main clay-rubble layers, with layer 6 having variants. The top layers 1–4 were formed in the Holocene. Layer 1 is a modern tramp and the remains of a speleologists' heap. Two Slovak State coins and a cartridge from World War II were found there. Layers 2–3 contain sparse modern ceramic material, which can be related to the 16th c. Layer 4 is transitional. Palaeolithic artefacts were extracted from layers 5–8, but their main deposit is layer 6a, constituting traces of a large hearth. Layer 9, silty-clayey of dark yellow colour, sterile both archaeologically and paleontologically, most probably formed in the Last Glacial Maximum (LGM; Fig. 3).[3]

Two AMS dates were obtained from charcoal from the fireplace: 12190 ± 60 BP (Poz-114742: 12316–11896 cal BC, at 95.4% confidence) and 12160 ± 60 BP (Poz-114743: 12260–11868 cal BC, at 95.4% confidence). An ibex mandible was also found in this fireplace, resulting in 12160 ± 60 BP (Poz-126122: 12270–11860 cal BC). From pit 6b adjacent to the fire, two further dates were obtained from charcoal: 12280 ± 60 BP (Poz-162378: 12542–12108 cal BC, at 95.4% confidence) and 12200 ± 50 BP (Poz-162379: 12367–12065 cal BC, at 95.4% confidence), indicating synchronicity with the fire, which is additionally confirmed stratigraphically. A slightly earlier date was obtained from a horse's jaw, found outside the excavation in the deeper part of the cave, protruding from unexamined sediment: 12400 ± 50 BP (Poz-154006: 12920–12258 cal BC, at 95.4% confidence). All these data (calibrated with OxCal Program v3.10; *Bronk Ramsey 2001*) points for Bölling interstadial (GI 1e).

[2] GPS coordinates N 49°13'14.8'', E 20°18'37.2'', C-KN 14 705/14, LV 402.

[3] Results of the sedimentological analysis carried out by L. Lisá.

Fig. 2. 1 – general view of the Belianske Tatras from the side of the village of Lendak with the approximate location of the Hučivá diera Cave (arrow) in the Kobylí vrch massif (1109 m), in the background, Lomnický Peak (2634 m; photo P. Valde-Nowak); 2 – wet screening of sediments from the Hučivá diera Cave in Biela Potok (photo M. Soják).

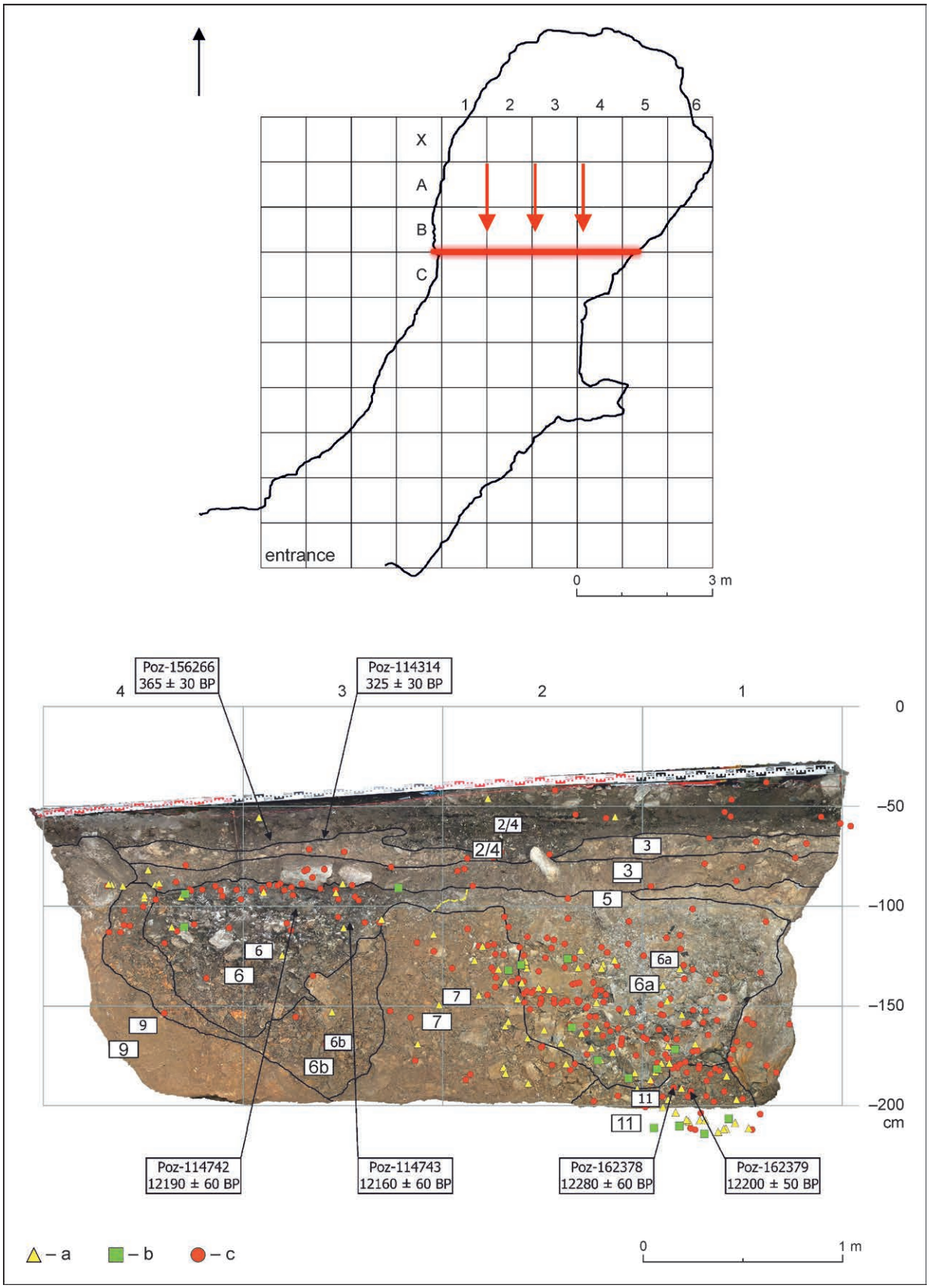

Fig. 3. Hučivá diera Cave. Cross-section of cave sediments (stand 2022) with numbered layers and the position of samples for AMS dating. Legend: a – scatter of stone artefacts; b – burnt stone artefacts; c – animal bones. Layout J. Skłucki.

Fig. 4. Hučivá diera Cave. Cross-section of cave sediments (stand 2024). Photo P. Valde-Nowak.

A sample of charcoal comes from the high cultural layer 2, which gave the early modern time, consistent with the characteristics of the fragments of pottery found there: 365 ± 30 (Poz-156266: 1453–1635 cal AD, at 95.4% confidence).

The southern profile (on the border of meters A and B) was chosen as the most demonstrative for stratigraphy and environmental research purposes (Fig. 3). Its addition of floor parts was made in the 2024 season (Fig. 4).

As a result of work, 812 stone artefacts have been discovered. In terms of raw materials, the inventory is in some cases difficult to determine due to patina. Some of the artefacts were made of radiolarite (77.83%), but there are artefacts from raw materials such as various flints from Polish territory and Volhynia (19.95%), limnosilicite from Middle Slovakia or the borderland between Northern Hungary and Slovakia (*Kaminská zost. 2014*) as well as the hornstone of the Stránská skála (at least one piece) type from the Moravia area (*Bartík et al. 2019*).

The share of different varieties of flints are as follows: 41 Cracow-Jurassic, 26 chocolate, 11 Bircza flint, 4 cretaceous from Volhynia, 80 undetermined pieces. Flint from Bircza must be present, which we can now treat as a good indicator of Magdalenian in its eastern province. The conditions in the cave significantly impacted the state of preserving the siliceous rock surface. Most isolated flints are patinaed with a deep, white patina. Their texture can also be substantially transformed. To a small extent, this also applies to some specimens made of steel-grey or green radiolarite. Additionally, the proximity of fire influenced the change in the original characteristics of flint products. Many specimens show traces of 'welding' and burning, which results in a change in the gloss, texture, and damage to the rock structure.

Among this remarkable blade industry, 3 cores, 108 flakes (without chips and non-diagnostic pieces), 162 blades and 105 tools occurred. The cores are in an extremely exploited form. Despite this, it still represents blade technology. All cores represent single platform cores or cores with changed orientation. One of the cores is shaped like a tablet, made most probably on the big flake. It is preserved in an extremely exploited form (Fig. 5: 1). Another one can be considered a micro-form with signs of a conical shape and is in a very advanced stage of use (Fig. 5: 2). The third can document traces of repeated unsuccessful separation of chips in the form of the so-called hinge (Fig. 5: 3). When assessing the technology used by core users, its high technical level must be emphasized. The core angle has been successively improved as evidenced by the negatives on the striking platform. A soft hammer was commonly used. Blades often confirm the formation of *en éperon* butts (*Inizian et al. 1999*, 136). Splintered bulbs on blades and bladelets are also confirmed. The maximum use of these specimens is impressive.

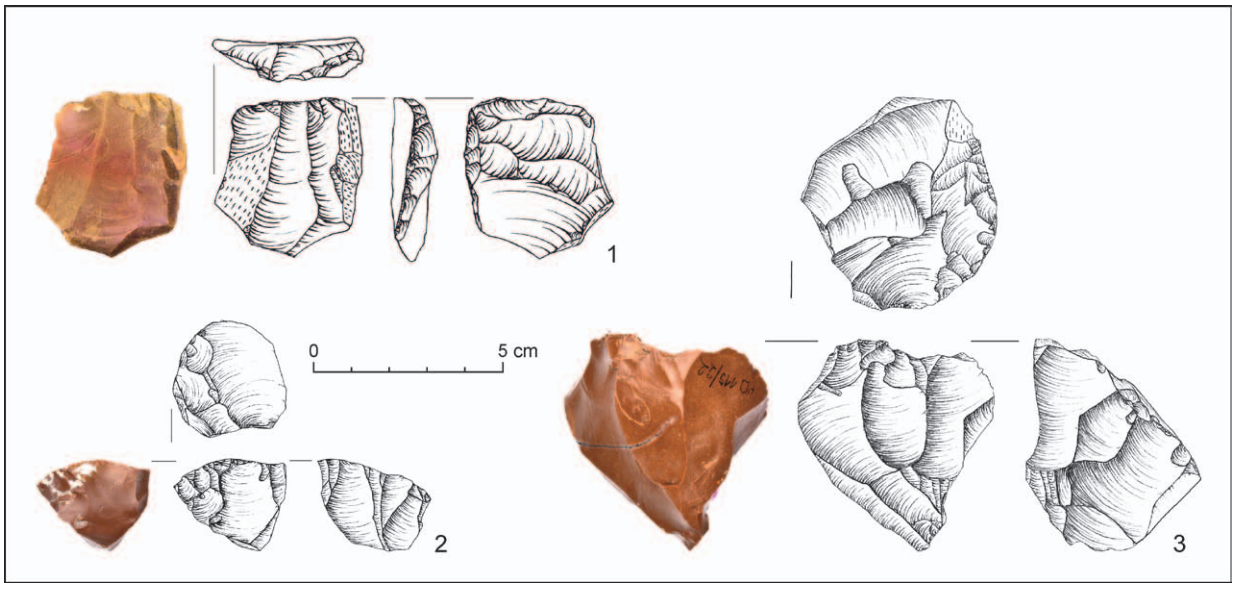

Fig. 5. Hučivá diera Cave. Cores made of radiolarite. Drawing J. Chowaniak, photo J. Skłucki.

The most characteristic tools are points (Fig. 6). Some of them resemble shouldered points (*Bohmers 1956*; *Maier 2015*), as well as specimens similar to the massive Creswell triangles (*Stapert 1985*). One item can be considered as double truncation called Cheddar point (*Barton et al. 2003*). There are also perforators, including a badly worn specimen with a twisted Zinken sting.[4] Oblique truncations are also present. It is also essential that the backed bladelets are visible.

The number of tools in the inventory can be presented as follows: 31 projectile points, 6 burins, 17 truncated pieces, 2 combined (end scraper + fine perforator), 20 perforators and borers, 18 retouched blades, 9 backed bladelets, 1 end scraper, 1 notched tool.

One shell has been discovered at the Hučivá diera Cave in 2019 season (Fig. 7: 4). It is a fossil Miocene shell of *Tiaracerithium pictum* (*de Basterot 1825*), a highly variable and widely abundant gastropod species in the Paratethys Sea, known from numerous localities in Poland, Slovakia, and Moravia (*Harzhauser/Guzhov/Landau 2023*, 144–153). The specimen is perforated with two holes made similarly.[5]

The inventory includes an awl (Fig. 7: 1) and two bone needles (Fig. 7: 2, 3), one preserved in two fragments.[6] There was also a tool made of lynx bone, which was worked intensively so that the tip was blunt, indicating tissue removal due to intense activity. Also noteworthy is a series of parallel cuts that give the impression of notation (Fig. 7: 5). Bone needles are a relatively common find in the inventories of the Magdalenian culture (*d'Errico et al. 2018*; *Stordeur-Yedid 1979*).

Two refitting fragments of sandstone found in the Hučivá diera Cave focal layer require separate attention. They can be interpreted as a lamp (Fig. 7: 6). Such a rock does not occur in the vicinity of the cave, and its reddish colour may be the result of thermal transformation. Minor traces of an unspecified organic substance with lipid characteristics were found on its walls.[7] Stone objects found in the Magdalenian context, known as candle lamps, are an integral element of this culture also on Polish territory, e.g., Ćmielów (*Paczkowski 2020*; *Paczkowski/Przeździecki 2021*, 173) and Wilczyce (*Kowalski 2014*).

During the 2019 excavation season, five pieces were collected and ascertained initially as ocher lumps. They derived from the three archaeological layers: 5, 6, and 6a, with depths between 125 cm and 135 cm below the current ground level. The chosen samples were subject to 56 singular SEM-EDS analyses. The main colouring agent, thanks to which all the specimens presented a red hue, appeared to be iron compounds. That would imply that all of the samples could be considered as ocher (see *Velliky et al. 2019*, 2).

[4] In the 2024 season, one more example of a Cheddar point was found.

[5] An almost identical specimen, also perforated with two holes, was found in the 2024 season. Rresults of the analysis carried out by A. Kurzawska.

[6] One more fragment of a needle was found in 2024 season.

[7] Results of the analysis carried out by E. Miśta-Jakubowska and R. Siuda.

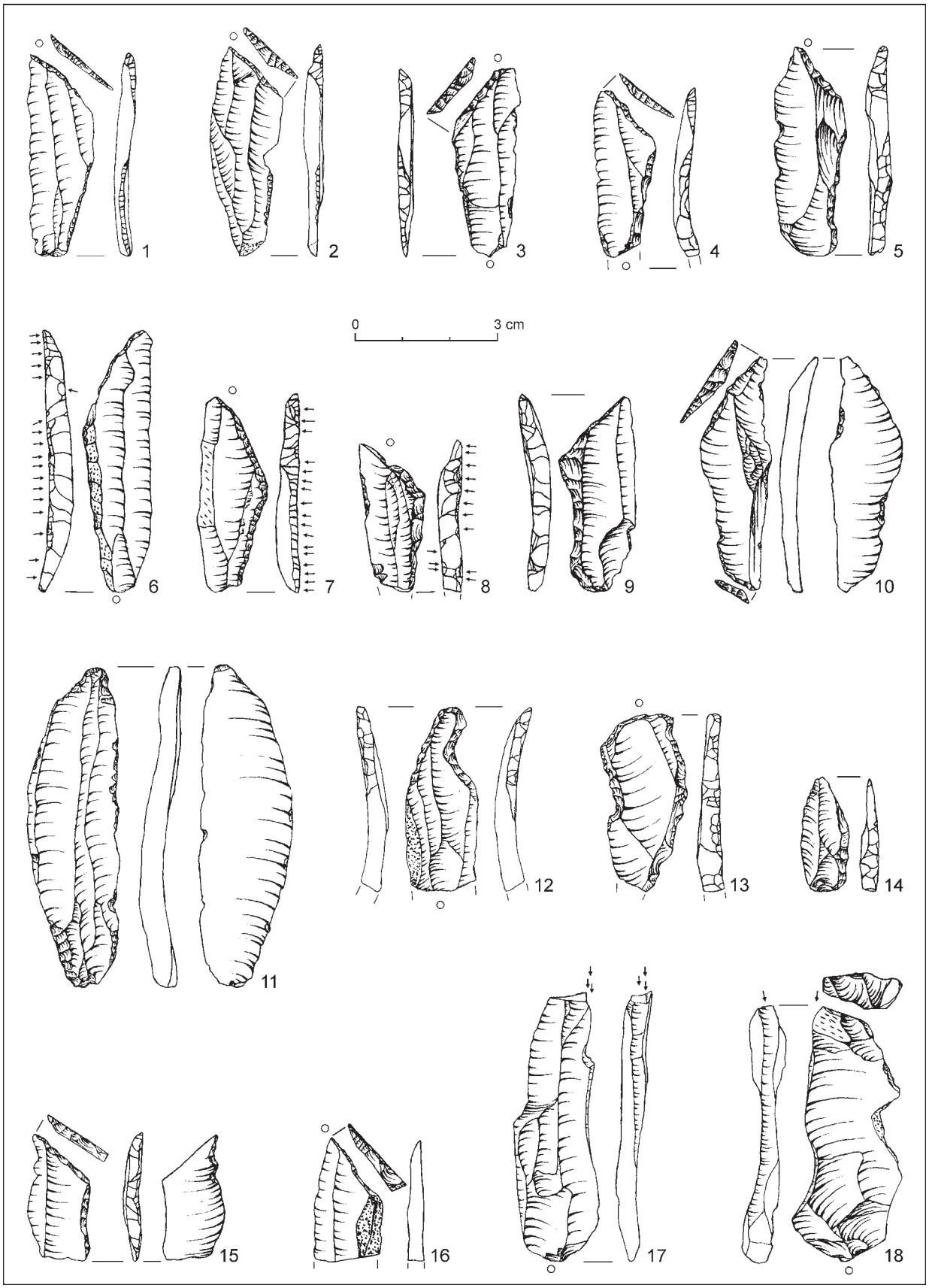

Fig. 6. Hučivá diera Cave. Selected stone artefacts. 1–3, 6–9 – creswell points; 4, 5 – shouldered points; 10 – cheddar point; 11, 13, 14 – perforators; 12 – Zinken; 15 – borer; 16 –truncation; 17, 18 – burins. Drawing J. Chowaniak.

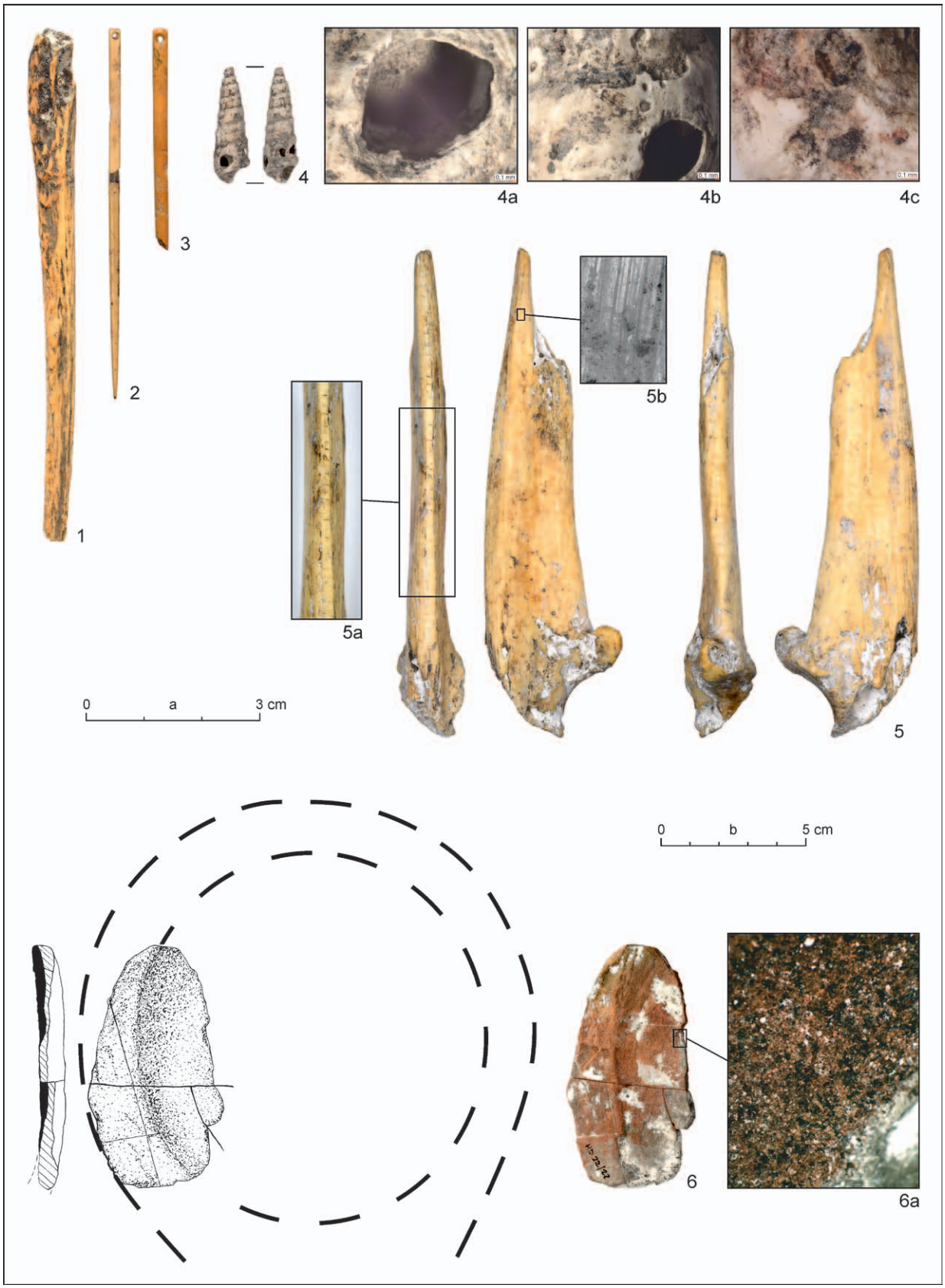

Fig. 7. Hučivá diera Cave. 1 – bone awl; 2, 3 – bone needles; 4 – shells of personal ornament; 5 – strongly polished bone tool (piercer or awl) with a visible series of parallel diagonal cuts; 6 – refitted fragments of sandstone lamp. Drawing J. Chowaniak, U. Bąk, photo A. Kurzawska, J. Skłucki. Scale: a – 1–5; b – 6.

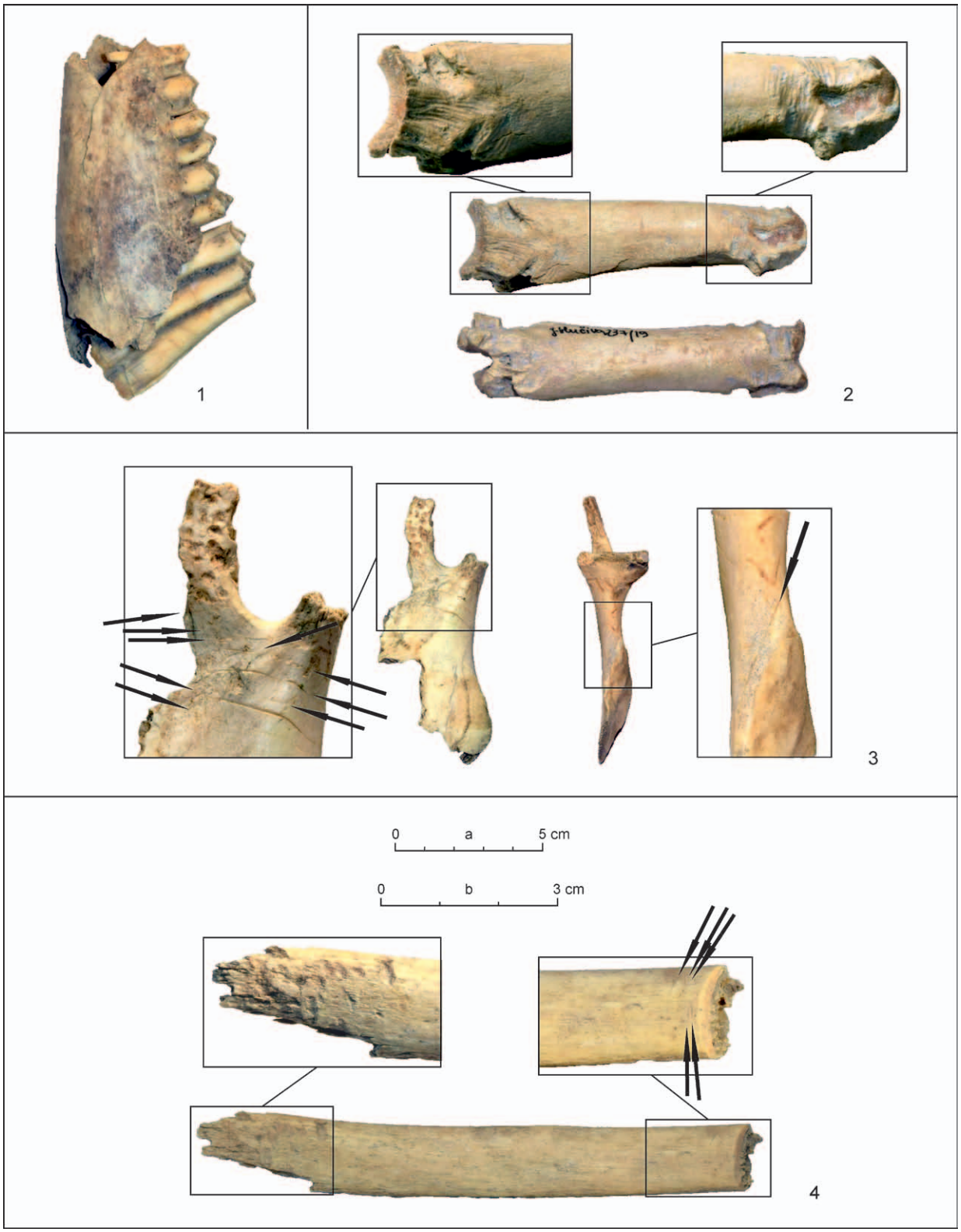

Fig. 8. Hučivá diera Cave. 1 – left mandible of an Alpine ibex (*Capra ibex*) with teeth from the third premolar to the third molar, view from the buccal side; 2 – a proximal phalanx of chamois (*Rupicapra rupicapra*), close-ups show damage caused by rodents gnawing (parallel grooves); 3 – fragment of the left mandibular branch of an Alpine ibex (*Capra ibex*) with numerous cut marks on the buccal and backside and gnawing marks by predators (punctures on the coronoid process); 4 – rib fragment of a medium-sized mammal with cutting marks at one end (multiple scratches at the right end and a smooth cut surface) and traces of gnawing by predators at the other end (punctures and crenulated edge at the left end). Photo and layout K. Wertz. Scale: a – 1, 3; b – 2, 4.

All layers yielded animal bones and teeth, but most of them were found in cultural layers 6 and 6a as well as layer 5. Remains belong to mammals (over 25 taxa have been determined) and birds (more than 15 species), supplemented by less numerous amphibians and very scarce snails. In total, almost 500 remains of small and large mammals and almost 370 bird bones were identified at the species or genus level.[8]

Among larger mammals, that could be hunted by the Magdalenian people, bone fragments and teeth of the Alpine ibex (*Capra ibex*) predominate in the fossil assemblages of cultural layers 6, 6a, 6b, and layer 5, and numerous cut marks are present on some of the bones (Fig. 8: 1, 3). The remains of wild horses (*Equus ferus*) were less numerous, and traces of exploitation were also less frequent. Chamois (*Rupicapra rupicapra*; Fig. 8: 2) and red deer (*Cervus elaphus*) were also identified, while fallow deer (*Dama dama*) and aurochs (*Bos primigenius*) were represented by single specimens only. Remains of carnivores are represented by the brown bear (*Ursus arctos*), red fox (*Vulpes vulpes*), lynx (*Lynx lynx*), and at least four species of mustelids (*Mustelidae*). The most abundant remains belong to brown bears.

In Hučivá diera Cave small mammals are represented by 12 rodent taxa and insectivorous mammals (bats, moles, and shrews), but their remains were few (NISP ca. 150). The rodent community from layer 6a, represented by 10 species, was characterized by the highest quantitative and qualitative diversity.

The studied sediment from the Hučivá diera Cave was characterized by very low pollen frequency (50–280 including terrestrial AP and NAP pollen on the surface of 10 microscopic slides) and, at the same time, a low taxonomic diversity of sporomorphs, among which only 36 taxa (including 9 cryptogams taxa) were determined.[9] Based on the taxonomic composition and frequency of the main pollen morphological types, two pollen sections were distinguished in the diagram.

The older pollen, representing the Late Glacial, was characterized by a predominance of Scots pine (*Pinus sylvestris*) type pollen (possibly including also dwarf mountain pine [*Pinus mugo*] pollen; up to 64%) and Norway spruce (*Picea abies*; up to 14%) as well as a very high frequency of herbaceous plant pollen. Among arboreal taxa sparse (*Pinus haploxylon*) type pollen (most likely representing stone pine [*Pinus cembra*] up to 2%), birch (*Betula*; 1.1%) as well as juniper (*Juniperus*; 0.7%) were found. The proportion of non-arboreal pollen (22–72%; average 46%) was very high and consisted mainly of representatives of subfamily *Cichorioideae* (up to 67% in sample 9), grasses (*Poaceae*; up to 6%), sedges (*Cyperaceae*; up to 6% and *Epilobium*; up to 4%).

The younger pollen zone represents the Holocene revealing a completely different picture of vegetation. The frequency of tree pollen was much higher. The spectra were co-dominated by Norway spruce (up to 48%) and Scots pine-type pollen (average 40%; up to 57%). Fir (*Abies alba*; up to 9%) was also determined. The pollen representation of deciduous trees, including mesophilous oak, birch (*Betula*), hazel (*Corylus avellana*), linden (*Tilia cordata*), and alder (*Alnus*) was low and only in sample 5 reached a total of 7%.

The density of finds (charcoal, wood, and seeds) per litre of original cave deposit calculated for all flotation samples shows a higher concentration of plant remains in the upper Holocene (layers 2, 2/5, 5) than in the late Pleistocene (layers 6, 6b and 8). The only exception is layer 6a associated with the hearth.

The charcoal and wood were strongly degraded, vitrified, often penetrated by calcareous plastic sinter and rarely exceeded 2 mm in size. This hindered the taxonomic determination, resulting in intermediate (e.g., *Salix*/*Populus*) and probability determination (cf. *Juniperus*) or wider taxon category (e.g., deciduous, coniferous). In evaluation, the taxa determined with probability were combined with the determined taxon (e.g., *Salix* and cf. *Salix*).

Taxonomically determined 500 fragments of charcoal and mineralised wood represent one-third of the assemblage of which one-third were assigned to genera or species.[10]

DISCUSSION

The problem of the penetration of Palaeolithic hunters into the areas of alpine relief in the Carpathians is closely related to the difficult access to these areas in the coldest phases of the Pleistocene (*Kłapyta et al. 2016*; *Makos 2015*) and has affected the availability of game animals (*Horáček et al. 2015*, 372–376).

The discoveries made so far in the Hučivá diera Cave are comprehensive and bring new content to several disciplines. Let's start with the problems caused by the marked presence of Palaeolithic man. The significance of the results obtained lies primarily in, that it can be assumed, one phase of the occupation of this place by people of the Magdalenian culture. We do not know whether

[8] Results of the analysis carried out by A. Nadachowski and his team.

[9] Results of the analysis carried out by A. Wacnik.

[10] Results of the analysis carried out by M. Hajnalová.

it was one continuous stay of a group of hunters or several stays in one or several seasons.

One of the signs of repeated visitation of the cave is probably the presence of limestone clast accumulation within layer 6. This accumulation reflects something like a sedimentation hiatus, which divided layer 6 into three sedimentary stages. The lower and upper parts reflect the presence of the man due to the charcoal accumulations, while the accumulation itself is the result of the natural roof falling. This type of sedimentation is typical for the end of the coldest periods in a cave environment (*Nejman et al. 2018*). The only layer showing the conditions of LGM reflected in the lenticular microstructure is layer 9. Such microstructure is very typical for freezing/thawing processes (*Vliet-Lanoë 2010*) and for example, a similar one was observed in the LGM strata of Kůlna Cave in Moravian Karst (*Lisá et al. 2013*) or Pod hradem Cave (*Nejman et al. 2018*). Despite that, in terms of archaeological periodization and taking into account the extremely strict AMS dating results, we have grounds to treat the obtained artefacts as a homogeneous group. We do not forget about the late medieval and early medieval traces from World War II at the top of the sequences.

Looking at the inventory of stone artefacts, it is worth emphasizing the extremely reduced workshop section. Only three cores found in a very used form are a document of significant limitations in the possibility of restoring the inventory by its users. The spectrum of raw materials is also clearly shown by a distinct group of flint tools, i.e. from raw materials brought from far away. Since all three found cores are made of local radiolarite and not flint, it can be concluded that the flint blades are the remains of the original hunters' equipment with which they came to the Tatra region, which was then renewed using local raw materials, especially radiolarites.

The features of the series of stone points are extremely peculiar. It is not easy to find references to them in the inventories from the general eastern Magdalenian province (*Bobak/Połtowicz-Bobak 2018*). We do not know them from the Moravia (e.g., *Kapustka et al. 2023*; *Kostrhun 2005*) except for single finds, such as from the Ochozská Cave dated similarly to Hučivá diera (*Valoch 2002*; *Valoch/Neruda 2005*) and a few Slovak sites that are considered Magdalenian (*Kaminská zost. 2014*, 288–296; *Valde-Nowak/Soják/Wąs 2007*).

Due to differences in concepts in terms of terminology and typology of these types of blades, the following clarifications are necessary. We can refer to *J. B. Campbell's* (*1977*) proposal to pay attention to specimens that are close to shouldered points but are different from them. These are Creswellian points (Campbell's AC l type).

Organizing the current terminology leads to the conclusion that the inventories related to the Creswellian tradition are dominated by specimens generally similar to shouldered points, but without a separate notch, creating a concave outline in this part of the entire shape, as we can see in Hamburgian shouldered points (*Burdukiewicz 1987*; *Kabaciński/Sobkowiak-Tabaka 2012*; *Weber 2009*; *2012*) and also, although occurring rarely, shouldered points of Magdalenian, e.g., in Etzdorf (*Pasda 2018*) and Petersfels (*Albrecht 1979*; *Maier/Liebermann/Pfeifer 2020*) and some Swiss sites, like Schweizersbild (*Höneisen/Peyer 1994*).

More or less typical shouldered points of the A2 type by *J. M. Burdukiewicz* (*1987*) have also been distinguished in the Hučivá diera Cave inventory, although less numerous than typical Creswell blades.

We are faced here with the classic problem of understanding the Magdalenian-Hamburgian relationship, in which the participation of shouldered points is a primary element. Without entering into this discussion, it should be recalled that the key element for distinguishing Hamburgian Magdalenians is the lack of retouched bladelets in the Hamburgian complexes (*Weber 2012*, 28). The presence of truncated bladelets in the Hučivá diera Cave inventory is one of the strong indicators of the Magdalenian affinities of the findings. Apart from the incidental appearance of a single mite in the inventory from Krucza Skała a specimen similar to the Creswell blade type, although it was not named as such (*Cyrek/Sudoł-Procyk/Czyżewski eds. 2020*) and a slightly larger series of shouldered points in Magdalenian context from Wrocław-Żerniki (*Burdukiewicz et al. 2013*, 150, fig. 11), we have practically no other references from the East Magdalenian province, e.g., Moravia and Poland. We can also recall two findings from the 19th-c. excavations mentioned several times in the literature but never associated with the typology of finds with Creswell features: a Creswell blade from Na Łopiankach Cave and a Cheddar point from Na Gaiku Cave (Collections of the Archaeological Museum in Kraków)

It is also worth mentioning the site of Rydno II/59, where an oblique and straight double half-back was discovered (*Schild et al. 2011*, 124, 125, fig. 103). Many years ago, this type of point was recorded in the inventory from the foothills of the Tatra Mountains, namely from the site Podczerwone in Podhale, included in the Magdalenian culture. Years later, it turned out that there were more traces at the foot of the Tatra Mountains that did not fit the Polish image of the Magdalenians. First, the site of Sromowce-Wyżne 'Kąty' should be mentioned (*Valde-Nowak 1991*), with a large inventory and at least one Creswell point made of chocolate flint.

Ongoing excavations in Obłazowa Cave (western entrance) also yielded a small inventory of double half-backed forms similar to Cheddar points (*Valde-Nowak et al. 2018*). Blades of this last-mentioned type are not known from Magdalenian settlements in Moravia and eastern Germany. They are concentrated in the southeastern part of the British Isles and the Netherlands (*Barton et al. 2003*). A single case is known from southern Germany from the Hohle Fels Cave (*Taller/Bolus/Conard 2012*).

The archaeological material from Hučivá diera Cave, in addition to typological references to the Creswell sites, contains elements known from the Magdalenians in Switzerland (*Sedlmeier 2015*). It is about techno-assemblage E (*Leesch et al. 2012*; *Nielsen 2016*) which slightly precedes the settlement in Hučivá diera Cave.

The Alpine ibex is a mountain species that in the late Pleistocene occurred first of all around the Alps and on the rocky coasts of the Mediterranean Sea. Alpine ibexes were victims of specialized hunting by people of the Magdalenian (*Gauvrit Roux 2022*) and Epigravettian people (*Fiore/Tagliacozzo/Cassoli 1998*). Currently, *Capra ibex* does not occur in the Tatra Mountains.

The overall assessment of the obtained inventory leads to quite obvious conclusions that we have traces of the operation of a specialized group of hunters in this cave, focused especially on hunting and butchering the hunted ibex on site. The mentioned chimney at the end of the chamber, just above the hearth, points to conscious planning of the camp space. This provided effective ventilation when using fire. Without this, the large fireplace at the back of the cave could not be used (*Y. Kedar/B. Kedar/Barkai 2019*).

The analysis of lime packages leads to the conclusion that the obtained slaked lime with chemically active properties could be used in the tanning process of leather. The presence of horse remains, as well as species that are alien to the high-mountain environment, e.g., swans, gives food for thought.

Some observations suggest that the late Pleistocene landscape exploited by humans occupying the Hučivá diera Cave was open with (possibly short, shrub-like) trees clustering in sheltered locations and along the watercourses. This picture can be compared to the situation of sites on the border between Switzerland and Germany (*Leesch/Bullinger/Müller 2019*).

Assuming that the obtained palynological image of vegetation is not the result of an accidental pollen import associated exclusively with the activity of Palaeolithic hunters using the cave, it may indicate an important role of open steppe-like grassland vegetation.

CONCLUSION

The discovery and comprehensive examination of the remains of late Paleolithic human activity in the Tatra cave have several paleogeographic consequences and point to the dynamics of the recolonization process after the LGM climate crisis.

The sedimentary profile excavated in Hučivá diera Cave offered an interesting insight into the formation of sediments at the transition of the glacial/interglacial period and the Holocene. The glacial period is recorded in silty loams, macroscopically and geochemically corresponding to loess. Its primary formation is probably a result of geliculation or some other kind of coluviation occurring during climatically sufficient periods. The micromorphology revealed the signs of freezing/thawing processes so typical for pleniglacial, but this is a post-sedimentary process that influenced already deposited material.

The formation of the cave record continued at the very end of the glacial period when a mass of limestone blocks frost eroded from the roof of the cave and its walls started to fall to the cave bottom. More or less at the same time, the Magdalenian occupation of the cave is present. The human presence is typical by the appearance of fireplaces full of charcoal, burned bones, and ash. All these features are well preserved there. The dilution of burned and unburned bones and probably also of guano is the provenance for the phosphatic nodules and impregnations, which are present as post-sedimentary features. Another post-sedimentary feature is carbonate neoformation, especially aragonite coating and its recrystallization into calcite. The upper part of the study section is probably the result of coluviation, in some cases combined with human action or post-sedimentary digging.

The cave is located in a high mountain zone, which in Böling's warming suddenly became accessible to humans and fauna after the decline of the oldest Dryas.

Looking at things from the extent of the then-Magdalenian colonization (*Połtowicz-Bobak 2013*), we must note that somewhere in this zone, there is the southern frontier of the colonization of this unit. To the south, one can also point out an open site on the Poprad River in Stará Ľubovňa (*Valde-Nowak/Soják/Wąs 2007*). Materials from old discoveries in the Gudenus Cave in Lower Austria (*Obermaier/Breuil 1908*) are probably related to Magdalenien, however from the older time as Hučivá diera Cave assemblage. A separate problem is the relationship between the Epigravettians and the Magdalenians in the watershed of the middle

Danube and the upper Vistula is becoming more and more relevant (*Lengyel et al. 2021*; *Wiśniewski et al. 2017*)

Among the distinguished groups of the Magdalenian culture, faunal references to the Hučivá diera Cave can be seen in the Danube group, stretching from the Swiss-German border to Franconia (*McCartin/Starkovich/Conard 2023*). In the sites of this group, apart from reindeer and horses, hunting of *Capra ibex* is confirmed, although these are not the main species. The distinct distinctiveness of the discovered blade forms, which only seem to represent shouldered points, but are illustrations of Creswell forms, is an important finding that sheds light both on the intergroup differentiation of the Magdalenians, as well as on the dynamics of contacts and even long-distance movements.

The simplest explanation for the originality of the Hučivá diera Cave inventory may be the distinctiveness of the environment around the cave, which we can define as a high-mountain periglacial area on a micro-scale. A clear focus on alpine ibexes also proves originality. It is also possible that Hučivá diera Cave was a point of animal dressing, in the sense of tanning skins on site. Many cut marks on the bones confirm the cutting of animal carcasses, and numerous lime packets lead to the conclusion that the skins were processed here with slaked lime. This aspect should be analysed in the future.

The repeatedly examined dating results of sites from various phases of Magdalenian development, along with more or less detailed conclusions regarding settlement dynamics, show the GRIP GI-1e phase as a time of widespread Magdalenian (*Miller 2012*) and the simultaneous emergence of units such as Creswellian and Hamburgian. The Hučivá diera Cave is part of this increase in Magdalenian activity in the younger part of this Bölling climatic phase.

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BIBLIOGRAPHY

Albrecht 1979 – G. Albrecht: *Magdalénien-Inventare vom Petersfels. Siedlungsarchäologische Ergebnisse der Ausgrabungen 1974–1976*. Tübinger Monographien zur Urgeschichte 6. Tübingen 1979.

Bartík et al. 2019 – J. Bartík/P. Škrdla/L. Šebela/A. Přichystal/L. Nejman: Mining and processing of the Stránská skála-type chert during the Late Neolithic and Early Eneolithic periods. *Archeologické rozhledy* 71, 2019, 373–417.
DOI: https://doi.org/10.35686/AR.2019.17

Barton et al. 2003 – R. N. E. Barton/R. M. Jacobi/D. Stapert/M. J. Street: The Late-glacial reoccupation of the British Isles and the Creswellian. *Journal of Quaternary Studies* 18/7, 2003, 631–643.
DOI: https://doi.org/10.1002/jqs.772

de Basterot 1825 – B. de Basterot: Description géologique du bassin tertiaire du sud-ouest de la France. *Mémoires de la Société d'Histoire Naturelle de Paris. Deuxième série* 2/1, 1825, 1–100.

Bella/Hlaváčová/Holúbek 2007 – P. Bella/I. Hlaváčová/P. Holúbek: *Zoznam jaskýň Slovenskej republiky. Stav k 30. 6. 2007*. Liptovský Mikuláš 2007.

Bella/Hlaváčová/Holúbek 2018 – P. Bella/I. Hlaváčová/P. Holúbek: *Zoznam jaskýň Slovenskej republiky. Stav k 31. 12. 2017*. Liptovský Mikuláš 2018.

Bobak/Połtowicz-Bobak 2018 – D. Bobak/M. Połtowicz-Bobak: Between Magdalenian and Epigravettian. A contribution to the study of Palaeolithic on the Polish-Ukrainian border. *Materialy i doslidzhennia z arkheolohii Prykarpattia i Volyni* 22, 2018, 42–53.
DOI: https://doi.org/10.33402/mdapv.2018-22-42-53

Bohmers 1956 – A. Bohmers: Statistics and Graphs in the Study of Flint Assemblages. II. A Preliminary Report on the Statistical Analysis of the Younger Palaeolithic in Northwestern Europe. *Palaeohistoria* 5, 1956, 7–25.

Bronk Ramsey 2001 – Ch. Bronk Ramsey: Development of the Radiocarbon Calibration Program. *Radiocarbon* 43, 2001, 355–363.
DOI: https://doi.org/10.1017/S0033822200038212

Burdukiewicz 1987 – J. M. Burdukiewicz: *Późnoplejstoceńskie zespoły z jednozadziorcami w Europie Zachodniej*. Studia Archeologiczne 14. Wrocław 1987.

Burdukiewicz et al. 2013 – J. M. Burdukiewicz/M. Koralewicz/D. Samulik/A. Szynkiewicz/J. Winnicki: Z badań

wielokulturowego stanowiska we Wrocławiu-Żernikach na obwodnicy autostradowej Wrocławia. *Śląskie Sprawozdania Archeologiczne* 55, 2013, 103–131.

Campbell 1977 – J. B. Campbell: *The Upper Palaeolithic of Britain: A Study of Man and Nature in the Late Ice Age*. Oxford 1977.

Cyrek/Sudoł-Procyk/Czyżewski eds. 2020 – K. Cyrek/M. Sudoł-Procyk/Ł. Czyżewski (eds.): *Late Magdalenian Campsite at Krucza Skała Rockshelter*. Toruń 2020.

d'Errico et al. 2018 – F. d'Errico/L. Doyon/S. Zhang/M. Baumann/M. Lázničková-Galetová/X. Gao/F. Chen/Y. Zhang: The origin and evolution of sewing technologies in Eurasia and North America. *Journal of Human Evolution* 125, 2018, 71–86.
DOI: https://doi.org/10.1016/j.jhevol.2018.10.004

Fiore/Tagliacozzo/Cassoli 1998 – I. Fiore/A. Tagliacozzo/P. F. Cassoli: Ibex exploitation at Dalmeri rockshelter (TN) and 'specialized hunting' in the sites of the Eastern Alps during the Tardiglacial and the Early Holocene. *Preistoria alpina* 34, 1998, 173–183.

Gauvrit Roux 2022 – E. Gauvrit Roux: Socio-economic dynamics of Magdalenian hunter-gatherers: Functional perspective. *PLoS ONE* 17/10, 2022, e0274819.
DOI: https://doi.org/10.1371/journal.pone.0274819

Harzhauser/Guzhov/Landau 2023 – M. Harzhauser/A. Guzhov/B. Landau: A revision and nomenclator of the Cainozoic mudwhelks (Mollusca: Caenogastropoda: Batillariidae, Potamididae) of the Paratethys Sea (Europe, Asia). *Zootaxa* 5272/1, 2023, 1–241.
DOI: https://doi.org/10.11646/zootaxa.5272.1.1

Höneisen/Peyer 1994 – M. Höneisen/S. Peyer: *Schweizersbild – ein Jägerlager der Späteiszeit. Beiträge und Dokumente zur Ausgrabung vor 100 Jahren*. Schaffhauser Archäologie 2. Zürich 1994.

Horáček et al. 2015 – I. Horáček/V. Ložek/M. Knitlová/L. Juřičková: Darkness under candlestick: glacial refugia on mountain glaciers. In: S. Sázelová/M. Novák/A. Mizerová (eds.): *Forgotten times and spaces. New perspectives in paleoanthropological, paleoetnological and archeological studies*. Brno 2015, 363–377.

Inizian et al. 1999 – M.-L. Inizan/M. Reduron-Ballinger/H. Roche/J. Tixier: *Technology and Terminology of Knapped Stone*. Préhistoire de la Pierre Taillé e 5. Translated by J. Féblot-Augustins. Nanterre 1999.

Jura 1955 – A. Jura: Grota Magury w Tatrach (1460 m), najwyżej w Polsce położona siedziba człowieka epoki lodowej. *Światowit* 21, 1955, 81–124.

Kabaciński/Sobkowiak-Tabaka 2012 – J. Kabaciński/I. Sobkowiak-Tabaka: The Eastern extension – new data on the Hamburgian in Poland. In: M. J. L. Th. Niekus/R. N. E. Barton/M. Street/Th. Terberger (eds.): *A mind set on flint. Studies in honour of Dick Stapert*. Groningen Archaeological Studies 16. Groningen 2012, 71–88.

Kaminská zost. 2014 – Ľ. Kaminská (zost.): *Staré Slovensko 2. Paleolit a mezolit*. Archaeologica Slovaca Monographiae. STASLO 2. Nitra 2014.

Kapustka et al. 2023 – K. Kapustka/N. Koštová/L. Kovačiková/E. Zazvonilová/S. Floriánová: The Magdalenian site of Hostim, Czech Republic, Central Europe. New insights into the old Record: Seasonality within the Bohemian Magdalenian. *Journal of Archaeological Science: Reports* 51, 2023, 104117.
DOI: https://doi.org/10.1016/j.jasrep.2023.104117

Y. Kedar/G. Kedar/Barkai 2019 – Y. Kedar/G. Kedar/R. Barkai: Setting fire in a Paleolithic Cave: The influence of cave dimensions on smoke dispersal. *Journal of Archaeological Science: Reports* 29, 2019, 102112.
DOI: https://doi.org/10.1016/j.jasrep.2019.102112

Kłapyta et al. 2016 – P. Kłapyta/J. Zasadni/J. Pociask-Karteczka/A. Gajda/P. Franczak: Late Glacial and Holocene paleoenvironmental records in the Tatra Mountains, East-Central Europe, based on lake, peat bog and colluvial sedimentary data: A summary review. *Quaternary International* 415, 2016, 126–144.
DOI: https://doi.org/10.1016/j.quaint.2015.10.049

Kostrhun 2005 – P. Kostrhun: Štípaná industrie magdalénienu z jeskyně Kůlny. *Acta Musei Moraviae. Scientiae sociales* 90, 2005, 79–128.

Kowalski 2014 – T. Kowalski: Various Uses of Igneous, Metamorphic and Sedimentary Rocks in the Camp of Wilczyce. In: R. Schild (ed.): *Wilczyce. A Late Magdalenian Winter Hunting Camp in Southern Poland*. Warszawa 2014, 295–317.

Leesch/Bullinger/Müller 2019 – D. Leesch/J. Bullinger/W. Müller: *Vivre en Suisse il y a 15000 ans. Le Magdalénien. Préhistoire de la Suisse*. Bâle 2019.

Leesch et al. 2012 – D. Leesch/W. Müller/E. Nielsen/J. Bullinger: The Magdalenian in Switzerland: Re-colonization of a newly accessible landscape. *Quaternary International* 272–273, 2012, 191–208.
DOI: https://doi.org/10.1016/j.quaint.2012.04.010

Lengyel et al. 2021 – G. Lengyel/A. Bárány/S. Béres/F. Cserpák/M. Gasparik/I. Major/M. Molnár/A. Nadachowski/A. Nemergut/J. Svoboda/A. Verpoorte/P. Wojtal/J. Wilczyński: The Epigravettian chronology and the human population of eastern Central Europe during MIS2. *Quaternary Science Reviews* 271, 2021, 107187.
DOI: https://doi.org/10.1016/j.quascirev.2021.107187

Lisá et al. 2013 – L. Lisá/P. Neruda/Z. Nerudová/A. Bajer: Geoarcheologický záznam středního a mladého paleolitu v jeskyni Kůlně, Moravský kras. *Acta Musei Moraviae. Scientiae sociales* 98, 2013, 197–214.

Maier 2015 – A. Maier: *The Central European Magdalenian. Regional Diversity and Internal Variability*. Vertebrate Paleobiology and Paleoanthropology. Dordrecht – New York 2015.

Maier/Liebermann/Pfeifer 2020 – A. Maier/C. Liebermann/S. J. Pfeifer: Beyond the Alps and Tatra Mountains – the 20–14 ka Repopulation of the Northern Mid-latitudes as Inferred from Palimpsests Deciphered with Keys from Western and Central Europe. *Journal of Paleolithic Archaeology* 3, 2020, 398–452.
DOI: https://doi.org/10.1007/s41982-019-00045-1

Makos 2015 – M. Makos: Deglaciation of the High Tatra Mountains. *Cuadernos de Investigación Geográfica* 41/2, 2015, 317–335.
DOI: https://doi.org/10.18172/cig.2697

McCartin/Starkovich/Conard 2023 – M. J. McCartin/B. M. Starkovich/N. J. Conard: New insights into Magdalenian subsistence at Petersfels (Hegau Jura, southwestern Germany). *Quaternary Science Reviews* 322, 2023, 108417.
DOI: https://doi.org/10.1016/j.quascirev.2023.108417

Miller 2012 – R. Miller: Mapping the expansion of the Northwest Magdalenian. *Quaternary International* 272–273, 2012, 209–230.
DOI: https://doi.org/10.1016/j.quaint.2012.05.034

Nejman et al. 2018 – L. Nejman/L. Lisá/N. Doláková/I. Horáček/A. Bajer/J. Novák/D. Wright/M. Sullivan/R. Wood/R. H. Gargett/M. Pacher/S. Sázelová/M. Nývltová Fišáková/J. Rohovec/M. Králík: Cave deposits as a sedimentary trap for the Marine Isotope Stage 3 environmental record: The case study of Pod Hradem, Czech Republic. *Palaeogeography, Palaeoclimatology, Palaeoecology* 497, 2018, 201–217. DOI: https://doi.org/10.1016/j.palaeo.2018.02.020

Nielsen 2016 – E. H. Nielsen: Eine jungpaläolithische Kerbspitze aus Bergkristall von Kottwil-seewagen 24 (Kt. Luzern/CH). *Archäologisches Korrespondenzblatt* 46, 2016, 431–443.

Obermaier/Breuil 1908 – H. Obermaier/H. Breuil: *Die Gudenushöhle in Niederösterreich*. Vienna 1908.

Paczkowski 2020 – M. Paczkowski: Zabytki kamienne. In: M. Przeździecki/W. Migal (red.): *Na granicy światów. Obozowisko kultury magdaleńskiej w Ćmielowie, woj. świętokrzyskie*. Warszawa 2020, 244–278.

Paczkowski/Przeździecki 2021 – M. Paczkowski/M. Przeździecki: Bowl-Shaped Stone Objects From The Magdalenian Site Ćmielów 95 'Mały Gawroniec'. *Wiadomości Archeologiczne* 72, 2021, 171–178. DOI: https://doi.org/10.36154/wa.72.2021.07

Pasda 2018 – C. Pasda: An essay on the archaeostratigraphy of the Magdalenian and the Final Palaeolithic in Central Germany. In: *Valde-Nowak et al. eds. 2018*, 167–173.

Połtowicz-Bobak 2013 – M. Połtowicz-Bobak: *Wschodnia prowincja magdalenienu*. Rzeszów 2013.

Schild et al. 2011 – R. Schild/H. Królik/A. J. Tomaszewski/E. Ciepielewska: *Rydno. A Stone Age Red Ochre Quarry and Socioeconomic Center. A Century of Research*. Warsaw 2011.

Sedlmeier 2015 – J. Sedlmeier: *Die letzten Wildbeuter der Eiszeit. Neue Forschungen zum Spätpaläolithikum im Kanton Basel-Landschaft*. Schriften der Archäologie Baselland 51. Basel 2015.

Soják 2024 – M. Soják: *Jaskyne na Slovensku ako objekty archeologického a historického poznania*. Nitra 2024.

Soják et al. 2019 – M. Soják/M. Cieśla/A. Kraszewska/K. Rak/J. Skłucki/P. Valde-Nowak: Pierwsze wyniki wykopalisk w Jaskini Huciva w Tatrach Bielskich. In: W. Wróblewski/P. Sala (red.): *Materiały 53. Sympozjum Speleologicznego. Szczawnica 10.–13. 10. 2019*. Kraków 2019, 73.

Soják/Struhár 2014 – M. Soják/V. Struhár: Pozoruhodné nálezy antických mincí z prostredia jaskýň. *Denarius* 4, 2014, 5–9.

Soják/Valde-Nowak 2019 – M. Soják/P. Valde-Nowak: Magdalenian key forms in Late Palaeolithic stone inventory in Huciva cave. In: A. Nemergut/I. Cheben/J. Ruttkayová/K. Pyżewicz (eds.): *16th SKAM Lithic Workshop. 'Fossil Directeur'. A Phenomenon over Time and Space. 21–23 October 2019 Nitra, Slovak Republic. Abstract Book*. Nitra 2019, 42.

Soják/Valde-Nowak 2021 – M. Soják/P. Valde-Nowak: Paleolitické osídlenie jaskyne Hučivá diera v Belianskych Tatrách. *Východoslovensky pravek* 12, 2021, 5–11.

Stapert 1985 – D. Stapert: A small Creswellian site at Emmerhout (province of Drenthe, the Netherlands). *Palaeohistoria* 27, 1985, 1–65.

Stordeur-Yedid 1979 – D. Stordeur-Yedid: *Les aiguilles à chas au Paléolithique*. Editions du C.N.R.S., XII' supplément à Gallia-Prehistoire 1. Paris 1979.

Šimková 2006 – Z. Šimková: Osídlenie jaskýň Liptova. (História speleoarcheologických výskumov a nálezov na Liptove.) *Slovenský kras* 44, 2006, 119–141.

Šimková 2014 – Z. Šimková: Jaskyňa Dúpnica v Západných Tatrách a jej okolie v praveku. *Sinter* 22, 2014, 14–18.

Taller/Bolus/Conard 2012 – A. Taller/M. Bolus/N. J. Conard: The Magdalenian of Hohle Fels Cave and the Resettlement of the Swabian Jura after the LGM. In: M. Otte/F. le Brun-Ricalens (coord.): *Modes de contacts et de déplacements au Paléolithique eurasiatique – Modes of contact and mobility during the Eurasian Palaeolithic. Actes du Colloque international de la commission 8 (Paléolithique supérieur) de l'UISPP. Université de Liège, 28–31 mai 2012*. Liège 2012, 383–399.

Valde-Nowak 1991 – P. Valde-Nowak: Studies in Pleistocene settlement in the Polish Carpathians. *Antiquity* 65, 1991, 593–606. DOI: https://doi.org/10.1017/S0003598X00080248

Valde-Nowak et al. 2018 – P. Valde-Nowak/A. Kraszewska/M. Cieśla/A. Nadachowski: Late Magdalenian campsite in a rock shelter at the Obłazowa Rock. In: *Valde-Nowak et al. eds. 2018*, 175–183.

Valde-Nowak et al. 2022 – P. Valde-Nowak/M. Baca/M. Cieśla/J. Kościuk-Załupka/A. Kraszewska/A. Lemanik/A. Nadachowski/D. Popović/J. Skłucki/M. Sojak: Hučivá Cave: a Magdalenian hunting camp in the Tatra Mountains. *Antiquity* 96, 2022, 1008–1014. DOI: https://doi.org/10.15184/aqy.2022.60

Valde-Nowak et al. 2024 – P. Valde-Nowak/K. Kerneder-Gubała/M. Kowal/J. Kościuk-Załupka/A. Kraszewska/K. Makuła/J. Skłucki: Archaeological research of three caves in the Tatra Mountains in 2019–2023. *Acta Archaeologica Carpathica* 59, 2024, 11–40. DOI: https://doi.org/10.4467/00015229AAC.24.002.21115

Valde-Nowak et al. eds. 2018 – P. Valde-Nowak/K. Sobczyk/M. Nowak/J. Źrałka (eds.): *Multas per gentes et multa per saecula. Amici magistro et collegae suo 10anni Christopho Kozłowski dedicant*. Kraków 2018.

Valde-Nowak/Soják 2018 – P. Valde-Nowak/M. Soják: Paleolithic Man in the Tatra Mountains. *Acta Archaeologica Carpathica* 53, 2018, 37–48.

Valde-Nowak/Soják/Wąs 2007 – P. Valde-Nowak/M. Soják/M. Wąs: On the Problems of Late Paleolithic Settlement in Northern Slovakia. Example of Stará Ľubovňa Site. *Slovenská archeológia* 55, 2007, 1–22.

Valoch 2002 – K. Valoch: Die Magdalénien-Fundstelle an der Ochoser-Höhle im Mährischen Karst. Ein Beitrag zur Problematik des Magdalénien in Mähren. In: J. Svoboda (ed.): *Prehistorické jeskyně. Katalogy, dokumenty, studie – Prehistoric Caves. Catalogues, Documents, Studies*. Dolnověstonické studie 7. Brno 2002, 183–225.

Valoch/Neruda 2005 – K. Valoch/P. Neruda: Kchronologii moravského magdalénienu. *Archeologické rozhledy* 57, 2005, 459–476.

Velliky et al. 2019 – E. C. Velliky/A. Barbieri/M. Porr/N. J. Conard/B. L. MacDonald: A preliminary study on ochre sources in Southwestern Germany and its potential for ochre provenance during the Upper Paleolithic. *Journal of Archaeological Science: Reports* 27, 2019, 101977.

Vliet-Lanoë 2010 – B. V. Vliet-Lanoë: 6 – Frost Action. In: G. Stoops/V. Marcelino/F. Mees (eds.): *Interpretation of Micromorphological Features of Soils and Regoliths*. Amsterdam 2010, 81–108. DOI: https://doi.org/10.1016/B978-0-444-53156-8.00006-4

Weber 2009 – M.-J. Weber: Fabrication and Use of Hamburgian Shouldered Points: New Data from Poggenwisch and Teltwisch 1 (Ahrensburg Valley, Schleswig-Holstein, Germany). *Palethnologie* 1, 2009, 98–132.
DOI: https://doi.org/10.4000/palethnologie.9361

Weber 2012 – M.-J. Weber: *From technology to tradition – Re-evaluating the Hamburgian-Magdalenian relationship*. Untersuchungen und Materialien zur Steinzeit in Schleswig-Holstein und im Ostseeraum 5. Neumünster 2012.

Wiśniewski et al. 2017 – A. Wiśniewski/M. Połtowicz-Bobak/D. Bobak/Z. Jary/P. Moska: The Epigravettian and the Magdalenian in Poland: New chronological data and an old problem. *Geochronometria* 44, 2017, 16–29.
DOI: https://doi.org/10.1515/geochr-2015-0052

Zwoliński 1955 – S. Zwoliński: Tatrzański rejon jaskiniowy. *Światowit* 21, 1955, 49–80.

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Tri sezóny výskumu v jaskyni Hučivá diera v slovenských Tatrách

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SÚHRN

Z pohľadu archeológie dnes možno sotva uvažovať o úlohe tatranského masívu pri prenikaní človeka v období praveku. Na slovenskej strane Tatier je známa jediná jaskynná archeologická lokalita, avšak bez stôp osídlenia z doby kamennej. V jaskyni Dúpnica (k. ú. Liptovské Matiašovce) v Západných Tatrách sa našli pamiatky (keramika, kovové artefakty, paleozoologický a antropologický materiál), datované do mladšej doby bronzovej, staršej i mladšej doby železnej a z mladších období.

V prípade poľských Tatier je situácia odlišná. Hlavný jaskyniar 19. stor. G. Ossowski sa snažil do vtedajšieho výskumu zahrnúť tiež tatranské jaskyne. Tak pre neho, ako aj pre jeho archeologických nasledovníkov v 30. rokoch 20. stor. sa tieto pokusy skončili s negatívnym výsledkom. Objektom záujmu archeológov bola od polovice 19. stor. jaskyňa Magura v poľských Tatrách, v ktorej sa neúspešne hľadali stopy prítomnosti pravekého človeka. Napriek odvolávaniu sa na vtedajšie vedecké autority, údajné kostené a kamenné artefakty z tejto jaskyne sa nakoniec nepotvrdili. Téma pravekého osídlenia v poľských Tatrách je tak dodnes prakticky uzavretá.

Pri speleologických prácach sa neraz, hoci náhodne a s iným zámerom (prednostne objav nových priestorov), objavia pozoruhodné archeologické nálezy. Preto sa ako ideálna ukazuje spolupráca jaskyniarov s archeológmi. Na sklonku r. 2018 sa podarilo M. Sojákovi v jaskyni Hučivá diera v Belianskych Tatrách (k. ú. Tatranská Lomnica) objaviť v profile jaskyniarskeho výkopu prvé praveké artefakty (*Soják/Valde-Nowak 2019*; *2021*). Autori predloženého príspevku ich predbežne zaradili do magdalénienskeho technokomplexu (*Valde-Nowak/Soják 2018*).

Jaskyňa s celkovou dĺžkou 16 m sa nachádza v nadmorskej výške 936 m, v skalnom brale na južnom svahu Kobylieho vrchu (1109 m n. m.) v Belianskych Tatrách, v blízkosti „Šumivého prameňa" (*Rausch Quelle*; obr. 2: 1). Vyvinula sa v ramsauských dolomitoch (*trias*, *fatrikum*) na zlomovej diskontinuite, ktorá predurčuje vznik horizontálnej jaskynnej chodby s vysokým stropom. Portálový

vchod trojuholníkového tvaru so základňou približne 4 m a výškou viac ako 2 m je reliktom horizontálnej (freatickej) jaskynnej chodby s dĺžkou 10 m (obr. 1: 3–5). Na konci jaskynnej chodby, kde sa nachádza miesto výkopu archeologického profilu, sa strop jaskyne prudko dvíha a pokračuje až k vrcholovej plošine vertikálnym komínom (obr. 1: 6). Úzky komín je vo vrchnej časti dnes už zatarasený skalami a zeminou, čo bráni jeho otvoreniu na povrch. Známky mrazového zvetrávania dokumentujú úlomky hornín a gravitačný rozpad, nahromadené v jaskyni a v jej blízkosti. Odtrhové plochy skalného rozpadu sú v súčasnosti zahladené zvetrávaním a rozpúšťaním presakujúcou vodou. Možno predpokladať, že v čase využívania jaskyne človekom bol uvedený komín otvorený a mohol tak odvádzať z jej interiéru dym z ohniska.

Archeologický ústav SAV, v. v. i. a Archeologický ústav Jagelovskej univerzity v Krakove podnikli v r. 2019 prvé záchranné práce, ktoré pokračovali ako systematický archeologický výskum v r. 2022 (*Soják et al. 2019*; *Soják/Valde-Nowak 2019*; *2021*; *Valde-Nowak et al. 2022*) a 2024. Počas výskumu sa detailne dokumentovali kamenné a iné artefakty, kosti a rastlinné mikrofosílie. Jaskynné sedimenty sa odkrývali v tenkých vrstvách (5 cm), pričom sa skúmala sieť o veľkosti 0,25 m^2, tvoriaca základnú výkopovú jednotku. Celý sediment sa preosieval za mokra na sitách s veľkosťou ôk menšou ako 1 mm (obr. 2: 2). Sedimenty sa skúmali v dvoch výkopoch. Jeden z nich sa nachádzal vo vstupnom otvore – v mieste, kde sa naplánovala a nakoniec aj realizovala (r. 2020) inštalácia vstupnej uzamykateľnej kovovej mreže. Doteraz boli sedimenty preskúmané na ploche približne 20 m^2, do hĺbky 250 cm. Skalné dno nebolo dosiahnuté v žiadnej časti výkopu.

Výkopové práce umožnili rozpoznať stratigrafiu s deviatimi hlavnými hlinito-kamenitými vrstvami, pričom vrstva 6 má niekoľko variantov. Vrchné vrstvy 1–4 vznikli v holocéne. Vrstva 1 je novoveká udupaná vrstva a pozostatky speleologickej haldy. Našli sa v nej dve mince Slovenského štátu a nábojnica z 2. svetovej vojny. Vrstvy 2 a 3 obsahujú nepočetný včasnonovoveký keramický materiál, ktorý súvisí s horizontom 16. stor. Vrstva 4 je prechodná. Paleolitické artefakty spočívali vo vrstvách 5–8, ale ich hlavný výskyt sa viaže s vrstvou 6a, ktorá reprezentuje stopy po väčšom ohnisku. Vrstva 9 – ílovito-hlinitá, tmavožltej farby – je archeologicky i paleontologicky sterilná a vznikla pravdepodobne v LGM (obr. 3).

Z uhlíkov pochádzajúcich z ohniska sa získali dve AMS dáta: 12190 ± 60 BP (Poz-114742: 12316–11896 cal BC) a 12160 ± 60 BP (Poz-114743: 12260–11868 cal BC). V uvedenom ohnisku sa našla aj čeľusť kozorožca, ktorej absolútny vek je 12160 ± 60 BP (Poz-126122: 12270–11860 cal BC). Z jamy 6b susediacej s ohniskom boli získané ďalšie dve dáta z uhlíkov 12280 ± 60 BP (Poz-162378: 12542–12108 cal BC) a 12200 ± 50 BP (Poz-162379: 12367–12065 cal BC), čo poukazuje na súvekosť s ohniskom, ktorá je dodatočne potvrdená stratigraficky. O niečo skorší dátum bol získaný z konskej čeľuste, nájdenej mimo výkopu v hlbšej časti západnej jaskynnej chodby, ktorá sčasti zasintrovaná vyčnievala z nepreskúmaného sedimentu; jej absolútny vek je 12400 ± 50 BP (Poz-154006: 12920–12258 cal BC). Všetky tieto údaje poukazujú na interštadiál bölling (GI 1e).

Vzorka uhlíkov z vrchnej kultúrnej vrstvy č. 2 poskytla včasnonovoveké datovanie, ktoré zodpovedá získanej tenkostennej keramike z tejto vrstvy 365 ± 30 (Poz-156266: 1453–1635 cal AD).

Južný profil (na hranici metrov A a B) bol vybraný ako najrelevantnejší pre účely stratigrafie a environmentálneho výskumu (obr. 3). Jeho doplnenie o podlahové časti sa uskutočnilo v sezóne 2024 (obr. 4).

Výsledkom dvoch výskumných sezón je 812 ks získaných kamenných artefaktov. Ich surovinové určenie je v niektorých prípadoch ťažko určiteľné kvôli patine. Časť bola vyrobená z rádiolaritu (77,83 %), ale vyskytujú sa tiež artefakty zo surovín, ako sú rôzne pazúriky z územia Poľska a Volyne (19,95 %), limnosilicit zo stredného Slovenska alebo z pohraničia medzi severným Maďarskom a Slovenskom (*Kaminská zost. 2014*), ako aj rohovec typu Stránska skála (minimálne jeden kus) z oblasti Moravy (*Bartík et al. 2019*). Podiel jednotlivých pazúrikových odrôd je nasledovný: jurský podkrakovský – 41, čokoládový – 26, typ Bircza – 11, volýnsky – 4, neurčený – 80 kusov. Pazúrik typu Bircza je pokladaný za dobrý indikátor magdalénienu v jeho východnej provincii. Na zmenu pôvodných vlastností silicitových výrobkov mala okrem úložných pomerov vo vlhkých jaskynných sedimentoch vplyv aj blízkosť ohňa. Mnohé vzorky vykazujú stopy menšieho či väčšieho prepálenia, čo má za následok zmenu lesku, textúry a poškodenie štruktúry horniny.

Medzi touto pozoruhodnou čepeľovou industriou sa vyskytli 3 jadrá, 108 úštepov (bez mikroúštepov), 162 čepelí a 103 nástrojov. Jadrá sú mimoriadne vyťažené. Napriek tomu vždy reprezentujú čepeľovú technológiu. Všetky jadrá sú jednopodstavové a so zmenenou orientáciou. Jedno z jadier má tvar plochej formy vyrobenej pravdepodobne na masívnom úštepe. Zachovalo sa v extrémne exploatovanej podobe (obr. 5: 1). Ďalšie možno považovať za mikroformu so znakmi kónického tvaru a je vo veľmi pokročilom štádiu používania (obr. 5: 2). Na treťom možno sledovať stopy po opakovanom neúspešnom oddeľovaní úštepov v podobe tzv. závesu (obr. 5: 3). Pri hodnotení použitej technológie možno zdôrazniť vysokú technickú úroveň. Uhol jadra sa postupne zdokonaľoval, o čom svedčia negatívy na úderovej ploche. Bežne sa používalo mäkké kladivo. Čepele často reprezentujú bodovú pätku s rímsou – *en éperon*. Objavujú sa aj odštiepované/redukované pätky na čepeliach a čepieľkach. Maximálne využitie týchto exemplárov je pôsobivé.

Najcharakteristickejšími nástrojmi sú hroty (obr. 6). Niektoré z nich pripomínajú hroty s vrubom (*Bohmers 1956*; *Maier 2015*), ako aj exempláre podobné masívnym trojuholníkom typu Creswell (*Stapert 1985*). Jeden exemplár možno pokladať za hrot typu Cheddar (*Barton et al. 2003*). Nachádzajú sa tu aj priebojníky, vrátane silne opotrebovaného exemplára s nachýleným tŕňom typu Zinken. Prítomné sú aj čepele so šikmo retušovaným koncom. Dôležitá je skutočnosť, že sú prítomné i čepieľky s otupeným bokom.

Štatistiku v skupine nástrojov možno prezentovať nasledovne: hroty – 31, rydlá – 6, čepele s otupeným bokom – 17, kombinované (koncové škrabadlo + jemný priebojník) – 2, priebojníky a vrtáky – 20, retušované čepele – 18, mikročepele s otupeným bokom – 9, koncové škrabadlo – 1, nástroj s vrubom – 1 kus.

V sezóne 2019 bola v jaskyni Hučivá diera objavená jedna ulita (obr. 7: 4). Ide o fosílnu miocénnu ulitu druhu *Tiaracerithium pictum* (*de Basterot 1825*), veľmi variabilného a v Paratethyskom mori hojne rozšíreného druhu ulitní-

ka, známeho z mnohých lokalít v Poľsku, na Slovensku a Morave (*Harzhauser/Guzhov/Landau 2023*, 144–153). Exemplár je perforovaný dvoma podobne vyhotovenými otvormi. Takmer identický exemplár, rovnako perforovaný dvoma otvormi, bol v skúmanej jaskyni nájdený v sezóne 2024.

Z ohniska pochádza jedna celá (zachovaná v dvoch fragmentoch) a dva ďalšie zlomky kostenej ihly (obr. 7: 2, 3). Pozornosť si zasluhuje fragment mierne prepáleného pieskovcového artefaktu, ktorý s najväčšou pravdepodobnosťou predstavuje lampu na svietenie. Na jej vnútornej ploche sa zistili nepatrné stopy neznámej organickej substancie (obr. 7: 6). Takéto či blízke lampy sú neoddeliteľnou súčasťou magdalénienskej kultúry aj na území Poľska, napr. v Ćmielowe (*Paczkowski 2020*; *Paczkowski/Przeździecki 2021*) a Wilczycach (*Kowalski 2014*). Súčasťou inventára je kostené šidlo (obr. 7: 1) a nástroj z kosti rysa, ktorý je výrazne opracovaný; jeho hrot je zatupený, čo svedčí o intenzívnom používaní (obr. 7: 5). Zo sezóny 2019 nechýbajú viaceré hrudky analyzovaného okrového farbiva.

Vo všetkých vrstvách sa našli zvieracie kosti a zuby. Najviac sa ich vyskytlo v kultúrnych vrstvách 6 a 6a, ako aj vo vrstve 5. Pozostatky patria cicavcom (bolo určených viac ako 25 taxónov) a vtákom (viac ako 15 druhov), ktoré dopĺňajú menej početné obojživelníky a vzácne slimáky. Celkovo bolo na úrovni druhov alebo rodov identifikovaných takmer 500 pozostatkov malých a veľkých cicavcov a bezmála 370 kostí vtákov. Spomedzi väčších cicavcov, ktoré boli lovené magdalénienskymi lovcami, prevládajú vo fosílnych súboroch kultúrnych vrstiev 6, 6a, 6b a vrstvy 5 fragmenty kostí a zuby kozorožca alpského (*Capra ibex*), pričom na niektorých kostiach sú prítomné početné stopy po rezoch (obr. 8: 1, 3). Pozostatky divých koní (*Equus ferus*) boli menej početné, ako aj stopy po intencionálnych zásahoch. Identifikované zostali tiež kamzíky (*Rupicapra rupicapra*; obr. 8: 2) a jelene (*Cervus elaphus*), kým daniele (*Dama dama*) a zubry (*Bos primigenius*) boli zastúpené len ojedinelými exemplármi. Pozostatky mäsožravcov sú doložené medveďom hnedým (*Ursus arctos*), líškou obyčajnou (*Vulpes vulpes*), rysom ostrovidom (*Lynx lynx*) a najmenej štyrmi druhmi z čeľade lasicovitých (*Mustelidae*). Najpočetnejšie pozostatky patria medveďovi hnedému. V jaskyni Hučivá diera sú drobné cicavce zastúpené 12 taxónmi hlodavcov a hmyzožravými cicavcami (krtkovia, netopiere a vretenica), ale ich pozostatkov sa našlo málo.

Skúmaný sediment z jaskyne sa vyznačoval nízkou frekvenciou peľu a zároveň nízkou taxonomickou diverzitou sporomorfov, medzi ktorými bolo determinovaných len 36 taxónov (vrátane 9 taxónov kryptogamov). Na základe taxonomického zloženia a frekvencie hlavných morfologických typov peľu boli v schéme vyčlenené dve peľové sekcie. Starší peľ reprezentujúci neskorý glaciál sa vyznačoval prevahou peľu borovice lesnej typu *Pinus sylvestris* (prípadne zahŕňal aj peľ kosodreviny *Pinus mugo*; až 64 %) a smreka obyčajného (*Picea abies*; až 14 %), ako aj veľmi vysokou frekvenciou peľu bylín. Spomedzi stromových taxónov sa zistil riedky peľ typu *Pinus haploxylon* (pravdepodobne reprezentujúci borovicu limbovú; *Pinus cembra*; do 2 %), brezy (*Betula*; 1,1 %), ako aj borievky (*Juniperus*; 0,7 %). Podiel nelesného peľu (22–72 %; v priemere 46 %) bol vysoký a pozostával najmä zo zástupcov podčeľade *Cichorioideae* (až 67 % vo vzorke 9), tráv (*Poaceae*; do 6 %), ostrice (*Cyperaceae*; do 6 % a *Epilobium*; do 4 %). Mladšia peľová zóna predstavuje holocén, ktorý odhaľuje úplne iný obraz vegetácie. Frekvencia peľu stromov bola oveľa vyššia. V spektrách spoluvládol peľ smreka obyčajného (až 48 %) a borovice lesnej (v priemere 40–57 %). Stanovený bol aj peľ jedle (*Abies alba* do 9 %). Zastúpenie peľu listnatých drevín vrátane mezofilného duba, brezy (*Betula*), liesky (*Corylus avellana*), lipy (*Tilia cordata*) a jelše (*Alnus*) bolo nízke a len vo vzorke 5 dosiahlo celkovo 7 %.

Uhlíky a zvyšky driev boli silne degradované, sklovité, často penetrované vápenatým plastickým sintrom a zriedkavo presahovali veľkosť 2 mm. To sťažovalo taxonomické určenie, čo viedlo k medzidruhovému (napr. *Salix*/*Populus*) a pravdepodobnému určeniu (por. *Juniperus*) alebo širšej kategórii taxónov (napr. listnaté, ihličnaté). Pri hodnotení sa taxóny určené s pravdepodobnosťou kombinovali s určeným taxónom (napr. *Salix* a cf. *Salix*). Taxonomicky určených 500 fragmentov uhlíkov a mineralizovaného dreva predstavuje jednu tretinu súboru, z ktorých jedna tretina bola priradená k rodom alebo druhom.

Doterajšie nálezy v jaskyni Hučivá diera sú komplexné a prinášajú nový pohľad do viacerých vedných disciplín.

Význam získaných výsledkov spočíva predovšetkým v tom, že ide s najväčšou pravdepodobnosťou o jednu fázu osídlenia tohto miesta ľudom magdalénienskej kultúry. Nevedno posúdiť či išlo o jeden súvislý pobyt skupiny lovcov, alebo o niekoľko pobytov v jednom alebo viacerých obdobiach. Jedným zo znakov opakovaného navštevovania jaskyne je pravdepodobne prítomnosť klastickej akumulácie vápenca v rámci vrstvy 6. Táto akumulácia odráža sedimentačný hiát, ktorý rozdelil vrstvu 6 na tri sedimentačné stupne. Spodná a vrchná časť odráža prítomnosť človeka v dôsledku akumulácie drevených uhlíkov, zatiaľ čo samotná akumulácia je výsledkom prirodzeného prepadu stropu. Tento typ sedimentácie je typický pre koniec najchladnejších období v jaskynnom prostredí (*Nejman et al. 2018*). Jedinou vrstvou vykazujúcou podmienky LGM, ktorá sa odráža v šošovkovitej mikroštruktúre, je vrstva 9. Takáto mikroštruktúra je typická pre procesy zmrazovania/rozmrazovania (*Vliet-Lanoë 2010*) a podobná bola pozorovaná napríklad v LGM vrstvách jaskyne Kůlna v Moravskom krase (*Lisá et al. 2013*) alebo jaskyne Pod hradom (*Nejman et al. 2018*). Napriek tomu máme z hľadiska archeologickej periodizácie a s prihliadnutím na mimoriadne prísne výsledky AMS datovania dôvod považovať získané artefakty za homogénnu skupinu. Na vrchole sekvencií nezabúdame ani na včasnonovoveké a neskoronovoveké stopy osídlenia z obdobia 2. svetovej vojny.

Pri pohľade na inventár kamenných artefaktov je potrebné zdôrazniť extrémne redukovanú dielenskú časť. Iba tri nájdené jadrá vo veľmi používanej podobe sú dokladom výrazného obmedzenia možností obnovy inventára jeho užívateľmi. Na spektrum surovín zreteľne poukazuje aj výrazná skupina pazúrikových nástrojov, teda zo surovín dovezených zďaleka. Keďže všetky tri nájdené jadrá sú vyrobené z miestneho rádiolaritu a nie z pazúrika, možno konštatovať, že pazúrikové čepele sú pozostatkom pôvodnej výbavy lovcov, s ktorou prišli do tatranskej oblasti, a ktorá bola následne obnovená s použitím miestnych surovín, najmä rádiolaritu.

Vlastnosti série kamenných hrotov sú mimoriadne osobité. Nie je ľahké nájsť o nich zmienky v inventároch

východnej magdalénienskej provincie (*Bobak/Połtowicz-Bobak 2018*). Nepoznáme ich ani z Moravy (napr. *Kapustka et al. 2023*) a tiež z niekoľkých slovenských lokalít, ktoré sú považované za magdalénienske (*Kaminská zost. 2014*, 288–296; *Valde-Nowak/Soják/Wąs 2007*). Pri hrotoch z Hučivej diery sa možno odvolať na *J. B. Campbellov* (*1977*) návrh označovania nástrojov, ktoré sú blízke hrotom s vrubmi, ale sú od nich odlišné. Ide o hroty Creswellienu (Campbellov typ AC l). V inventároch súvisiacich s creswellskou tradíciou prevládajú z našej jaskyne exempláre vo všeobecnosti podobné hrotom s vrubom, ale bez zvýrazneného vrubu, ako to možno vidieť na hamburských hrotoch (*Burdukiewicz 1987*; *Kabaciński/Sobkowiak-Tabaka 2012*; *Weber 2009*; *2012*) a tiež, hoci sa vyskytujú zriedkavo, hroty magdalénienske, známe napr. z lokalít Etzdorf (*Pasda 2018*) a Petersfels (*Albrecht 1979*; *Maier/Liebermann/Pfeifer 2020*) a na niektorých švajčiarskych náleziskách, ako je Schweizersbild (*Höneisen/Peyer 1994*). Viac-menej typické hroty s vrubom typu A2 podľa *J. M. Burdukiewicza* (*1987*) boli rozlíšené aj v inventári z Hučivej diery, aj keď v menšom počte ako typické creswellské artefakty.

Stojíme tu pred klasickým problémom chápania magdalénsko-hamburských vzťahov, v ktorom je účasť hrotov s vrubom primárnym prvkom. Možno pripomenúť, že kľúčovým prvkom pre rozlíšenie hamburských magdaléniencov je absencia retušovaných čepeľových hrotov v hamburských komplexoch (*Weber 2012*, 28). Prítomnosť čepieľok s otupeným bokom v inventári z Hučivej diery je jedným zo silných indikátorov magdalénienskej príbuznosti nálezov. Okrem náhodného výskytu jedného exemplára blízkeho typu Creswell z Kruczej Skaly, hoci ten nebol takto pomenovaný (*Cyrek/Sudoł-Procyk/Czyżewski eds. 2020*), a o niečo väčšej série hrotov s vrubom v magdalénienskom kontexte z lokality Wrocław Żerniki (*Burdukiewicz et al. 2013*), nemáme z východomagdalénienskej provincie prakticky žiadne iné analogické nálezy.

Za zmienku stojí aj nálezisko Rydno II/59, kde bol objavený jeden podobný artefakt (*Schild et al. 2011*, 124, 125, obr. 103). Pred mnohými rokmi bol tento typ hrotu zaznamenaný v inventári z podhoria Tatier, konkrétne z lokality Podczerwone v Podhalí, a zaradený do magdalénienskej kultúry. Po rokoch sa ukázalo, že na úpätí Tatier sa nachádza viac stôp, ktoré nezapadajú do poľského obrazu magdalénienskej kultúry. Na prvom mieste možno spomenúť lokalitu Sromowce-Wyżne „Kąty" (*Valde-Nowak 1991*) s početnými nálezmi štiepanej kamennej industrie a s minimálne jedným creswellským hrotom z čokoládového pazúrika. Prebiehajúce vykopávky v jaskyni Obłazowa (západný vchod) priniesli aj skromný kamenný inventár foriem podobných čedarským hrotom (*Valde-Nowak et al. 2018*). Hroty typu Cheddar nie sú známe z magdalénienskych sídlisk na Morave a vo východnom Nemecku. Sú sústredené v juhovýchodnej časti Britských ostrovov a v Holandsku (*Barton et al. 2003*). Z južného Nemecka je známy jediný prípad z jaskyne Hohle Fels (*Taller/Bolus/Conard 2012*).

Celkové vyhodnotenie získaného inventára vedie k celkom zjavným záverom, že v prezentovanej jaskyni máme stopy pôsobenia špecializovanej skupiny lovcov, zameranej najmä na lov a spracovávanie ulovených kozorožcov priamo na mieste. Spomínaný komín na konci komory, tesne nad ohniskom, poukazuje na vedomé plánovanie priestoru táboriska. Ten zabezpečil účinné vetranie pri použití ohňa. Bez neho by veľké ohnisko v zadnej časti jaskyne nebolo možné používať (*Kedar/Kedar/Barkai 2019*).

Analýza sintrových povlakov vedie k záveru, že získané hasené vápno s chemicky aktívnymi vlastnosťami by sa dalo použiť pri činení kože. Prítomnosť pozostatkov koní, ale aj druhov, ktoré sú pre vysokohorské prostredie cudzie, napr. labute, dáva podnet na zamyslenie.

Niektoré pozorovania naznačujú, že krajina neskorého pleistocénu využívaná ľuďmi obývajúcimi jaskyňu Hučivá diera bola otvorená so stromami (možno drobnými, kríkovými), zoskupenými v chránených polohách a pozdĺž vodných tokov. Tento obraz možno porovnať so situáciou lokalít na hranici Švajčiarska s Nemeckom (*Leesch/Bullinger/Müller 2019*).

Za predpokladu, že získaný palynologický obraz vegetácie nie je výsledkom náhodného importu peľu spojeného výlučne s aktivitou paleolitických lovcov využívajúcich jaskyňu, ten môže naznačovať významnú úlohu voľnej stepnej vegetácie.

Nález a komplexné analyzovanie pozostatkov ľudskej činnosti v tatranskej jaskyni na konci mladého paleolitu má viacero paleogeografických poznatkov a poukazuje na dynamiku procesu rekolonizácie po klimatickej kríze LGM.

Sedimentárny profil vyhĺbený v jaskyni Hučivá diera ponúkol zaujímavý pohľad na vznik sedimentov na prechode glaciálu/interglaciálu a holocénu. Obdobie ľadovej doby je zaznamenané na sprašových hlinách, ktoré makroskopicky a geochemicky zodpovedajú spraši. Mikromorfológia odhalila znaky procesov zmrazovania/rozmrazovania, ktoré sú typické pre pleniglaciál, ide však o postsedimentárny proces, ktorý ovplyvnil už uložený materiál.

Tvorba jaskynnej výplne pokračovala aj na samom konci doby ľadovej, keď zo stropu jaskyne vymŕzala masa vápencových blokov a jej steny začali padať na jaskynné dno. Viac-menej súčasné je prítomné magdalénienske osídlenie jaskyne. Ľudskú prítomnosť zvýrazňuje preskúmané ohnisko plné uhlíkov, spálených kostí a popola.

Jaskyňa sa nachádza vo vysokohorskom pásme, ktoré sa v bölingskom oteplení po úpadku najstaršieho dryasu náhle sprístupnilo lovcom i faune.

Pri pohľade na magdalénsku kolonizáciu (*Połtowicz-Bobak 2013*) možno poznamenať, že niekde v tejto zóne sa nachádza južná hranica kolonizácie tejto jednotky. Na juhu leží tiež otvorená lokalita na pravom brehu rieky Poprad v Starej Ľubovni (*Valde-Nowak/Soják/Wąs 2007*). Materiály zo starších nálezov v jaskyni Gudenus v Dolnom Rakúsku (*Obermaier/Breuil 1908*) pravdepodobne súvisia s kultúrou magdalénien, sú však zo staršieho obdobia ako súvrstvie z Hučivej diery. Samostatným problémom je vzťah medzi kultúrami epigravettien a magdalénien v povodí stredného Dunaja a hornej Visly (*Lengyel et al. 2021*; *Wiśniewski et al. 2017*).

Zastúpenie fauny v Hučivej diere indikuje skupinu lovcov z dunajskej skupiny, ktorá sa tiahne od švajčiarsko-nemeckých hraníc až po Francúzsko (*McCartin/Starkovich/Conard 2023*). V lokalitách tejto skupiny je okrem sobov a koní potvrdený lov kozorožca (*Capra*), ktorý však nie je hlavným druhom lovnej zveri. Výrazná osobitosť objavených foriem hrotov, ktoré len zdanlivo predstavujú hroty s vrubom, sú výraznými typmi creswellských foriem, dokladajúcich medziskupinovú diferenciáciu magdalé-

nienskych skupín, ako aj dynamiku kontaktov a dokonca pohyby na veľké vzdialenosti.

Najjednoduchším vysvetlením originality inventára z jaskyne Hučivá diera môže byť rázovitosť prostredia v okolí jaskyne, ktorú možno na mikroúrovni definovať ako vysokohorskú periglaciálnu oblasť. Originalitu dokazuje aj jednoznačné zameranie lovcov na alpské kozorožce. Nemožno celkom vylúčiť, že jaskyňa bola miestom garbiarskeho spracovania kožušín ulovených zvierat. Mnohé rezné stopy na kostiach potvrdzujú porciovanie tiel zvierat a početné hrudy vápna vedú k záveru, že kože sa tu spracovávali haseným vápnom. Tento aspekt by sa mal v budúcnosti analyzovať.

Opakovane skúmané výsledky datovania lokalít z rôznych fáz vývoja magdalénienu a viac či menej podrobné závery týkajúce sa dynamiky osídlenia sú v podstate konzistentné a poukazujú na fázu GRIP GI-1e ako na dobu rozširujúceho sa magdalénienu (*Miller 2012*) a súčasného vzniku kultúrnych jednotiek Creswellien a Hamburgien. Jaskyňa Hučivá diera je súčasťou tohto nárastu aktivity magdalénienu v mladšej časti tejto böllingskej klimatickej fázy.

Obr. 1. Jaskyňa Hučivá diera. 1 – celková poloha; 2 – poloha na mape Slovenska; 3 – plán jaskynnej komory s vyznačeným výkopom žltou farbou na pozadí metrovej siete; 4 – vchod do jaskyne; 5 – celkový pohľad na preskúmanú sondu (profil) v sezóne 2022; 6 – pozdĺžny rez jaskyňou ako výsledok 3D skenovania. Kresba J. Skłucki, sken M. Cheben.

Obr. 2. 1 – celkový pohľad na Belianske Tatry z obce Lendak s približnou polohou jaskyne Hučivá diera (šípka) v masíve Kobylieho vrchu (1109 m), v pozadí Lomnický štít (2634 m; foto P. Valde-Nowak); 2 – preplavovanie sedimentov z jaskyne Hučivá diera v potoku Biela (foto M. Soják).

Obr. 3. Jaskyňa Hučivá diera. Priečny rez jaskynnými sedimentmi (stav 2022) s očíslovanými vrstvami a polohou vzoriek pre AMS datovanie. Legenda: a – kamenné artefakty; b – prepálené kamenné artefakty; c – zvieracie kosti. Grafická úprava J. Skłucki.

Obr. 4. Jaskyňa Hučivá diera. Priečny rez jaskynnými sedimentmi (stav 2024). Foto P. Valde-Nowak.

Obr. 5. Jaskyňa Hučivá diera. Jadrá z rádiolaritu. Kresba J. Chowaniak, foto J. Skłucki.

Obr. 6. Jaskyňa Hučivá diera. Výber kamenných artefaktov. 1–3, 6–9 – creswellské hroty; 4, 5 – hroty s nevýraznými vrubmi; 10 – čedarský hrot; 11, 13, 14 – priebojníky; 12 – priebojník typu Zinken; 15 – vrták; 16 – čepeľ so šikmo retušovaným koncom; 17, 18 – rydlá. Kresba J. Chowaniak.

Obr. 7. Jaskyňa Hučivá diera. 1 – kostené šidlo; 2, 3 – kostené ihlice; 4 – prevŕtaná mušľa ako ozdoba; 5 – silne vyleštený kostený nástroj (priebojník alebo šidlo) s viditeľnou sériou paralelných diagonálnych rezov; 6 – opracované fragmenty pieskovcovej lampy. Kresba J. Chowaniak, U. Bąk, foto J. Kurzawska, J. Skłucki. Mierka: a – 1–5; b – 6.

Obr. 8. Jaskyňa Hučivá diera. 1 – ľavá dolná čeľusť kozorožca alpského (*Capra ibex*) so zubami od tretieho premoláru po tretiu stoličku, pohľad z lícnej strany; 2 – proximálny falang kamzíka (*Rupicapra rupicapra*), pri detailnom pohľade je vidieť poškodenie spôsobené hlodaním hlodavcami (paralelné ryhy); 3 – fragment ľavej čeľustnej vetvy kozorožca alpského (*Capra ibex*) s početnými reznými stopami na lícnej a zadnej strane a so stopami po ohlodaní predátormi (vpichy na korunkovom výbežku); 4 – fragment rebra stredne veľkého cicavca so stopami po rezaní na jednom konci (početné škrabance na pravom konci a hladký rezný povrch) a stopami po ohlodaní predátormi na druhom konci (vpichy a vrúbkovaný okraj na ľavom konci). Foto a grafická úprava K. Wertz. Mierka: a – 1, 3; b – 2, 4.