The Epigravettian of Kůlna Cave? A revision of artefacts

Epigravettien v jeskyni Kůlna? Revize dostupných nálezů

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Dedicated to the memory of Slavomil Vencl

Several archaeological artefacts from Kůlna Cave (Blansko disctrict, Czech Republic) date its settlement to the last 250 thousand years. The stratigraphy both inside the cave and at the entrance was complicated, so that macroscopically similar sediments may have comprised of Magdalenian, Gravettian, and Micoquian industries. The first radiocarbon dates surprisingly showed one Epigravettian date, obtained from an animal bone from layer 5, supposedly belonging to the Magdalenian. Also, a further series of dates from strictly controlled contexts (i.e., those definitely correlated with a single layer) showed interstratification of finds between layers. The question of whether there was indeed an Epigravettian settlement phase of the cave was tested with the analysis of butts of debitage, and preserved cores from layers 5 and 6, to specify the used knapping technology. It became clear that the used technology was uniform throughout Magdalenian layers 5 and 6, but spatial analysis of hearths and heated artefacts indicate these were likely to have been disturbed and may also include older material.

Epigravettian – Kůlna Cave – knapping technology – chert of Olomučany type – GIS

Jeskyně Kůlna (okr. Blansko, Česká republika) poskytla velké množství archeologických nálezů, dokládající osídlení jeskyně po dobu posledních 250 tisíc let. Stratigrafická situace uvnitř i v sondách ve vstupu do jeskyně nebyla jednoduchá a proto se v makroskopicky témž sedimentu mohly nalézt společně industrie magdalénienu, gravettienu a micoquienu. Překvapením bylo první radiokarbonové datování, ve kterém bylo mimo jiných dat získáno datum odpovídající dnes epigravettienu, pocházející ale ze zvířecí kosti z vrstvy 5, která měla náležet magdalénienu. I další série radiokarbonových dat přes to, že vzorky byly důsledně kontrolovány, aby jejich asociace s patřičnou vrstvou byla jistá, přinesla další doklady interstratifikace nálezů mezi vrstvami. Bylo otázkou, zda epigravettienské datum ze zvířecí kosti odpovídá nějakému epizodickému osídlení jeskyně, nebo zda jde jen o náhodně zavlečenou kost do jeskynní stratigrafie. Byla proto provedena analýza charakteru patek debitáže a dochovaných jader, pocházejících z vrstvy 5 a 6 za účelem identifikace technologie jejich sbíjení. Ukázalo se, že technologie sbíjení je v magdalénienských vrstvách uniformní, ale prostorová analýza ohnišť a teplem ovlivněných artefaktů nevylučuje promíchání vrstev včetně intruze staršího materiálu.

epigravettien – jeskyně Kůlna – technologie kamenné industrie – rohovec typu Olomučany – GIS

1. Introduction

Investigation of the Late Upper Palaeolithic in Moravia before the spread of the Magdalenian has identified two probably different cultural groups from between 23 and 15 thousand years cal BP (*Nerudová – Neruda 2015*; *Škrdla et al. 2015*). The first, with slightly older radiocarbon dates and industries with carinated endscrapers, burins and Sagaidak-Muralovka-type microliths (the so-called Epiaurignacian; *Demidenko – Škrdla – Rios-Garaizar 2019*), the second, with occasional finds of backed bladelets and without carinated elements (Epigravettian). In the past their mutual relation was usually deemed unclear due to the high variability of the analysed industries (*Svoboda – Novák 2004*). As a result of both

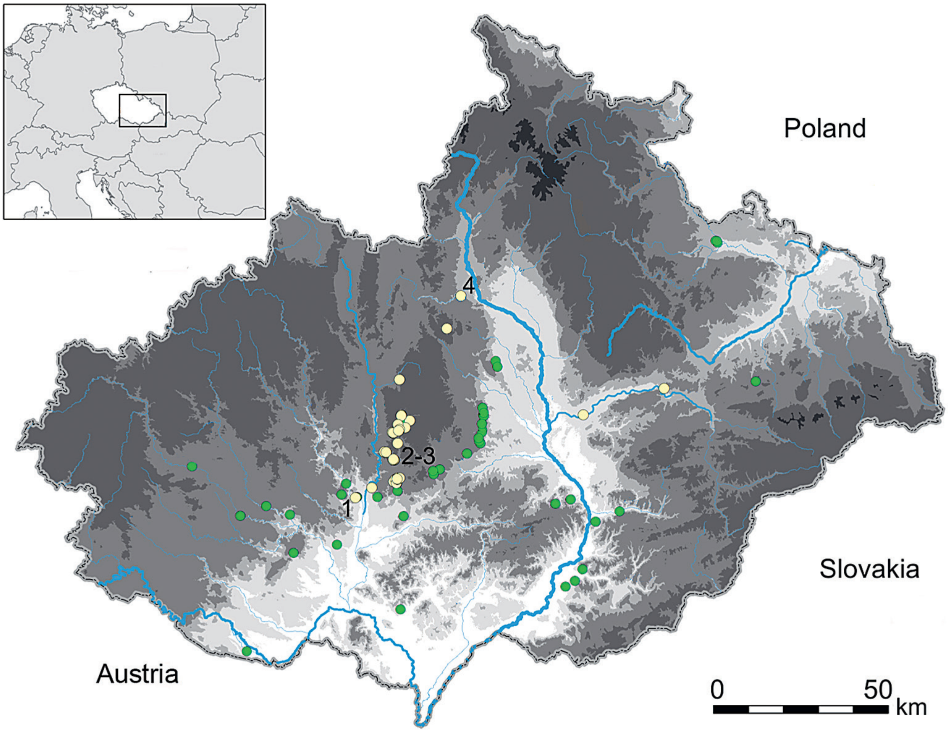

Fig. 1. Moravian (Czech Republic) sites from the analyzed period. Yellow circles – Magdalenian sites, green circles – Epigravettian sites; 1–4: sites discussed in the text.
Obr. 1. Mapa Moravy (Česká republika) s vyznačením lokalit spadajících do sledovaného období, které jsou diskutované v textu.
1 – Brno-Štýřice III, 2 – Kůlna Cave, 3 – Balcarka cave, 4 – Loštice.

new excavations (*Nerudová – Neruda 2014b*; *Škrdla et al. 2014*) and revisions of older information (*Nerudová 2010*; *Nerudová et al. 2012*; *Svoboda 1997*; *1999*; *Svoboda – Fišáková 1999*; *Svoboda ed. 2008*; *Škrdla 1999*; *Škrdla – Plch 1993*), the settlement pattern from this period has been modelled for the Moravian territory (*Nerudová – Neruda 2015*), and later actualized and upgraded with (e.g.) analysis of visibility (*Nerudová – Neruda 2019*). Through this analysis and visualisation of available data, it has been possible to reconstruct the settlement density of Moravia during the Last Glacial Maximum (LGM) and speculate about two non-competing hunter-gatherer groups of different subsistence and settlement strategies – the Epigravettians and the Epiaurignacians (*Nerudová – Neruda 2015*; one further study in preparation).

As regards the LGM, dated between 22 and 17 thousand years BP (*Clark et al. 2009*), it has now become clear that despite worsened climatic conditions, all settlements were situated in the open air (*fig. 1*). From this point of view, the settlement of Kůlna Cave during the LGM has been rather overlooked. Kůlna Cave (Moravian Karst, Czech Republic; *fig. 2*) is one of the most investigated caves in the Czech Republic. An almost continuous human settlement during the last 250 thousand years (from the Saalian glaciation to the Holocene) has been evidenced there. The most important excavations took place there

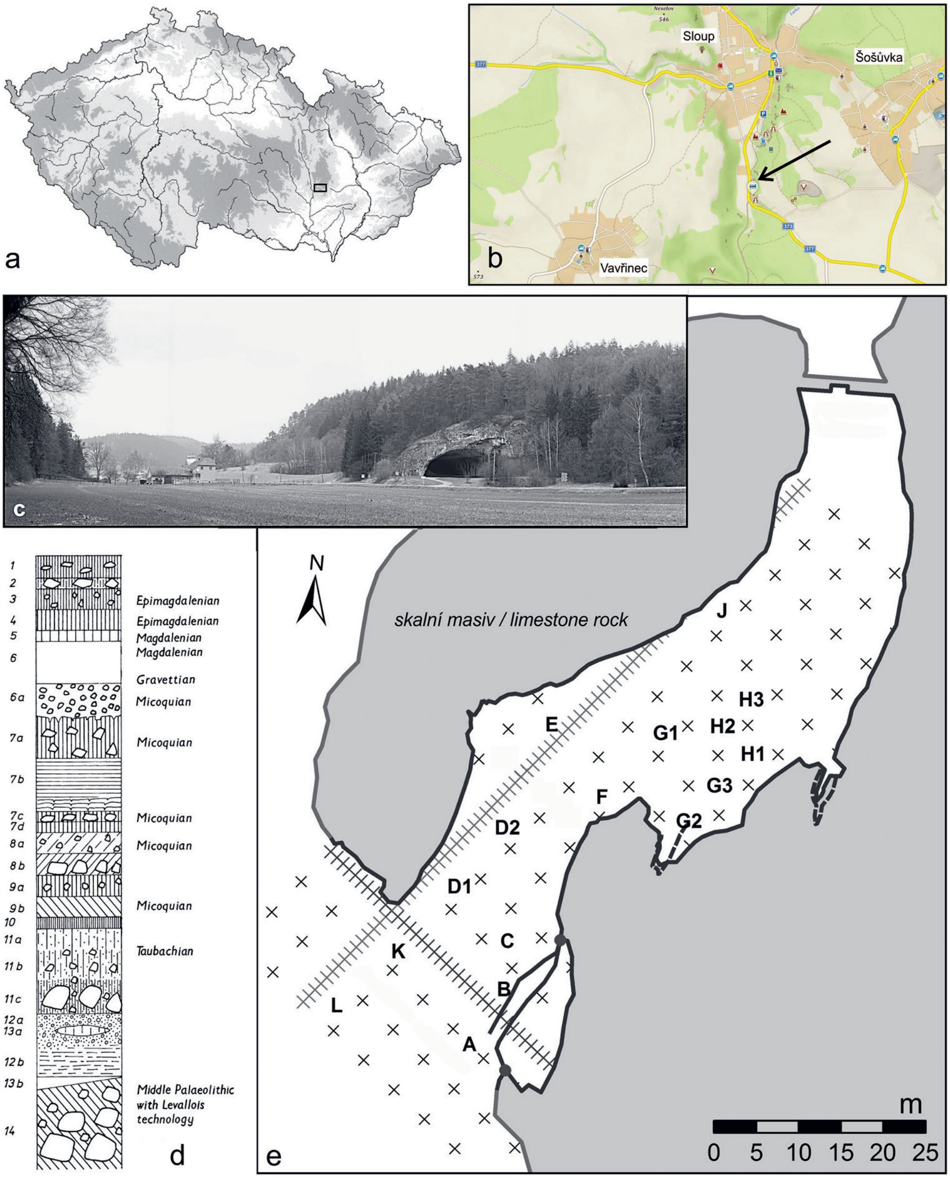

Fig. 2. The Kůlna Cave; localization of the cave (a, b), entrance into the cave, the so-called southern entrance (c), schematic profile of the Middle & Upper Palaeolithic layers after *Valoch 1988* (d), the cave area with designated sectors (e). Digitalized and photo by P. Neruda.
Obr. 2. Jeskyně Kůlna; lokalizace jeskyně (a, b), jižní vchod do jeskyně (c), schematický profil středo a mladopaleolitického souvrství podle *Valocha 1988* (d), půdorys jeskyně s vyznačenými sektory (e).

between 1961 and 1976 and were conducted by Karel Valoch from the Anthropos Institute of the Moravian Museum (*Valoch 1988*). With regard to the Upper Palaeolithic period, the Epimagdalenian was evidenced here (in layers 4 and 3) for the first time in Moravia;

the settlement of the cave during the Gravettian (its upper phase) is unusual (*Mook 1988*, 285), whereas the Early Upper Palaeolithic (EUP) was evidenced indirectly through radiocarbon dating (*fig. 2: d*; *Nerudová – Neruda 2014a*).

In a series of radiocarbon dates there was one which, though also published by *Valoch* (*1988*; *2011*), was rather left aside. The date did not fit the accepted archaeological dating of the cave as it came from the supposedly Magdalenian layer 5, but was much older: GrN 6103: 17 480±155 uncal BP. This is why it was never taken into consideration. From today's perspective, this date from Kůlna Cave layer 5 answers to the Moravian Epigravettian. Should this be confirmed, the first Epigravettian cave settlement in the Czech Republic would be documented. The date comes from unburned animal (undetermined) bone vaguely localized to squares I-III/K-L (an area of 6 m^2). What is certain is the depth of the find, stated between 180 and 190 cm (*Mook 1988*, 285; *Valoch 2011*, 69).

The problem, however, is confirmation of the date. Finding new samples from within the cave for dating is not too probable.[1] In the recent past, a series of animal bones with anthropic modifications from Valoch's excavations has been dated, sampled from apparently undisturbed contexts. It became clear, however, that a number of post-depositional processes led to an admixture of younger organics in Magdalenian, Epimagdalenian, and other layers (*Nerudová – Neruda 2014a*). If osteological material does not bring unambiguous results, revision excavation is not possible, and typology of tools is not informative enough, we may have to rely on butt types of flakes and blades and their comparison with other similarly analysed collections. Concrete differences between the technology of the Magdalenian, Gravettian and Epigravettian were already mentioned by *Juraj Mozola* (*2013*). The differences lay in the exploitation of local cherts, absence of striking platform abrasion and the presence of punctiform and plain butts in the Epigravettian (*Mozola 2013*, 57), as opposed to Gravettian and Magdalenian ones. This trend has been evidenced in the broader geographical context of Late Upper Palaeolithic industries where soft hammers (wood, antler, bone, ivory…) were complemented with soft hammerstones, related to changes in knapping technique.

The stone material from Kůlna Cave layers 5 and 6 was analysed in *Petr Kostrhun*'s (*2005a*) master's thesis and published soon afterwards (*Kostrhun 2005b*). The author, apart from analysing all finds from layers 5 and 6, included also unlocalized finds of so called "debris" from Valoch's excavations and conducted density analysis of finds related to hearths. In this way, a marked concentration of artefacts made of Olomučany chert was evidenced in the area in front of the cave (sector A; *fig. 2:e, 4:a*). According to Kostrhun, exploitation of this chert took place there as it comprises 76.4 % of the total of localized finds (*Kostrhun 2005b*) when 62 pieces of the chert were evidenced in layer 5 and 71 pieces in layer 6. Furthermore, the author pointed to the general aspect of the Magdalenian settlement of Kůlna Cave, which is rather small in its extent, in contrast with the overall extent of the cave. At the time when Kostrhun was analysing his assemblage there were still no indications or possibilities of recognizing different knapping technologies within Magdalenian inventories. These appeared only later with new knowledge based on personal experience of one of the co-authors.

[1] Layer 5 in the Kůlna Cave is preserved only as a relic approximately 50 × 60 cm large. The number and quality of osteological remains suitable for ^{14}C dating, stored at the Anthropos Institute is disscused in *Nerudová – Neruda 2014a*.

In this study, we focus on a previously unanalysed aspect of butts on blanks (flakes and blades) from the (supposedly) Magdalenian layers 5 and 6 from Kůlna Cave. Moreover, special attention is paid to the distribution of local Olomučany chert because, according to our knowledge (*Nerudová 2016*), local materials may have represented a specific trait of the Epigravettian population. Similarly, lithic concentrations in sectors L and K, where Moravian cherts were abundant, were considered to belong to a different cultural techno-complex, probably the Epigravettian (*Blinková – Neruda 2015*, 291). We tested the hypothesis whether this type of chert was processed in the same way as the other raw materials in the cave (as documented in the Epigravettian site Brno-Štýřice III; *Nerudová 2016*) or if it was processed in a particular way (e. g. using different knapping techniques). Moreover, the locations of the Olomučany chert artefacts were plotted on a map to discover if they are related to specific areas or hearths within/in front of the cave.

2. Methods

The technology of knapping and type of hammer used were determined on the basis of our experience and with the help of known literature (*Pelegrin 2002*; *2012*; *Pelegrin – Texier 2004*). The collections from Brno-Štýřice III (Epigravettian), Loštice and Balcarka Cave (both Magdalenian) were used for comparison. A number of criteria for distinguishing the technique and manner of knapping were used in the analysis. The method of flint-knapping stone materials can be different. Knapping techniques[2] include percussion and pressure (direct percussion using a stone hammer, direct percussion using an antler billet, indirect percussion by antler punch or wooden billet, indirect percussion by counterblow, pressure with a short pelvic crutch and pressure in hand). The strike should be realized with either a soft (mineral or organic) or hard (stone) hammer (*Andrefsky Jr. 1998*, 11; *Inizan et al. 1995*, 30; *1999*, 30) depending on existing conditions and requirements. Characteristic traces on butts of blanks or even cores can distinguish between the various ways of striking the core and detachment of blanks (*Andrefsky Jr. 1998*, 137; *Inizan et al. 1995*, 74 sq.; *1999*, 73 sq.). A thick butt is typical for a hard stone hammer which usually creates a flaking angle of 60–85° between the blank's butt and its ventral surface. A protruding point of impact is visible on the ventral surface of the blanks. A soft stone hammer usually creates thin pointed butts (*fig. 3: 9, 10*), which are impossible to precisely measure (*Klaric 2003*). A flat splinter negative can appear on both the ventral and dorsal surfaces of the artefacts.

An organic hammer (wood, antler, etc.) penetrates into the material (*Pelegrin 2002*). It is necessary to abrade the edge between the striking platform and the removal surface before the strike as the edge is fragile. The active point of contact between the hammer and the striking platform lies several millimetres behind the point of impact. Traces of abrading a core's edge are visible on the dorsal surfaces of blanks as fine dorsal abrasion or preparation. The resulting butts have an elliptical shape and thickness of 2–3 mm. The use of soft hammers is generally expected for the Upper Palaeolithic in Europe (*Inizan et al. 1995*, 75; *Lengyel – Chu 2016*). For blanks removed by a soft hammer is characteristic

[2] We used the French criteria and determitation because the definitions differ between the French and Anglo--Saxon literature.

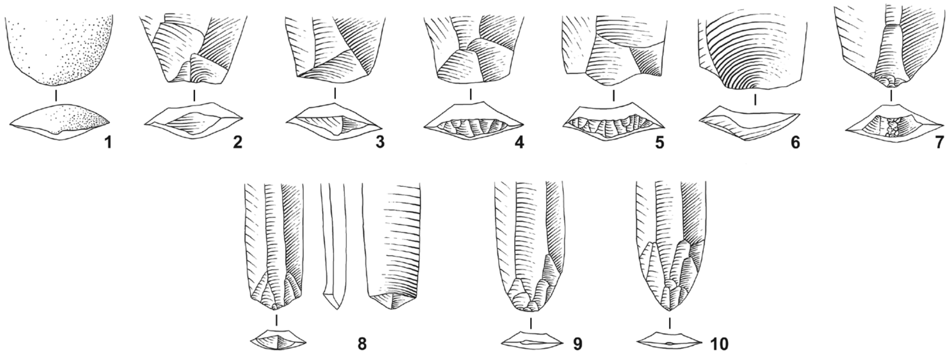

Fig. 3. Various types of butts; cortical (1), plain (2), dihedral (3), facetted (4), *en "chapeau de gendarme"* (5), winged (6), pecked (7), spur – *en éperon* (8), linear (9), punctiform (10). According to *Inizan et al. 1999*, fig. 62.
Obr. 3. Typy patek; s kůrou (1), hladká (2), lomená (3), preparovaná – připravená více údery (4), typu *chapeau de gendarme* – charakteristická pro levalloiské produkty (5), podlouhlá zvlněná *en aile d'oiseau* (6), piketovaná (7), *en éperon* (8), přímá (9), bodová (10). Podle *Inizan et al. 1999*, fig. 62.

morphological marker described as lip (*Inizan et al. 1999*, 144). During the Late Upper Palaeolithic organic soft hammers and soft stone hammers were used for different types of blade products (*Pelegrin 2002*).

Definition of a butt and different butt types

The butt is a part of a core striking platform and is detached through a strike or pressure. Its morphology and dimensions depend upon the knapping technique used, i.e. the type of hammer used and whether a striking platform was prepared. According to *Inizan et al.* (*1995*, 163; *1999*, 136), ten basic butt types can be distinguished: 1. cortical, 2. plain (prepared with one strike), 3. dihedral, 4. facetted (with more detachments) 5. *en "chapeau de gendarme"* type (characteristic for Levallois products), 6. winged, 7. pecked, 8. spur (*en éperon*), 9. linear, and 10. punctiform (*fig. 3*). In Czech terminology, moreover, cortical butts are usually distinguished from butts with moraine cortex (i.e. cortex originated during glacial transport) when erratic (Baltic) flints were used. An elongated butt, originating from the detachment of two previous superposed chips, is not known in European prehistory and is characteristic for specific areas and periods (Egypt – the Neolithic; Near East – Bronze Age; *Inizan et al. 1999*, 134). Linear and punctiform butts can be probably considered identical due to the impossibility of their measurement.

Should the collection from Kůlna Cave, layers 5 and 6, belong to the Magdalenian, it should comprise of butts typical for this culture, i.e. *en éperon* type (*Cheynier 1956*; *Karlin 1972*). These originate as follows: an isolated point is prepared with a series (2–3) of small elaborate strikes on the surface of – and stemming from – a core striking platform, aiming at more precise blade detachment (*Inizan et al. 1995*, 163; *Surmely – Alix 2005*). The resulting beak on the blade's butt appears as a peculiar curved shape resembling the keel of ancient ships (*en éperon*; *fig. 3: 8*). Some authors distinguish robust and gracile varieties of these butts according to the character of the final blades; their (the butt's) metrics are also of chronological significance in West-European environments (*Surmely – Alix 2005*).

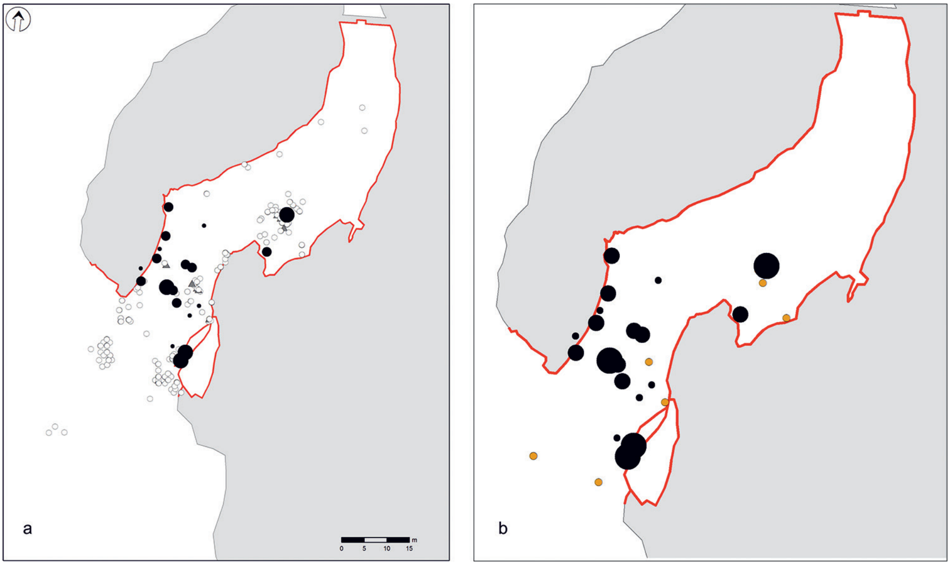

Fig. 4. Kůlna Cave; a – localization of hearths (black spots) and distribution of raw materials (white circles; Olomučany chert by grey triangles) within layer 6; b – artefacts from within layer 6 sampled for analysis (brown circles) and their relation to hearths (black spots).
Obr. 4. Jeskyně Kůlna; a – umístění ohnišť (černé plochy) a distribuce surovin (bílé body, rohovec typu Olomučany – šedé trojúhelníky) ve vrstvě 6; b – artefakty vrstvy 6 (hnědé body) odebrané k analýzám a jejich vztah k ohništím (černé plochy).

Minimum Analytical Module Analysis

As mentioned above, the general aspect of the Magdalenian settlement of Kůlna Cave is rather small in its extent. Final products and tools are missing here. To describe the amounts and character of artefacts we applied the Minimum Analytical Module Analysis (MANA). The MANA method (*Ahler 1989*; *Kornfeld – Frison – Larson 2016*) is a good alternative to other knapped stone analyses in the case when e.g. refittings are impossible or non-representative. The method interprets what was brought to the site, what happened there and what was carried away. Artefacts are divided into different categories based on the similarity between raw materials. The minimum number of groups (MAN) answers to one block of raw material brought to the site (*Kornfeld – Frison – Larson 2016*).

The relation of hearths and burned artefacts

To identify individual settlement events (e. g. the Epigravettian), we also focused on hearth identification inside the cave based on burned lithic estimation (*fig. 4: b*). The first archaeological excavations at Kůlna Cave were carried out by J. Wankel, J. Knies, and M. Kříž at the end of the 19th century. During the excavations, the excavators more or less systematically excavated the central part of the cave, mostly sediments with Upper Palaeolithic archaeological finds. The excavators gradually uncovered 17 or 18 hearths in total (*Kostrhun 2005b*; *Valoch 2011*). It is impossible to reconstruct the location of these old excavations or the exact position of the finds made there, and unfortunately, the georeferencing of the newly excavated (*Valoch 1988*) finds is also somewhat problematic (*Blinková – Neruda 2015*). For the spatial reconstruction of hearths and lithic artefacts in Layer 5, we used data collected by *Blinková* and *Neruda* (*2015*) complemented by information concerning the position of artefacts selected for further analysis (as regards heat modification, for example; *fig. 4: b*), and the location of Olomučany chert (*fig. 4: a*).

For the identification of heating[3], we used non-destructive macroscopic and microscopic (stereomicroscope) characteristics on the lithics. Contrary to controlled heat-treatment, which is always intentional, gradual, ideally non-destructive, and usually requires a few hours to complete the process of heating and cooling, burning is frequently un-intentional and destructive to the material. Burned artefacts are informative in that they potentially indicate the location of prehistoric hearths, the temperatures they reached, and the spatial organization of activities performed on-site (*Dorta Pérez 2010*). Although a number of instrumental methods (*Moník et al. 2019*, fig. 3) can be used to identify both heat-treatment and burning, color changes, cracks ("mud-bricks"), pot lids, disintegration or exfoliation, inherent to burned material (*Dorta Pérez 2010*; *Frick et al. 2012*), can be usually observed macro- or stereomicroscopically by a trained eye.

3. Results

Reduction strategy and types of butts in Kůlna Cave

The total number of butts analysed by us answers to those with precise localization (this is why our numbers differ from those in *Kostrhun 2005a*, 126; *2005b*). Layer 5 delivered 187 blanks and 256 blanks were acquired from layer 6 (*tab. 1*). Some butts could not be distinguished due to missing proximal parts of blanks. Still, it is evident that plain butts predominate in both layers, followed by punctiform ones. Punctiform butts are relatively more frequent in layer 6. Dihedral butts where the edge is transverse are also rather numerous. Only in two cases were they longitudinal, i.e., resembling a thinning strike directed into the butt. Cortical butts or butts with moraine cortex indicate the preparation of chert and flint nodules on the site. Facetted butts (with more negatives) indicate more elaborate preparation of a core striking platform. The amount of *en éperon* butt types is rather low (*fig. 5*; *tab.1*). This, however, does not answer to the traces on preserved core striking platforms: these very often show the typical preparation needed for *en éperon* butt detachment. Traces of dorsal abrasion or preparation were observed evenly in the two layers, in about 59 cases.

Chert of Olomučany type and its spatial distribution

Spatial analyses by Kostrhun have shown a concentration of artefacts made of Olomučany type chert in sector A, in front of the cave entrance (*Kostrhun 2005b*, 116; see above). A noticeable concentration of (undetermined) Moravian cherts is also apparent in layer 6. Here they concentrate mostly in sector L and less in sectors K and A (*Blinková – Neruda*

[3] It is necessary to distinguish between heated, heat-treated and burned artefacts (see text) when "heated" doesn't specify whether the artefact was burned or heat-treated.

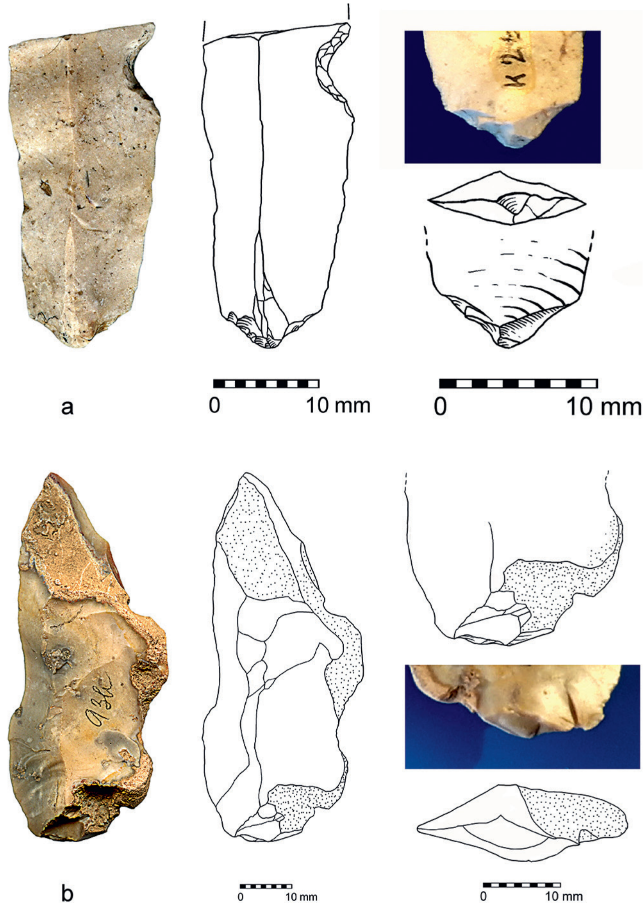

Fig. 5. Kůlna, layer 5: a – artf. No. 264/61, erratic flint, butt *en éperon*; b – artf. No. 325/61, erratic flint, plain butt. Figs. 5–7: drawing T. Janků, photo by T. Janků and Z. Nerudová. Obr. 5. Kůlna vr. 5: a – artf. č. 264/61, eratický silicit, patka typu *en éperon*; b – artf. č. 325/61, eratický silicit, hladká patka.

2015, Fig. 5). It thus appears that only Moravian cherts were exploited in sector L. Specific types of these cherts are not distinguished in the plan. If we return to Olomučany chert artefacts, these belong mostly among debris and were thus not precisely localized so they are visualized in GIS only in a few cases. Their resulting spatial distribution is thus not so indicative (*fig. 4: a*). Artefacts made of Olomučany cherts were also rarely evidenced inside the cave, close to hearths. From the point of view of its exploitation, flakes and blades (debitage) are most frequent in layers 5 and 6. Tools and cores are rather scarce. Slightly more frequent are debris (fragments).

The Olomučany chert is visually well-distinguishable and, in theory, refittable but no such refittings were possible between or within layers 5 and 6 of Kůlna Cave. If we use the MANA method for Olomučany chert artefacts we are able to distinguish, on the basis of raw material similarity and for the two layers at the same time, 14 groups, which is a rather large number given just 36 artefacts made of this chert. This probably means that finds from layers 5 and 6 represent leftovers, non-representative or further unexploited pieces: small exhausted cores, preparation flakes, and different fragments. Final products and tools are missing and probably were mostly carried away from the site. This observation

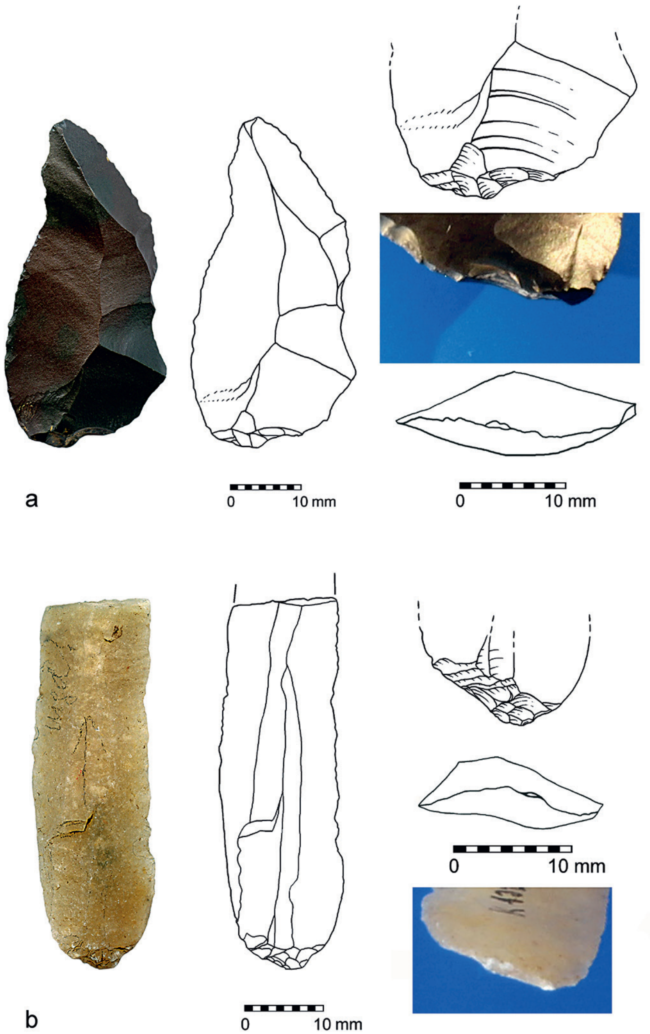

Fig. 6. Kůlna layer 5, artf. No. 1146/61, radiolarite, punctiform butt (a); Kůlna layer 6, artf. No. 1321/62, spongolite, punctiform butt (b).
Obr. 6. Kůlna vr. 5, artf. č. 1146/61, radiolarit, bodová patka (a); Kůlna vr. 6, artf. č. 1321/62, spongolit, bodová patka (b).

can also be applied to other cherts and flints, used in layers 5 and 6. Mostly prepared raw material was brought on site, reflected in few corticated butts or butts with moraine cortex (*tab. 1*). The high percentage of undetermined butts reflects the number of incomplete artefacts (or how many of them were preserved completely or at least by their proximal part). In our analyses, layer 5 comprised of about 50 % artefacts (i.e. flakes and blades) without their proximal part whereas this number was even higher (57 %) in layer 6 (*tab. 1*). The large number of reparation blanks (like platform rejuvenation flakes) or overshots (*outrepassé*) probably speak for accidental, repetitively used refuge in the case of Kůlna Cave layers 5 and 6 (cf. *Kostrhun 2005b*). Other indicators for this are variable raw materials and hearths in superpositions.

According to raw material analysis, the Magdalenian of Kůlna Cave made use of at least 12 different raw materials. Predominant was spongolite (in both layers) followed by

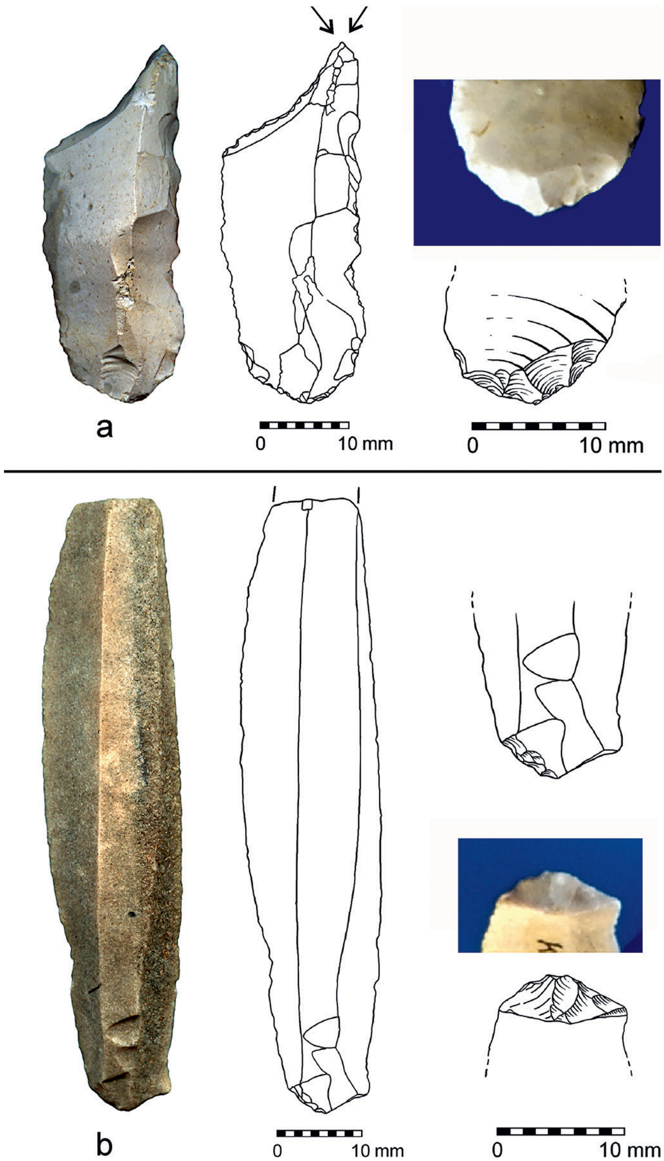

Fig. 7. Loštice, artf. No. 116307, erratic flint, butt *en éperon* (a); Kůlna, layer 6, artf. No. 325/61, erratic flint, butt *en éperon* (b).
Obr. 7. Loštice, artf. č. 116307, eratický silicit, patka typu *en éperon* (a); Kůlna, vr. 6, artf. č. 325/61, eratický silicit, patka typu *en éperon* (b).

erratic flint (*Kostrhun 2005b*). The least numerous were materials from distant sources: radiolarites, flints of Polish Jurassic Highland and of chocolate type, indicating long-distance transport. Similarly, a broad spectrum of raw materials was also evidenced in Balcarka Cave: apart from the predominant erratic flint, a further 14 raw materials were distinguished there (*Nerudová – Neruda 2010*, 75). The settlement of both caves was also similar in the concentrations of hearths; the function and seasonality of Balcarka Cave was also reconstructed as a result of use-wear analysis of stone tools (*Kufel 2010*, 96) and taphonomy of animal remains (*Rašková Zelinková 2010*, 151).

Site	Dating	cortical	dihedral	nat. surf.	linear	plain	facetted	punc.	und.	*en éperon*	Σ	References
Brno-Štýřice III	EPIGR	98	258	132	172	448	59	577	899	0	2643	*Nerudová 2016*
Stadice	EPIGR	39	99	38	64	146	33	333	*	0*	752	this issue
Kůlna L. 5	MAGD	8	9	1	1	36	5	27	99	1	187	this issue
Kůlna L. 6	MAGD	5	14	3	1	25	3	56	146	3	256	this issue
Loštice I	MAGD	9	42	10	21	43	2	139	1379	18	1663	*Neruda – Nerudová 2008*
Balcarka	MAGD	3	26	6	3	38	5	81	8	6	176	*Nerudová – Neruda 2010*
Kůlna L. 3	EPIMAG	14	4	0	*	72	3	80	180	*	353	*Moník 2014*
Kůlna L. 4	EPIMAG	11	9	0	*	100	11	168	210	*	509	*Moník 2014*

Tab. 1. Studied sites and types of butts (Σ in pcs). Nat. surf. – with natural surface, punc. – punctiform, und. – undiagnostic/not preserved. *not monitored.
Tab. 1. Studované lokality a přítomné typy patek (Σ v ks). *nesledováno.

Hearths and lithic artefacts

A total of 13 artefacts (9 made on Olomučany chert, 2 on porcellanite, 1 on radiolarite and 1 on erratic flint) were macroscopically estimated as having been heated, i.e. either burned or heat-treated. After their stereomicroscopic observation it turned out that only seven were heated, there was no gloss contrast on the surfaces of these artefacts (the whole surface of one piece *fig. 8: 4* is glossy, though), typical for heat-treatment (*Bordes 1969*, 197), and most were blackened, dimmed or cracked indicating unintentional burning (*fig. 8: 1–3, 5, 6*; the heated radiolarite piece not pictured here). Similar results were obtained by analysing Olomučany chert artefacts from Balcarka Cave (*Moník et al. 2019*), i.e., there were no heat-treated artefacts but several burned ones.

The relationship between hearths and lithics was visualised for Magdalenian layer 6 (*fig. 4: a, b*), Magdalenian layer 5 (*Blinková – Neruda 2015*) and the Middle Palaeolithic layers 6a–11 (*Neruda 2011*). In the Kůlna Cave, different types of hearths can be observed: small hearths with a low number of items with specialized activities in their vicinity (*Neruda 2011*), hearths serving as a heat source, and large hearths with numerous overlapping items (*Kostrhun 2005b*; *Blinková – Neruda 2015*). The extent of individual hearths in layers 5 and 6 indicates disturbed sediments or palimpsests rather than single-event occupation (*Blinková – Neruda 2015*). Burned/heated pieces are not frequent in the Magdalenian layers either (see above) and bear no relation to the hearths (*fig. 4: b*). There were only three small hearths each in the Micoquian layer 7a and Taubachian layer 11. Heated artefacts or burnt animal bones were not present at all in layer 7a (*Neruda 2011*, 138).

4. Discussion

Distinguishing between Magdalenian and Epigravettian industries lies in the identification of knapping technique, preparation of striking platforms, and the presence or absence of butts of *en éperon* type, the preparation of dorsal surface of blanks, the presence of long regular blades, and the angle between the butts and ventral surfaces of artefacts

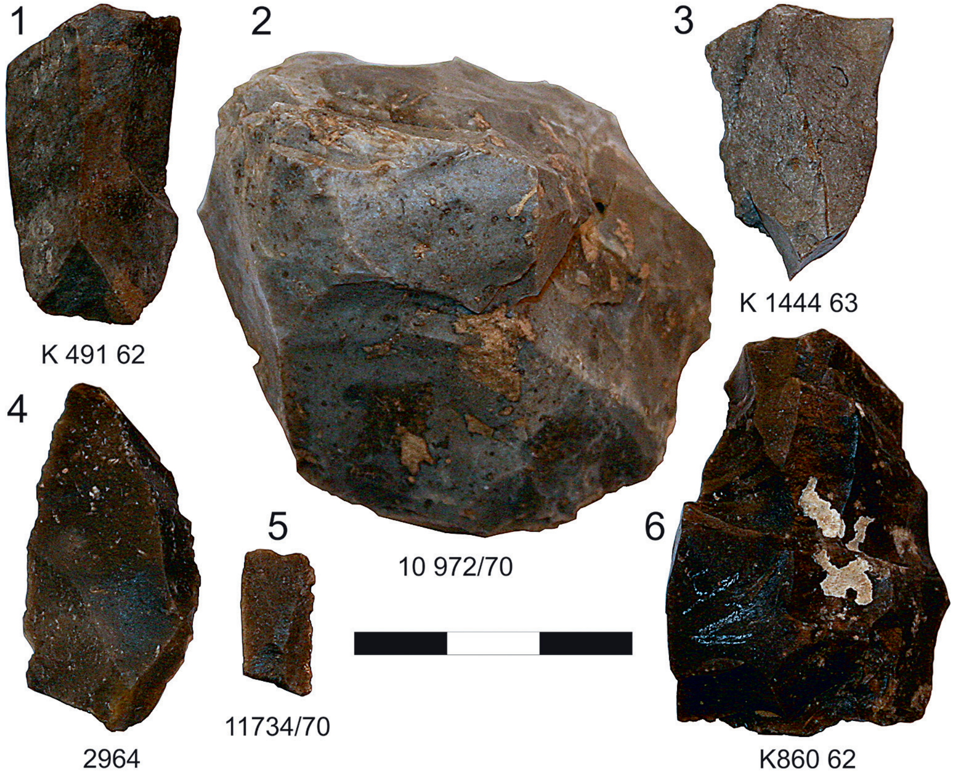

Fig. 8. Kůlna, selected heated artefacts. 1, 3–6 Olomučany chert; 2 erratic flint.
Obr. 8. Kůlna, vybrané teplotně ovlivněné artefakty. 1, 3–6 olomučanský rohovec; 2 eratický pazourek.

(*Maier 2015*, 33; *Wiśniewski 2015*). These criteria, however, have to be applied with care and, if possible, in combination with one another. No knapping technique can, for example, be unambiguously connected with a specific Palaeolithic culture. Most authors, however, consider the *en éperon* butts (*fig. 5: a, 7: b*) to be indicative of direct percussion from elaborately prepared cores, using an organic (or soft stone) hammer (above all in the Central European area; *Floss – Weber 2012*, 235; *Maier 2015*, 33; *Pelegrin 2002*; *2012*; *Pigeot 2004*; *Valentin – Pigeot 2000*).

Although the presumed goal of coring was to obtain slender, regular long blades (or bladelets) with *en éperon* butt, the amount of such butts in Moravian Magdalenian assemblages varies greatly, and is often quite low. From among the assemblages where butt types were analyzed, the percentages are 3 % for Balcarka Cave, 1 % for Kůlna Cave, layer 6, and Loštice I, and just 0.5 % for Kůlna Cave, layer 5. Maier identified butts of *en éperon* type in the assemblages from Hostim (Bohemia), Velká Kobylanka and Mokrá V (*Maier 2015*, tab. A.27, A.50). One butt of *en éperon* type was also identified at the Horákov-“Macocha” site (*Škrdla 2002*). This reduction strategy is well documented in Germany, e.g. very frequently in Andernach-Martinsberg (27 %), rather scarcely in Oelknitz-Sandberg (1.4 %; *Gelhausen 2015*) or Ahlendorf (*Balthasar 2015*), and often in the “classical” Oelknitz site, and is encountered together with organic hammers (*Maier 2015*, 157).

Magdalenian		Epigravettian
+	Preparation of core striking plattform	-
+	Dorsal abrasion of proximal part of blanks	Not frequent
+	Long regular blades	-/?
+	Butts *en éperon*	-
+	Mineral (soft stone) hammer	+
+	Organic (antler) hammer	-
+	Direct percussion	+

Tab. 2. Technological characteristics of the Magdalenian and the Epigravettian.
Tab. 2. Technologické charakteristiky magdalénienu a epigravettienu.

French Magdalenian sites usually comprise of high percentages of *en éperon* butts, e. g. 12 % in Abri Pataud or 23 % in layer 36 of Laugerie-Haute-Est. In the Le Blot collection it reaches 51 % (*Surmely – Alix 2005*). Rather few (10 %) such butts were evidenced in Pincevent layer IV-20, whereas Laitier Pile delivered 44 % of butts of the *en éperon* type (*Bodu et al. 2006*).

No precise numbers are given for Klementowice (Poland) though *Wiśniewski* (*2015*) mentions 45 % prepared butts, some of them being of *en éperon* type. Similarly, both cores and blanks with *en éperon* butts appear in Sowin 7 (Poland; *Wiśniewski et al. 2012*). The technique is rarely applied in Poland in general, though (*Połtowicz-Bobak 2013*, 232). Characteristic (though unspecified) butts of the Magdalenian are stated to come from northern Slovakia (*Valde-Nowak – Soják – Was 2007*). According to Maier, butts of *en éperon* type are most common between 16 and 14 thousand years cal BP where they represent 12–69 % of the total in assemblages from Bohemia, Poland and Thuringia. This period is marked by relative techno-typological uniformity in these regions. Later, between 14 and 13 thousand years cal BP, *en éperon* butts decrease in number. Mineral percussors are now used instead of organic ones, and different tool types begin to predominate (mostly projectiles; *Maier 2015*, 158). Apart from the chronological aspect, regional differences are observable in the intensity of the application of *en éperon* butts throughout the Magdalenian world.

Butts of *en éperon* type also appear on the most "beautiful" products, i.e. regular and large tools, often made of the finest flints. They were also mostly knapped with antler hammers, whereas other blanks were acquired with mineral hammers (*Bodu et al. 2006*). Only the best flint-knappers had the "right" to knap the finest materials near fireplaces in Étiolles (*Pigeot 1987*, 101). The selection of raw materials for the production of relatively long and wide blades was also observed in Sowin 7 (*Wiśniewski et al. 2012*, 406). It thus appears that the use of *en éperon* butts was restricted to a few "luxurious" products or even selected persons whereas "usual" products did not require such preparation.

When we compare Magdalenian knapping technique with the Epigravettian technique some striking differences are obvious (*tab. 2*). Blades from the Epigravettian site Sant-Antoine in Italy possessed plain or abraded butts in 49 % of cases, knapped with soft mineral hammer (*Bracco et al. 1997*). Detailed examination of the lower layer from Sowin 7 has shown technological differences from Magdalenian layers. The striking platform of cores was oval and prepared with one strike. The edges of striking platforms are abraded, similar to Gravettian ones. The blades have plain butts and are curved in their distal parts

Site	Dating	N of artefacts	N OL	% OL	Reference
Balcarka Cave	MGD	314	7	2.22	*Moník et al. 2019*
Barová Cave all layers	MGD	22	-	25.0	*Seitl et al. 1986*
Býčí skála Cave	MGD	5491*	36*	0.65	*Oliva et al. 2015*
Hadí Cave	MGD	538	1	0.18	*Klíma 1961*
Kolíbky Cave	MGD	104	19	18.26	*Svoboda et al. 1995*
Kůlna Cave, Layer 3	EPIMGD	430	78	18.1	*Valoch 1988*
Kůlna Cave, Layer 4	EPIMGD	450	68	15.11	*Valoch 1988*
Kůlna Cave, Layer 5	MGD	783	62	7.91	*Kostrhun 2005b*
Kůlna Cave, Layer 6	MGD	1429	71	4.96	*Kostrhun 2005b*
Kůlna Cave, Layer 6	GRAV	316	3	0.94	*Valoch 1988*
Kůlna Cave, Layer 6a	MCQ	248	4	1.61	*Neruda 2011*
Kůlna Cave, Layer 7a	MCQ	1737	14	0.80	*Neruda 2011*
Kůlna Cave, Layer 7c	MCQ	55	5	9.10	*Neruda 2011*
Kůlna Cave, Layer 11	TAUB	8925	63	0.70	*Neruda 2011*
Kůlna Cave, Layer 14	MP	109	2	1.83	*Neruda 2011*
Kůlnička Cave	MGD	7	1	14.28	*Přichystal 2002*
Michalova skála Cave	MGD	49	38	77.55	*Valoch 1960*
Pekárna Cave	MGD	24267	1570	6.46	*Voláková 2005*
Rytířská Cave	MGD	106	1	0.94	*Valoch 1965*
Srnčí Cave	MGD	48	31	64.58	*Přichystal 2002*
Verunčina Cave	MGD	137	1	0.72	*Přichystal 2002*
Žitného Cave	MGD	1680	30	1.78	*Dvořák et al. 1957*

Tab. 3. Overview of sites situated in Moravian Karst with the presence of the Olomučany chert (OL). N – number of artefacts, * splinters and waste are not included.
Tab. 3. Přehled lokalit Moravského krasu s výskytem rohovce typu Olomučany (OL). N – počet artefaktů, * není započítán odpad a drobné šupiny.

(*Wiśniewski et al. 2012*). Similarly in Brno-Štýřice III, most of the butts show signs of knapping with soft mineral hammer, i.e. dorsal abrasion of artefacts and punctiform butt (*Nerudová 2016*), whereas *en éperon* butt types are missing completely, which is concordant with the preparation of preserved cores. Similar situation can be observed in the Epigravettian site at Stadice where punctiform and plain butts predominate significantly (*tab. 1*) and the used technology is characteristic of soft mineral hammer.[4] No evidence of *en éperon* butts is present there; among the faceted butts three pieces remind one of *en éperon* butts, but they are by no means typical.

The trend to abandon techno-typological stability and turn towards mineral hammers, as described by *Maier* (*2015*) and mentioned above, is also observable in the Late Palaeolithic layers 4 and 3 of Kůlna Cave. Plain and punctiform butts predominate, particularly in layer 4 (unpublished of data of one of the authors). It is of interest that raw material preferences in these younger layers were similar to those from layers 5 and 6 in the predominance of Olomučany cherts, erratic flints and spongolites. The procurement strategies thus seem to have been similar to the Magdalenian, including the transport of exotic

[4] Detailed techno-typological characteristic of the assemblage was in preparation by M. Oliva and S. Vencl.

materials (rock crystal, obsidian, Jurassic-Cracow flint, Świeciechów flint etc.) but the knapping technology is more simple, perhaps similar to the Epigravettian.

The reason for the low amount of *en éperon* butts in the Moravian Magdalenian thus seems to have been given by rather simplified technology when compared to SW European analogies, but not by the presence of the Epigravettian as this latter culture would probably be reflected by complete absence of *en éperon* butt types. We must point out that the character of cores in Kůlna Cave in both Magdalenian layers corresponds to the Magdalenian reduction strategy. The striking platforms of the cores have marks of forming the point of percussion (see chapt. 2.1).

Although several hearths with surrounding burned animal bones and artefacts have been unearthed during the decades of excavations of Kůlna Cave, closer inspection has shown that, with regard to Magdalenian layers, heated lithics are not too numerous and are not related to hearths. As we deal here with burned artefacts rather than heat-treated artefacts (which should be looked for outside of hearths; *Brown et al. 2009*), it is probable that the layers are partially disturbed, possibly representing a palimpsest of several occupation events. This would include the area in front of the cave which has a marked concentration of Olomučany chert artefacts.

According to *Antonín Přichystal* (*2002*), the significance of this chert in LUP collections has increased. Regarding the known and published material, it was most frequently used in Michalova skála and Srnčí caves (*tab. 1*), where its numbers predominated (77.5 % and 65.5 %, *tab. 3*) over other analysed assemblages. But these two assemblages are not as numerous as, e.g. those from Býčí skála or Pekárna Caves where the share of Olomučany chert varies between 0.65 % (Býčí skála Cave) and 6.46 % (Pekárna cave). In Kůlna Cave, the share of Olomučany chert also varies significantly – its highest share is documented in the Epimagdalenian layer 3, whereas e. g. (Micoquian) layers 7a and 11 comprise relatively few artefacts made of this chert. The technological and spatial analysis we conducted indicates that the concentration of Olomučany chert in the area in front of the cave is the result of unusually intensive (Magdalenian) knapping of this material or the random accumulation of redeposited sediment.

5. Conclusion

This study focuses on the identification of potential Epigravettian layers within the Magdalenian layers of Kůlna Cave. We can conclude, that the presence of Epigravettian, indicated by one radiocarbon date, is not sufficiently corroborated by the used technology or by the use of local material, the Olomučany chert in this case. The existence of the Epigravettian, assumed by *Z. Blinková* and *P. Neruda* (*2015*, 291) in sectors K and L based on different raw material use, technology and typology was not confirmed by our study.

The ratio of *en éperon* butts, indicative of the Magdalenian, is rather low in both Magdalenian layers (5 and 6). Although *en éperon* butt types, typical for the Magdalenian, are rather limited, the analysed cores were reduced in concordance with Magdalenian technology. The explanation for this is probably the nature of the analyzed material, which practically represents debris and fragments, not reflecting a concrete situation in time and space. Also, industries from neither of the two Magdalenian layers are that numerous, especially considering the extent of the excavation area (cf. *Kostrhun 2005b*).

If we take into account the analogies mentioned in the Discussion, we may observe two kinds of production within Kůlna Cave: the more "luxurious", with butts of the *en éperon* type, aimed at obtaining long regular blades which are, however, poorly represented; and the "usual", destined for other, less important products. Based on this information we may suppose that the industries from layers 5 and 6 correspond to the Magdalenian and their differences from other Central and SW European Magdalenian collections are technological, not cultural.

We also looked for burned artefacts to confirm the location of hearths in Kůlna Cave. It became clear, however, that burned lithics are frequently encountered outside of hearths and may indicate redeposition, the formation of palimpsests, and possible inclusion of older material into the Magdalenian layers, a fact potentially responsible for the ^{14}C dating of one bone to the Epigravettian.

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Epigravettien v jeskyni Kůlna?
Revize dostupných nálezů

Výzkumy pozdního mladého paleolitu na Moravě (mezi 23 až 15 tis. lety kal. BP) před rozšířením magdalénienu identifikovaly dvě, pravděpodobně rozdílné kulturní skupiny (*Nerudová – Neruda 2015*; *Škrdla et al. 2015*). Pro první skupinu, s poněkud staršími radiometrickými daty a industriemi s kýlovitými škrabadly, rydly a mikrolity typu Sagaidak-Muralovka (*Demidenko – Škrdla – Rios-Garaizar 2019*), je užíván termín epiaurignacien. Druhá skupina, bez kýlovitých typů nástrojů a s čepelkami s otupeným bokem, je označována jako epigravettien. Při revizi dosud získaných dat byla provedena rekonstrukce hustoty osídlení Moravy v době posledního glaciálního maxima datovaného mezi 22 až 17 tis. let BP (*Clark et al. 2009*). Na základě provedených analýz se uvažuje o dvou vzájemně si nekonkurujících skupinách (tj. epigravettienu a epiaurignacienu) s rozdílnými subsistenčními a sídelními strategiemi (*obr. 1*; *Nerudová – Neruda 2015*). Navzdory zhoršenému klimatu je veškeré známé osídlení na Moravě té doby situováno pod širým nebem. Jako jediná jeskynní lokalita byla indikována jeskyně Kůlna, a to radiokarbonovým datem z magdalénienské vrstvy 5: GrN 6103: 17 480±155 nekalibrovaně BP (*Mook 1988*, 285; *Valoch 2011*, 69). Toto datum chronologicky spadá do pozdního mladého paleolitu, konkrétně do epigravettienu. Pokud by bylo epigravettienské osídlení jeskyně Kůlna potvrzeno, jednalo by se z hlediska rekonstrukce osídlení o unikátní zjištění (*obr. 2*).

Otázkou bylo, jakým způsobem osídlení potvrdit, jestliže radiometrická datování vzorků neposkytují v důsledku post-depozičních změn odpovídající výsledky (*Nerudová – Neruda 2014a*). Jednou z možností byla analýza charakteru tvaru patek úštěpů a čepelí a jejich porovnání s podobnými kolekcemi. Na technologické rozdíly v přípravě podstav jader a způsobu sbíjení mezi gravettienskými, magdalénienskými a epigravettienskými soubory poukázal *J. Mozola* (*2013*, 57). Zejména v epigravettienu je nápadné využití lokálních rohovců, nepřítomnost abraze úderové plochy, a naopak výskyt bodových a hladkých patek, jako důsledek používání měkkého kamenného (minerálního) otloukače. Přestože byla kamenná štípaná industrie magdalénienských vrstev 5 a 6 jeskyně Kůlny podrobně analyzována P. Kostrhunem, který mj. upozornil na nápadnou koncentraci (tvořenou 76,4 % artefaktů z rohovce typu Olomučany) v sektoru A (*obr. 2: e*, *4: a*; *Kostrhun 2005a*; *2005b*), potenciální rozdíly v technologii sbíjení nebyly v daných studiích sledovány.

V této práci jsou předloženy výsledky studia dříve neanalyzovaných charakterů patek úštěpů a čepelí z magdalénienských vrstev 5 a 6 v Kůlně se zvláštním přihlédnutím k rohovci typu Olomučany, o němž se nyní usuzuje, že by mohl být typickou surovinou epigravettienu (*Nerudová 2016*; srov. *Blinková – Neruda 2015*, 291). Testovali jsme, zda byl rohovec typu Olomučany v jeskyni Kůlna sbíjen stejně jako ostatní typy surovin (jako tomu bylo v epigravettienské lokalitě Brno–Štýřice III: *Nerudová 2016*), nebo zda byly pro různé suroviny využívány různé způsoby sbíjení. Dále jsme provedli analýzu, zda má v rámci Moravy prostorové rozmístění artefaktů z rohovce typu Olomučany nějaký vztah k ohništím. K širšímu srovnání byly použity soubory Brno–Štýřice III (epigravettien), Loštice a jeskyně Balcarka (magdalénien).

Každý způsob sbíjení úderem nebo tlakem zanechává charakteristické stopy nejen v průběhu přípravy těžní podstavy jádra, ale i na odbitém úštěpu nebo čepeli (*Andrefsky Jr. 1998*, 11, 137; *Inizan et al. 1995*, 30, 74; *1999*, 30, 73 n.). Pro naše analýzy byly významné zejména stopy charakteristické pro užití měkkého kamenného otloukače (malá bodová patka s neměřitelnými rozměry; *obr. 3: 9, 10*; *Klaric 2003*), tj. malé ploché odštěpy v dorzální nebo ventrální ploše artefaktu a stopy po dorsální abrazi, neboť měkký kamenný (minerální) otloukač je diagnostický pro sbíjení v mladém a pozdním paleolitu (*Inizan et al. 1995*, 75; *Lengyel – Chu 2016*; *Pelegrin 2002*).

Kromě použitého otloukače (technologie sbíjení) jsme sledovali typy patek. Definice patky a její jednotlivé typy vycházejí z užívané terminologie (*Inizan et al. 1995*, 163; *1999*, 136; *obr. 3*). S ohledem na jeskyni Kůlnu jsme sledovali pro magdalénien typické patky typu *en éperon* (*Cheynier 1956*; *Karlin 1972*), jejichž charakteristický tvar vzniká jako důsledek specifické přípravy těžní podstavy jádra (*Inizan et al. 1995*, 163; *Surmely – Alix 2005*; *obr. 3: 8*). K popisu kamenného inventáře z jeskyně Kůlna jsme použili metodu MANA (Minimum Analytical Module Analysis), která pomáhá určit (na základě vnitřní podobnosti kamenné suroviny), kolik kamenného materiálu bylo v lokalitě zanecháno (*Ahler 1989*; *Kornfeld – Frison – Larson 2016*). Metoda se používá v případě, že je soubor nedostatečně reprezentativní, nebo není možné provést zpětné skládanky (remontáže). Za účelem identifikace jednotlivých epizod osídlení jsme se zaměřili na vztah mezi ohništi odkrytými staršími výzkumy a přepálenými artefakty (*obr. 4: b*).

Výsledky analýzy patek (*tab. 1*) ukazují, že hladké a bodové patky převládají a že patky typu *en éperon* nejsou příliš časté (*obr. 5*; *tab. 1*). To ale neodpovídá dochovaným stopám na těžních podstavách jader, které naopak často vykazují stopy po preparaci nezbytné ke sbíjení produktů s těmito typy patek. Jak mnozí autoři naznačují, patky typu *en éperon* (*obr. 5: a*, *7: b*) jsou diagnostické pro přímý úder (nejčastěji) organickým otloukačem do specificky připravené těžní podstavy jádra (*Floss – Weber 2012*, 235; *Maier 2015*, 33; *Pelegrin 2002*; *2012*; *Pigeot 2004*; *Valentin – Pigeot 2000*). Účelem bylo získat pravidelné dlouhé čepele. V kolekcích z Moravy i z Čech jsou patky typu *en éperon* spíše vzácné, na rozdíl od Německa či Francie. Sporadicky se patky *en éperon* vyskytují také v Polsku (*Połtowicz-Bobak 2013*, 232). V širším měřítku bylo pozorováno nejen jejich rozdílné regionální zastoupení, ale i určitá chronologická závislost (*Maier 2015*, 158). Srovnáme-li technologii sbíjení magdalénienu a epigravettienu, jsou patrné určité rozdíly (*tab. 2*). Mezi nejdůležitější patří absence preparace těžní podstavy jádra, patky typu *en éperon* a užití organického (parohového) otloukače v epigravettienu. Do budoucna by bylo přínosné zjistit, zda naznačené technologické rozdíly mezi oběma kulturami mají obecnější platnost.

Prostorová analýza rohovce typu Olomučany není dostatečně vypovídající, protože nebylo možné bezpečně lokalizovat všechny nalezené artefakty (*obr. 4: a*). K problematice rekonstrukce osídlení v jeskyni Kůlna se detailně vyjadřují *P. Kostrhun* (*2005a*; *2005b*) a *Z. Blinková* a *P. Neruda* (*2015*). Rohovce typu Olomučany bylo ojediněle možné nalézt nejen v prostoru ve vchodu (sektory K a L; *obr. 2: e*), ale i uvnitř jeskyně, poblíž ohništím. Ačkoliv byly v magdalénienských vrstvách jeskyně Kůlna makroskopicky identifikovány i přepálené artefakty (změna barvy suroviny, přítomnost trhlin, prasklin a termických puklin; *obr. 8*) nejsou takové nálezy časté a nemají žádný vztah k uvedeným ohništím (*obr. 4: b*), což snad naznačuje jejich rozvlečení postdepozičními procesy.

Běžná debitáž, tj. úštěpy a čepele, byly přítomny v obou vrstvách 5 a 6. Nástroje a jádra jsou spíše vzácné. Nepodařilo se provést žádnou remontáž rohovce typu Olomučany ani v rámci jednotlivé vrstvy, ani napříč vrstvami. Analýza MANA ukázala, že je možné na základě podobnosti suroviny rozlišit 14 skupin, což je vzhledem k počtu artefaktů neúměrně mnoho. Znamená to, že artefakty z rohovce typu Olomučany ve vrstvě 5 a 6 představují nepoužitelné zbytky a že vhodné polotovary nebo hotové nástroje byly z lokality odneseny. Podobné výsledky vyplývají i pro další typy surovin determinované v magdalénských vrstvách jeskyně Kůlny, jak konstatoval již *P. Kostrhun* (*2005b*); analogii k využívání surovin a chování v lokalitě můžeme nalézt v jeskyni Balcarka (*Nerudová – Neruda 2010*, 75), která byla podobně jako jeskyně Kůlna také jen sezonní lokalitou (*Kufel 2010*, 96; *Rašková Zelinková 2010*, 151). Rohovec typu Olomučany byl ostatně používán nejen v jeskyni Kůlna, ale i v dalších lokalitách Moravského krasu (*tab. 3*). Jeho podíl je ale v daných kolekcích značně variabilní a, vezmeme-li v úvahu charakter těchto lokalit, nedosahuje takového významu jako v Brně–Štýřicích III.

Lze konstatovat, že epigravettienské osídlení jeskyně Kůlna nebylo potvrzeno ani z hlediska technologie sbíjení jader. Přestože výskyt patek typu *en éperon* je v Kůlně v obou diskutovaných vrstvách poměrně nízký a technologie sbíjení je zde obecně uniformní, dochovaná jádra naznačují, že tyto patky byly při těžbě vytvářeny. „Luxusní" artefakty byly však pravděpodobně z lokality odnášeny, jak ukázaly i dřívější analýzy. Prostorová analýza ohnišť a teplem ovlivněných artefaktů nevylučuje promíchání vrstev včetně intruze starším materiálem, což bylo zřejmě důvodem přítomnosti staršího materiálu (v našem případě zvířecí kosti) v jedné z magdalénienských vrstev.

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