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The influence of redeposition on the anthracological records from the Moravian Karst caves (Czech Republic, Central Europe)

Abstract

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The study focuses on some methodological problems associated with the research of cave sites. A large amount of anthracological material came from the context of the layers with archaeological material from the Pod hradem Cave (Moravian Karst, Czech Republic). Some samples were determined as *Taxus*, which in this context would be among the first evidence of yew in the Middle Pleistocene. However, their dating showed significant secondary redepositions. Similar redepositions of material were repeatedly found in the dating of material from the Kůlna Cave (Moravian Karst, Czech Republic). Here, too, in certain parts of the cave, there was secondary redeposited archaeological material in seemingly intact sediments. Both caves were inhabited – Kůlna Cave from MIS 8 to MIS 2, Pod hradem Cave – from MIS 3e to MIS 2. At the same time, intensive post-sedimentation processes took place in both caves, accompanied by the activities of large carnivores inhabiting these caves alternately with humans. The last important factor influencing stratigraphy was the archaeological excavations at the end of the 19th and the beginning of the 20th century.

Keywords: Pod hradem Cave, Kůlna Cave, Anthracology, ^{14}C dating, Post- depositional processes

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1. Introduction

This study is a contribution to the issue of cave research methodology. It deals with the evaluation of two examples in which scientific samples were obtained from seemingly intact cave sediments by archaeological research. Research on the Pod hradem Cave, the first example, was conducted in the first half of the 1950s: (Valoch 1965). Species determination for the remaining charcoals was only performed in 2012. In several cases, the results were in conflict with the presumed (archaeological and geological) age of the strata from which the samples were taken. The second example is Kůlna Cave (Valoch 1988), from where properly contextually controlled samples of osteological material were taken for new absolute dating from 1961–1976 (Neruda and Nerudová 2014; Nerudová and Neruda 2014).

In this paper, we present the unpublished assessment of charcoals from the Pod hradem Cave, radiometric dating of selected samples and compare them with similar results obtained from the Kůlna Cave.

Study area

The caves of the Moravian Karst (Czech Republic, Central Europe) are world famous from an archaeological point of view (e.g. Neruda 2016; Valoch 2011). In the northern part of the Moravian Karst is Pod hradem Cave, situated in the Pustý žleb Dry Valley, approximately 4 km SSW of Kůlna Cave (Fig. 1B). Its entrance is situated on a north-facing slope 60 m

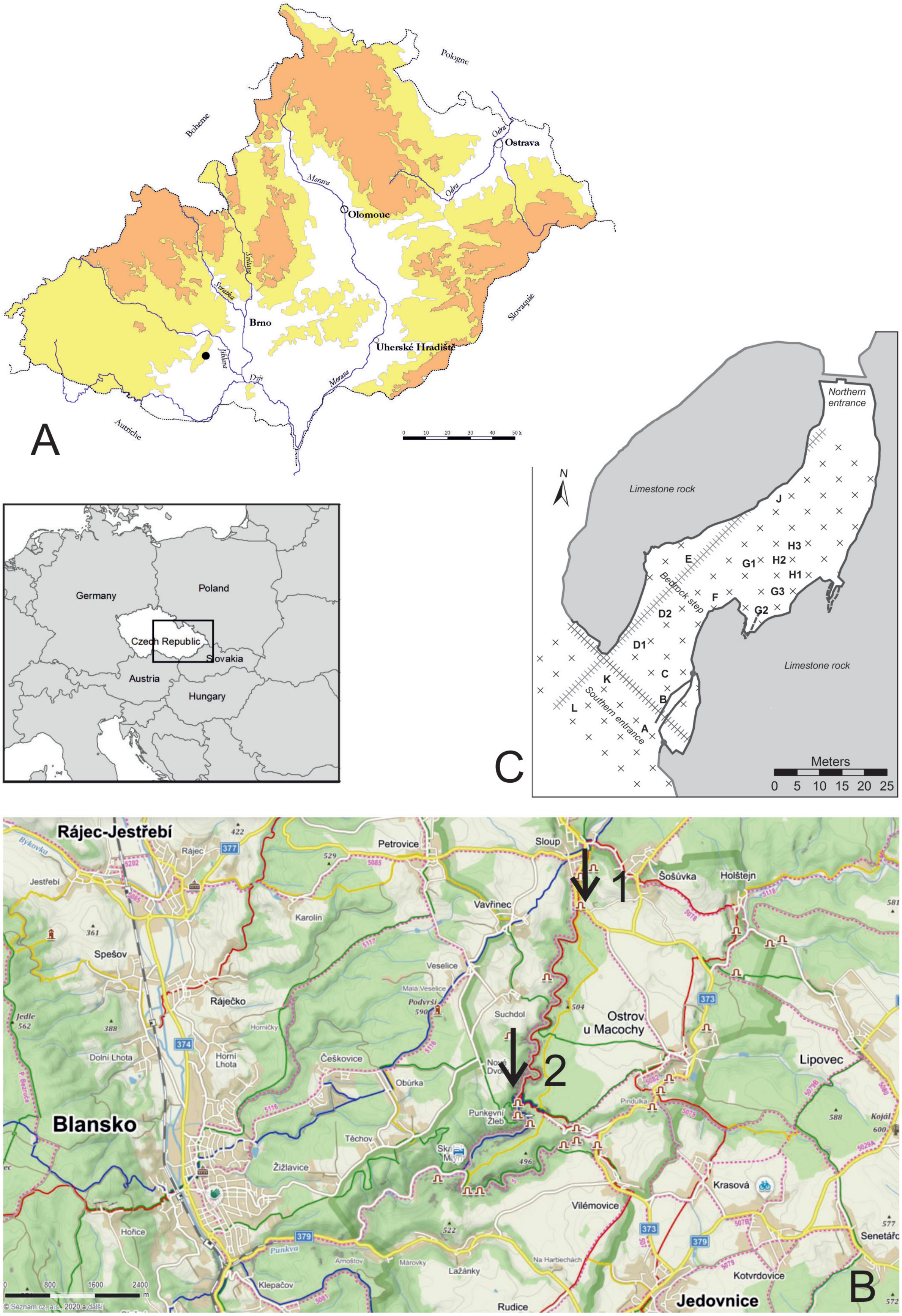

Fig. 1. Area under study. A – Position of the Czech Republic and detail of Moravia region; B – detail localisation of the Kůlna Cave (1) and Pod hradem Cave (2); C – ground plan of the Kůlna Cave.

above the valley floor. The narrow portal is 4 m wide and 2 m high. The cave was occasionally inhabited by humans during the MIS 3 period (Nejman *et al*. 2018; Nerudová *et al*. 2012). In addition, it was intensively used by predators (Musil 1965; Valoch 1965). Palaeontological research has been carried out here since the end of the 19th century. The first unique artifact – a leaf-point, which has since been lost – was obtained from here in the 1930s. Multidisciplinary archaeological research took place in the cave between the years 1956–1958 (Valoch 1965). One longitudinal probe was placed along the entire entrance part of the cave and two smaller probes in the rear part of the cave in the side corridor (Fig. 2A, B; Nerudová *et al*. 2012). Where the main probe was located, a profile 27 m long with a maximum depth of 5.5 m was documented (Fig. 2C). This provided the most complex stratigraphic sequence. In addition to a considerable amount of palaeontological material, particularly bear bones (*Ursus ingressus*), a large hearth and unique archaeological finds were discovered; these were associated with the cultures of the Upper Palaeolithic, namely the Szeletian, Aurignacian, and Gravettian (Valoch 1965, 96).

In the northern part of the Moravian Karst is Kůlna Cave (Fig. 1B, C). It is a long, S-shaped curved tunnel cave with two entrances. Palaeolithic settlement in the cave was concentrated in the area around the northern entrance to the central part of the cave. Intensive research carried out since the end of the 19th century has excavated mainly Holocene and Late Glacial sediments with evidence of Gravettian and Magdalenian settlements in several places and partially also older sediments (for more details see Valoch 1988; Neruda and Valoch 2011). In the years 1961–1976, interdisciplinary research was carried out here, which revealed most of the area in the entrance and the middle part of the cave up to the bedrock (Fig. 1C). Although research has found evidence of Palaeolithic settlement from the Taubachian to the Epi-Magdalenian, in contrast to the numerous chipped stone industry and osteological material, anthracological remains are not very numerous (cf. Opravil 1988).

2. Material and methods

As part of the research on the Pod hradem Cave (1956–1958), a total of 37 charcoal samples were taken, coming from different layers and places of the entire researched area (Tab. 1). They should, therefore, represent the time period from the beginning of the

Table 1. Pod Hradem Cave, analyzed samples. The square description is according to Musil 1965, depth is in cm. Interpretation (performed by ZN) is based on the column note and depth. The information was compared and re-measured to the published overall longitudinal profile, which was reproduced in detail in colour at scale 1:10 in Musil 1965 (see Fig. 2 here). Each sample in Table 1 represents the content of one glass test tube. For a comparison of sample positions see Fig. 2.

Sample	Square	Depth	Museum Label Note	Interpretation
1	2	3	4	5
1	33–35	70–90	1956, W2/3	Layer 5, closely over the Gravettian hearth (perhaps touching the hearth?)
2	29–30	60–70	W2/3	Layer 6a, perhaps touching the periphery of Gravettian hearth
3	31–32	140–150	W1/2	Layer 14 (significantly below the Gravettian hearth and significantly above the layer with leaf point)
4	10–12	100	New Age	Layer 4
5	10–12	150–160	grey, LBK culture	Layer 3
6	7–9	180–190	light grey-brown; below the LBK	Layer 5a
7	13–14	30–80		unclear; according the profile include basis of Layer 1, Layers 1a and 2
8	15–16	60–70	surface of dark	Layer 2
9	31–32	10–20	ligh yellow-brown	unclear; Layer 2 or 3; both were surface and outside of archaeological finds

1	2	3	4	5
10	23–24	160–170		Layer 13b
11	29–30	40–50		Layer 6a, perhaps touching the periphery of Gravettian hearth
12	19–20		white sediment, depth sonda	unclear
13	7–9	150–160		Layer 3a
14	13–14	30–80		unclear; according the profile include basis of Layer 1, Layers 1a and 2
15	31–32	40–50		Layer 5, outside of Gravettian hearth
16	10–12	160–170	light grey-yellow	probably transition of Layer 3 and Layer 3a
17	21–26	340–350		samples come from 6 sq m, but the indicated depth was achieved here
18	10–12	150–160	grey, LBK culture	Layer 3a
19	12	160–170	in the corner Middle Age	Layer 5a
20	13–14	120–130	grey, LBK culture	Layer 3
21	21–22	120–130	disorder	unclear; discorder reached deep 150 cm, then excavated only 90 cm depth
22	29–30	20–30	W3, light yellow-brown	Layer 5, above the Gravettian hearth
23	19–20		depth sonda, brown loess-like sediment	unclear
24	25–26	150–160	cf. cofee brown soil, second W1-2	basis of Layer 13b or Layer 13c
25	11–12	170–180	yellow-brown	Layer 5a
26	10–12	150–180		Layer 3a? Layer 5a? Uncleare.
27	13–14	110–120	grey, LBK culture	Layer 3
28	2–30	10–20	soil W3, light yellow-brown	unclear; it looks like charcoals from Layer 5 from the whole entrance of the cave
29	10–12	180–190	yellow-brown	Layre 5a, basis
30	11–12	160–170	light grey-brown	Layer 3
31	10	160–170	black	probably Layer 3a, according to the profile
32	13–14	100–110	grey-brown, cinereous	Layer 3 or Layer 5a
33	29–30	70–80	W2/3	transition of Layers 6a and 6, outside the Gravettian hearth
34	25–26	160–170		Layer 13b
35	33–35	150–160		Layer 14
36	29–30	80–90		bordeline between basis of Layer 6 and Layer 7
37	29–30	50–60		probably Layer 6a – upper level, probably touching the Gravettian hearth

Upper Palaeolithic to its upper phase, i.e., 40,000–20,000 uncal BP. Unfortunately, for the purposes of publication (Opravil 1965) only a selected part was determined (from layers Würm 1/2, Würm 2/3 and Holocene; see Opravil 1965, 149).

Similarly, not all of the samples from the Kůlna Cave were used. As we identified some decades later, not all available anthracological findings were included in the monograph, not even in the monographic interdisciplinary treatment of Kůlna Cave (Valoch 1988).

The material from Pod hradem Cave seemed to be a suitable reference (temporal) analogy. Therefore, an as yet unrealized anthracological analysis of samples from the Pod hradem Cave was performed. Practically simultaneously, the hitherto undetermined charcoals from the Kůlna Cave were also determined. The remaining part of the unspecified charcoals from the Kůlna and Pod hradem caves was handed over for assessment in 2011–2012. The determination was performed by J. Novák; subsequent radiocarbon dating took place in an Oxford laboratory.

2.1 The collection of samples

The collection of samples took place within the archaeological research of the sites in 1956–1958 (Pod hradem Cave) and 1961–1976 (Kůlna Cave). Archaeologists took samples of varying volumes: individual bigger charcoals (0.5–2 cm) macroscopically distinguishable in the course of preparation of the archaeological layer and target sediment samples of 2–4 cm^3 from places with dispersed pieces of charcoals. Unfortunately, the methodology of sampling is not known. Dry-sieving of the sediments was performed on both sites (Musil 1965, 13; Valoch 1988, 13–14). The charcoal samples taken from both studies were stored at the Anthropos MZM Institute in glass test tubes. Each sample contained location data (site, square, depth, note, see Tab. 1).

2.2 Laboratory preparations and analysis of fossil samples

Charcoal analysis was performed on fragments from the largest fraction (>1mm). The charcoals were identified using an episcopic interference microscope (Nikon Eclipse 80i) with

200–500 magnification and the reference collection. Additional standard identification keys were also used (Heiss 2000; Schweingruber 1990). Species abundance was expressed in the number of charcoal fragments (e.g. proposed by Delhon 2006) and charcoal anthracomass (e.g. Carcaillet and Thinon 1996). The individual taxa were weighted with an accuracy of 0.001 g. The sediment anthracomass (milligram of charcoal per kilogram of sediment; Talon *et al.* 1998) was derived from charcoals larger than 1 mm.

2.3 Radiocarbon dating

New radiocarbon dating was performed at a laboratory in Oxford using the accelerator mass spectrometry (AMS) method. Samples underwent standard laboratory procedure (Bronk Ramsey *et al.* 2004b). Before dating, the charcoals were determined.

According to laboratory standards, the dates are uncalibrated in radiocarbon years BP. Isotopic fractionation was corrected for using the measured $\delta^{13}C$ values measured on the AMS. The quoted $\delta^{13}C$ values were measured independently on a stable isotope mass spectrometer (to ±0.3 per mil relative to VPDB). Chemical pretreatment, target preparation and AMS measurement was done according to the standards (Bronk Ramsey *et al.* 2004a; Bronk Ramsey *et al.* 2004b; Bronk Ramsey *et al.* 2002). The calibration was measured using the 'INTCAL09' calibration curve (Reimer *et al.* 2009).

3. Results

3.1 Anthracological analysis

Our study analyzed 413 charcoal fragments from Pod hradem Cave and 105 charcoal fragments from Kůlna Cave (Tab. 2). The anthracological analysis from Pod hradem Cave revealed fifteen different charcoal taxa: *Abies, Acer, Carpinus, Corylus, Fagus, Fraxinus, Juniperus, Larix/Picea, Pinus, Pinus cf. cembra, Quercus, Salix/Populus, Taxus, Tilia,* and *Ulmus* (Tab. 2, Fig. 1, 2). Detailed diagrams are shown in Figures 3 and 4.

We obtained a higher density of charcoal samples at layers 13 and 14. Samples are characterised by the dominance of *Larix/Picea* charcoals and the common presence of *Pinus.* The abundant presence of *Taxus* charcoals was characteristic for layers 5–7 and 14. Other deciduous broad leaf trees (*Acer, Carpinus, Corylus, Fagus, Fraxinus, Quercus, Tilia, Ulmus*) were determined. In addition to the relatively common species, the presence of yew is particularly striking. Also found were maple, oak, hazel, elm, and beech, which are all unexpected species due to the context of the find.

From Kůlna Cave, charcoals from the Micoquian layer 7a were selected for determination. In addition to fragments of burnt bones, relatively large charcoals of oak and pine were determined (Tab. 3).

Table 2. Pod hradem Cave. In Table 2, the samples are sorted in ascending order by the layers as identified by us (see Table 1, Interpretation column). The individual layers represent different time periods of cave settlement and correspond to the layers that Nejman also identified by his revision research. 12 sedimentary layers were recognized in the excavated section (Nejman *et al.* 2017). Red – problematic sample, yellow – dated samples from clear controllable contexts.

Sample	Layer	Square	Depth (cm)	Abies	Acer	Carpinus	Corylus	Fagus	Fraxinus	Juniperus	Larix/Picea	Pinus	Pinus cf.cembra	Quercus	Salix/ Populus	Taxus	Tilia	Ulmus
1	5	33–35	70–90		1	0			0	0	4	0	0	0	0	0	0	0
2	6a	29–30	60–70		1						2					4		
3	14	31–32	140–150		3						4					14		
4	4	10–12	100	9	15													
5	3	10–12	150–160					3			8	1				9	10	
6	5a	7–9	180–190		1						1	1		2			2	
7	1,2	13–14	30–80													6		
8	2	15–16	60–70								2							
9	2,3	31–32	10–20	1	2		3	8	1							1	1	
10	13b	23–24	160–170		1			2			32	2					1	
11	6a	29–30	40–50								4				2		1	1
12	?	19–20	depth sonda					1										
13	3a	7–9	150–160				1				5				1	1		
14	1,2	13–14	30–80		1											4		
15	5	31–32	40–50				14		1		2			7		3	1	
16	3, 3a	10–12	160–170								5	2		1		1		
17	21	21–26	340–350							1	23	2	9					
18	3a	10–12	150–160		7			2		1	11						6	
19	5a	12	160–170		2											1	2	
20	3	13–14	120–130							1	4							
21	?	21–22	120–130								3	1						
22	5	29–30	20–30	1			1	1			1						2	
23	?	19–20	depth sonda								1					1		
24	13b	25–26	150–160								11				1			
25	5a	11–12	170–180				1				3	2		1		3		
26	3a	10–12	160–170		1		2				7					11		
27	3	13–14	110–120								3					2		
28	5	29–30	10–20	2		2	1	1	1		2					1	1	
29	5a	10–12	180–190				2	1								2		
30	3	11–12	160–170								4	2				1		
31	3a	10	160–170								1	5		1		1		
32	5a/3	13–14	100–110				1				6					1		
33	6a	29–30	70–80		3						3							
34	13b	26–26	160–170		2						5							
35	14	33–35	150–160								5							
36	7	29–30	80–90				2				2			1				1
37	6a	29–30	50–60												1			
Σ				13	40	2	28	19	3	3	164	18	9	13	5	67	27	2

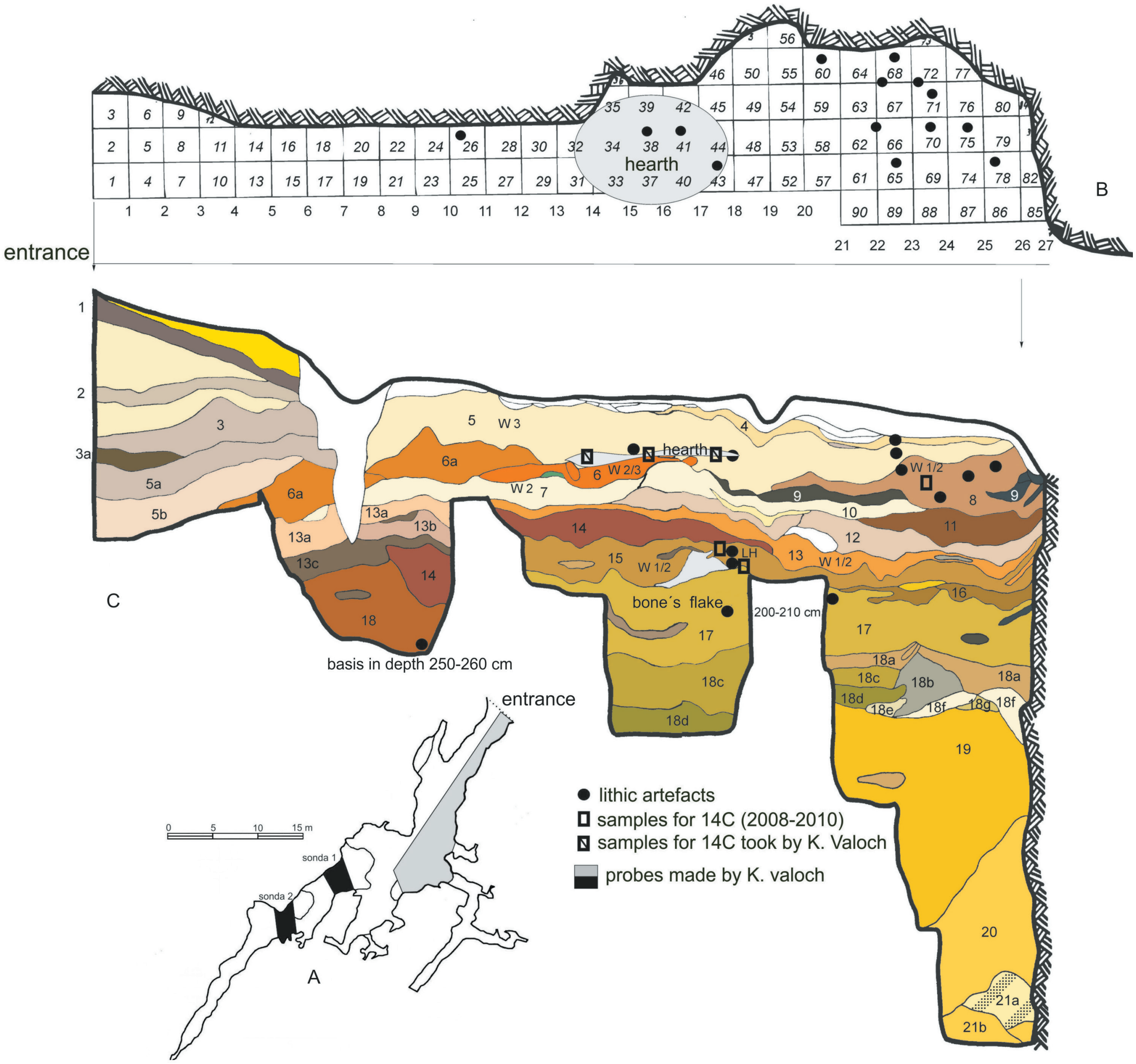

Fig. 2. The plan of Pod hradem Cave digitized and reconstructed according to Valoch (Nerudová *et al.* 2012) and subsequently modified. A – ground plan of the cave. By grey – K. Valoch's excavation, black – sound 1 and 2 made in the inner part of the cave by K. Valoch during his excavations; B – horizontal plan of the excavations with numbering of square metres, horizontal distribution of lithic artefacts (black dots) and probable extension of the hearth (grey oval); each square is 1 × 1 m; C – digitized stratigraphy with vertical position of lithic pieces (black dots), hearth (grey oval), samples for ^{14}C taken by Valoch (crossed out rectangles) and samples for dating taken between 2008–2010 from material stored in the Moravian Museum (rectangles). Probe 1 (sound 1) was probably situated in the place where Simon found a leaf point. In sound 2 at a depth of 190–200 cm the sediment was macroscopically identical to the sediment in Layer 15. Valoch took a sample for dating from this depth and sediment.

3.2 Results of radiocarbon dating

From Pod hradem Cave, three different samples of *Taxus* species (Tab. 2) were sent for dating. According to our analysis, all samples came from places unaffected by post-Palaeolithic settlements. In contrast to their presumed age due to the archaeological context, we obtained unexpectedly young data from them. The samples are placed from the 3rd century BC to 3rd millennium BC (Tab. 3).

Unexpectedly recent data was also obtained from Kůlna Cave. These did not correspond to the archaeological age of layer 7a at the cave. These data represent the period of the 2nd century BC to the 9th millennium BC (Tab. 3).

Table 3. Above: Kůlna Cave, Layer 7a. List of determined species the number of pieces. The samples taken for dating are marked with an asterisk. Below: The results of dating from the Kůlna (KUL) and Pod hradem (PH) caves.

Square	**Depth (cm)**	***Fraxinus***	***Pinus***	***Picea / Larix***	***Quercus***	**Burnt bone**
11/i	270		6*	2	49*	
g/34–37	190–220					3
2–5/bc	430–440	15*	13*			
11/i, 26 1/11	270		10		40	

OxA Sample	Material (species)	$\delta^{13}C$	uncal BP
OxA-26996	PH2012-1 charcoal (*Taxus baccata*)	–26.24	320 ± 24
OxA-26997	PH2012-1 charcoal (*Taxus baccata*)	–26.30	347 ± 24
OxA-26998	PH2012-2 charcoal (*Taxus*)	–23.30	2534 ± 27
OxA-25719	KUL2011-1 charcoal (*Fraxinus*)	–23.29	4001 ± 28
OxA-25720	KUL2011-2 charcoal (*Pinus*)	–25.02	149 ± 23
OxA-25721	KUL2011-4 charcoal (*Pinus*)	–24.72	8832 ± 37
OxA-25781	KUL2011-3 charcoal (*Quercus*)	–25.38	8940 ± 40

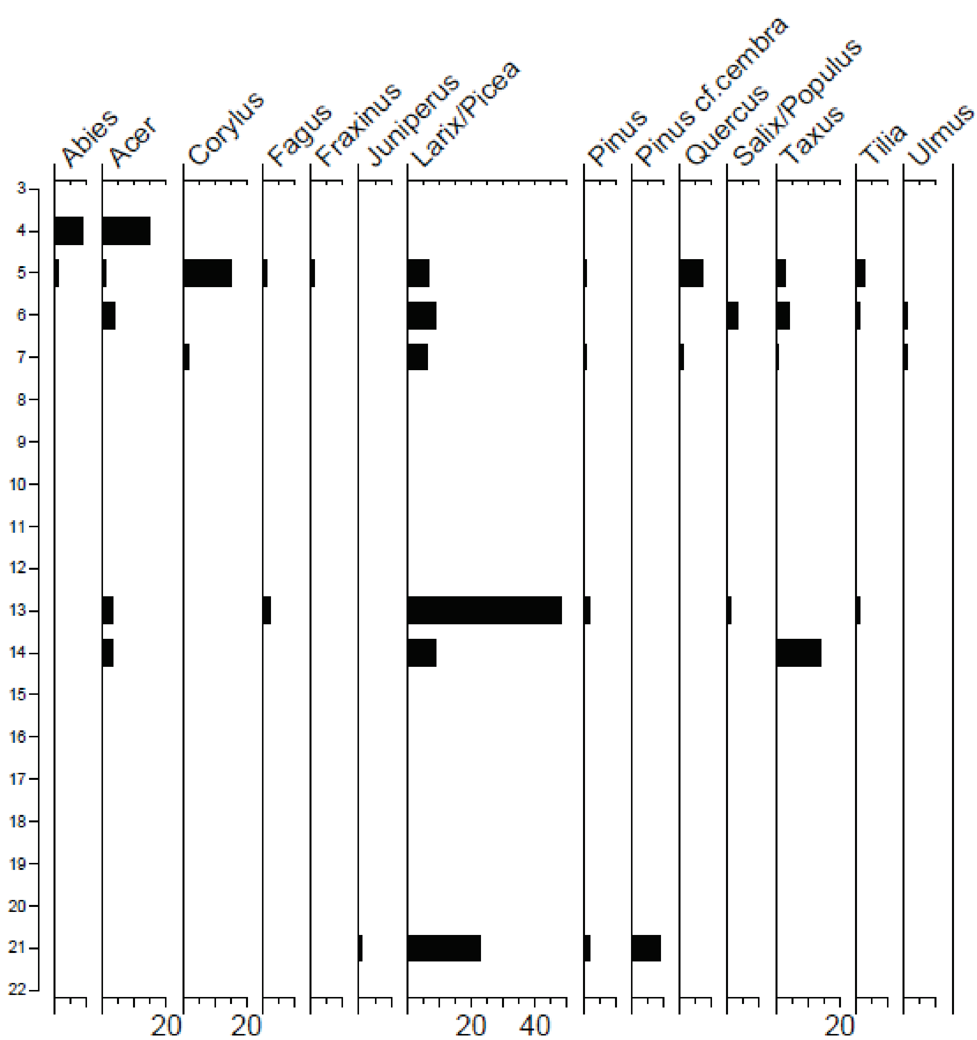

Fig. 3. Pod hradem Cave, all analyzed samples from layers 3–21 (Y-axis)

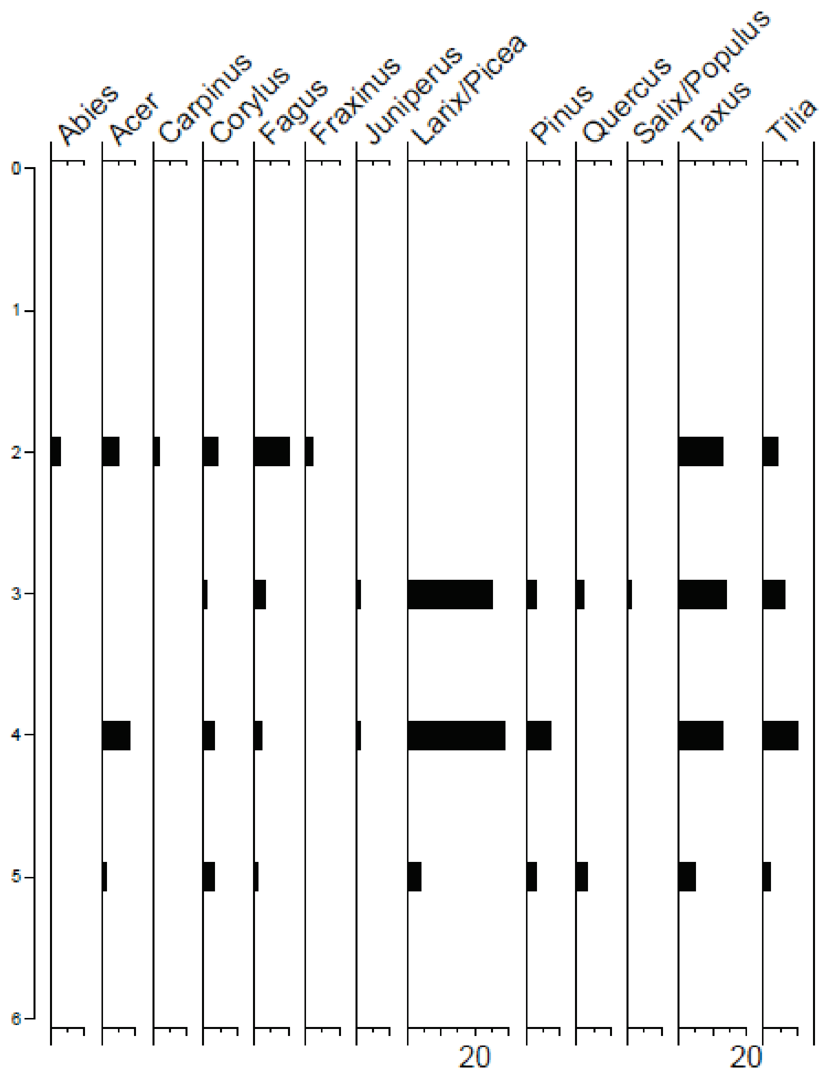

Fig. 4. Pod hradem Cave, the detail of samples from layers 1–5 (Y-axis).

4. Discussion

4.1 Anthracology

The genus *Taxus* is a tree, the wider occurrence of which is usually associated with the Holocene in Central Europe (Batchelor *et al.* 2019; Bevan-Jones 2016; Deforce, Bastiaens 2007; Uzquiano *et al.* 2015). Although this tree occurred and was used at least in the Middle Pleistocene (a find from Clacton-on-Sea), evidence of its occurrence is generally rather poor. In the Czech Republic, documentation in the late Pleistocene – Gravettian is registered, for example, in Dolní Věstonice (Mason *et al.* 1994). *Taxus* charcoals are more abundantly found in wells from the period of agricultural prehistory (Neolithic-Bronze Age) and in sandstone rock shelters in North Bohemia (e.g. Novák *et al.* 2015).

The amount of yew recorded in the intact Middle Palaeolithic layers of Pod hradem Cave (Tab. 2) is really unexpected. In addition, relatively large, burnt fragments of wood were present. Along with yew, a number of other deciduous trees such as maple, oak, hazel, elm, and beech, were found. The question was whether, on the basis of identified tree species, we could consider that the generally presented character of the vegetation of the natural environment could be much more varied in places than is generally assumed. Indications suggested that the yew from Pod hradem Cave could be one of the oldest evidences of this taxon in Central Europe (for an overview of the presence of yew during the Pleistocene see Deforce and Bastiaens, 2007). Charcoal-dated yew from Moravany (Slovakia) from 22,000 BP is mentioned in the literature along with hazel, oak, ash, alder and beech (Slavíková-Veselá 1950), but its refugium is generally assumed to be in regions with a mild, oceanic climate (Deforce, Bastiaens 2007). Revision of the archaeological research has provided some guidance.

Charcoal was recovered from layer 3 (3 samples) and layer 10 (574 charcoal samples in total) from new excavations conducted by L. Nejman between 2011–2012. In layer 10 the most common species was *Larix / Picea* (larch / spruce) followed by *Pinus* cf. *cembra*.

Two species of charcoal *Taxus baccata* and *Fagus sylvatica* were identified in the small number of fragments recovered from layer 3 (Nejman *et al.* 2017). Further analyzes also showed that *Picea / Larix* and *Pinus cembra* were not only numerous in layer 10 but also in upper layer 9 and the underlying layer 11 (cf. Nejman *et al.* 2018, Fig. 5). Less common species included *Populus / Salix* and *Juniperus.*

If we analyze the findings from the Pod hradem Cave (Tab. 2) and compare them with the reconstructed plan (Fig. 2), we can observe several tendencies. A large amount of carbon from yew and other unusual woody plants was identified mainly in layers 1–3 (Tab. 2). These are layers which, according to research by Valoch and also by Nejman, represented the youngest phase of the cave's settlement. Also, Nejman *et al.* (2018) refer to the information that "Layer 1 contained ceramic and metal artefacts, some of which are associated with early medieval occupation". Layer 2 chronostratigraphically corresponds to the Atlantic climatic optimum (with phases of Mesolithic, Lower and Middle Neolithic, and Upper Neolithic). Layers 3, 4, and the upper part of Layer 5 were AMS dated to approximately 36–28 cal kyr BP (Nejman *et al.* 2018). At the same time, based on analyzes (pollen, anthracology, and sedimentology), the authors do not rule out the possibility that layers 3 and 4 were contaminated with Holocene material (Nejman *et al.* 2018, 208). No Palaeolithic artifact comes from layers 3 and 4 of Nejman's research.

If we compare Nejman's stratigraphy with that of Valoch's, we find that they fully correspond with each other. Valoch does not indicate layer 1, his findings of linear ceramics (LBK) are in layer 3 (see Tab. 1), which corresponds to layer 2 in Nejman's research. In Table 1 we can see that Valoch presents modern finds at a depth of 100 cm; according to the profile we interpreted this should be layer 4. At the same time, LBK was located in these places (squares 10–12).

On the contrary, the places where yew was not identified were the areas of squares 23, 24, 25, 26, and 28, i.e., before that ash lens (hearth; although its spatial distribution was only reconstructed approximately). Theoretically, these could be "intact" places (see below). L. Nejman's probes were located rather in places opposite the hearth (cf. Nejman *et al.* 2017, fig. 2), because the aforementioned *Taxus* also comes from his research. We could label all the lower horizons in the Pod hradem Cave, i.e., layer 5 and deeper, as relatively "safe" layers.

Nevertheless, the findings of *Taxus* charcoals also come from layer 5 and deeper layers.

4.2 Dating

All obtained radiocarbon data from both the Kůlna and Pod hradem caves did not correspond to their presumed age. This repeated discrepancy can be influenced by several factors. The general problem is the limitations of the use of the old collections, here represented by samples from the Kůlna and Pod hradem caves. Similarly, the younger date mentioned in the Nietoperzowa Cave (Krajcarz *et al.* 2018), the Ciemna and Obłazova caves (Alex *et al.* 2017) are results of possible admixture of some material in sediments. Another explanation for the observed discrepancy between the expected and resulting dates is also discussed by other colleagues, recently with regard to Koziarnia Cave (Kot *et al.* 2020). The results of dating burnt materials (bones, charcoals) can be influenced by the temperature of burning, e.g., charcoals burned at relatively low temperatures. This may likely produce a shift to younger radiocarbon dates (Kot *et al.* 2020).

5. Interpretation

The reconstruction of the course of the layers in the Pod hradem Cave shows a rather complex, often area-limited sedimentation from several directions, so that the deposition of some layers took place only in a part of the cave. Although the research was conducted in intact sediments and the only significant defect was documented near the entrance to the cave, i.e., away from places with archaeological finds, there were significant post-deposition changes in the cave, caused mainly by large carnivores, as the cave served as a winter habitat for cave bears.

A planar and vertical reconstruction of the distribution of archaeological finds (*Nerudová et al.* 2012), carried out on the basis of known information (Valoch 1965), indicates the main problems of sedimentation and interpretation of archaeological horizons. Not all of the layers associated with archaeological cultures were in direct superposition. An extensive hearth or ash-deposit, which provided several indistinct stone artifacts and a date belonging to the Gravettian period, was located in an extended place in the middle part of the cave, at the level of length meters 15–18 (Fig. 2B). A lone leaf point was found in layer 15 one meter deeper and in approximately the same location. Another industry attributed to the Aurignacian (the so-called second cultural circuit) was then scattered in several layers between lengths of 21–25 (Fig. 2B,C). These findings are usually associated with absolute data from probe 2, which dated the so-called horizon W1/2 and which was related to the findings based on the similarity of sediments.

As indicated in the introduction, the Pod hradem Cave, although initially only providing palaeontological material, has been studied by archaeologists since the 19th century. The cave was primarily a bear cave, only occasionally inhabited by humans. The bear bones were occasionally scavenged by wolves and hyenas.

Not only the intensive activity of carnivores and sedimentation processes in the cave (better illustrated by the profile published by Valoch 1965; see also Nejman *et al*. 2018) but also later interventions in the cave caused tree charcoals to move out from their layered sediments and penetrate deeper. Two radiocarbon dates correspond to finds from the Middle Ages; the third date is later in the Late Bronze Age. At the same time, the data correspond to known knowledge about the spread of yew in our environment (Batchelor *et al*. 2019; Deforce, Bastiaens 2007).

Archaeological layer 7a in Kůlna Cave was considered to be unaffected by secondary post-deposition processes (Neruda and Valoch 2011), especially with regard to the results of dating the findings from the Micoquian 6a layer at the cave entrance (Neruda, Nerudová 2014). No recent contamination was evident in the set of osteological material, and radiocarbon data obtained from osteological material confirmed the archaeological age of the layer (Neruda and Nerudová 2014). However, the situation is different with the isolated charcoals. Their relocation into Middle Palaeolithic positions was most likely caused by digs conducted by amateur archaeologists in the 19th and 20th centuries. One sample almost precisely coincides with the time of excavations by Wankel (Neruda and Nerudová 2014).

The Mesolithic date confirms a small collection of lithic industry from layer 3 to the Mesolithic period. The last date from the Neolithic/Eneolithic transition undoubtedly pertains to numerous post-Palaeolithic occupations of the cave.

6. Conclusions

Radiocarbon dating of three charcoal samples, which were identified as *Taxus baccata* from the Pod hradem Cave, and dating of four charcoal samples from the Micoquian layer 7a of the Kůlna Cave showed a significantly younger age of dated material that did not correspond to the real age of the archaeological layers from which these samples were removed for dating. Similar results were found earlier, as part of a project focused on climate reconstruction and chronostratigraphy in the Kůlna Cave, when anthropically affected osteological material was dated. The occurrence of tree species which did not correspond to published global climate reconstructions, seemingly confirmed the specific climatic condition in Moravia in the Czech Republic and showed its exceptional tree diversity with several temperate deciduous tree taxa (for comparison see Jankovská and Pokorný 2008). Woody assemblages dated to between 35 and 30 ka cal BP are mentioned in the literature. These also include the oceanic *Taxus baccata* in Moravia (Feurdean *et al*. 2014). The results of radiocarbon dating illustrate extremely well why it is not worth dating isolated charcoals, unless we are interested in learning more about the period when the archaeological layer was contaminated.

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