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PALAEOLITHIC/MESOLITHIC STRATIGRAPHIC SEQUENCES AT ÚDOLÍ SAMOTY AND JANOVA ZÁTOKA ROCK SHELTERS (NORTHERN BOHEMIA)

This paper is an addition to a series of previous publications discussing the recent Mesolithic discoveries in the sandstone areas of Northern Bohemia, Czech Republic (Svoboda 2003; Svoboda et al. 2007; Šída / Prostředník 2007; Šída / Prostředník / Kuneš 2011). During the 2007-2011 research, previously unknown Late Palaeolithic horizons have come to light below the Mesolithic layers, in sedimentary deposits at the base of two rock shelters, thus providing a more complex evidence of the Pleistocene/Holocene transition and subsequent development. We studied the formation processes of these stratigraphic sequences at two different types of rock shelters – Údolí samoty and Janova zátoka (fig. 1). At Údolí samoty (okr. Česká Lípa) we documented a thick sequence with a complex stratigraphy while at Janova zátoka (okr. Děčín) we recorded just a thin sedimentary sequence, partly affected by post-depositional processes. At both sites, we also addressed the question of a change in environment and in resource exploitation around the Pleistocene/Holocene boundary (tab. 1).

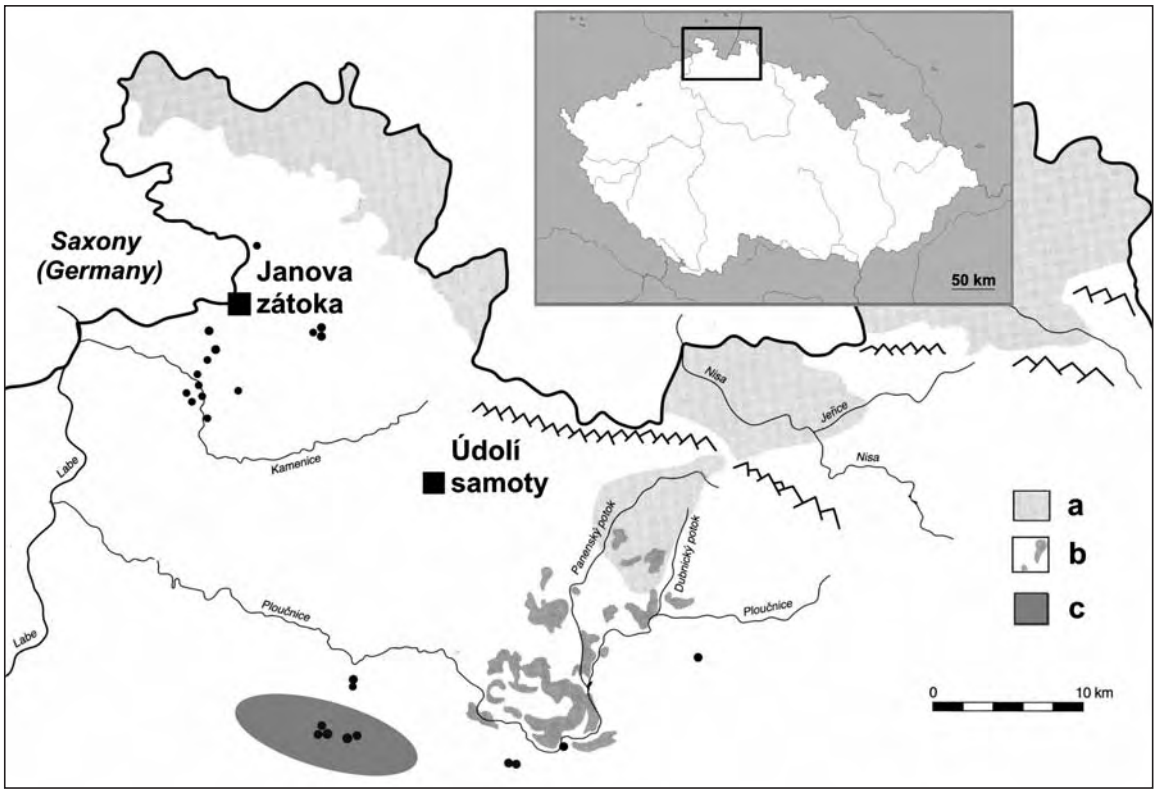

Fig. 1 Map of Northern Bohemia (Czech Republic) showing the locations of Údolí samoty (okr. Česká Lípa), Janova zátoka (okr. Děčín), related Mesolithic sites (●), and local raw materials. – Patterns: **a** extension of glacial sediments with occurrences of erratic flints (after D. Nývlt in: Svoboda 2003, fig. VI, 1); **b** fluvial deposits with rare erratic flints; **c** approximative concentration of the Stvolínky-type quartzites. – (Map J. Svoboda).

sample no.	site	depth/ context	result (BP)	result (cal BC)
Poz-43847	Údolí samoty	pit/upper	115 ± 25	not calibrated
Poz-43848	Údolí samoty	pit/bottom	139.15 ± 0.4	not calibrated
Poz-48373	Údolí samoty	120-140 cm	7960 ± 50	6882 ± 113
Poz-43850	Údolí samoty	165 cm	8730 ± 50	7770 ± 102
Poz-43849	Údolí samoty	180 cm	9360 ± 50	8641 ± 64
OxA-25772	Údolí samoty	270 cm	11 750 ± 50	11 684 ± 127
Poz-23176	Janova zátoka	25 cm/pit	9250 ± 60	8466 ± 95
Poz-48371	Janova zátoka	60 cm	1960 ± 25	not calibrated
Poz-23178	Šamanská rokle	110-120 cm	8170 ± 50	7187 ± 85
Poz-23177	Prasečí kámen	90-100 cm	7940 ± 50	6863 ± 122
Poz-23179	Šibeniční kámen	110 cm	7510 ± 50	6360 ± 67

Tab. 1 Radiocarbon dating of Údolí samoty, Janova zátoka, and other rock shelters excavated after 2005 (for related ^{14}C dates from Northern Bohemia see Svoboda 2003; Svoboda et al. 2007; Šída / Prostředník / Kuneš 2011). All dates are from charcoal. – Calibrated by OxCal 4.1. using calibration curve IntCal09.

Fig. 2 Údolí samoty (okr. Česká Lípa). Location of the rock shelter dominating the shallow valley, during excavation in 2011. – (Photo J. Svoboda).

ÚDOLÍ SAMOTY (LONELINESS VALLEY), K. Ú. RADVANEC, OKR. ČESKÁ LÍPA

Údolí samoty consists of an isolated, north-south oriented valley in the Cretaceous sandstone formation at the foot of the Lusatian Mountains. Geographically, it represents a potential link between the Mesolithic provinces of Česká Lípa Basin to the south and Bohemian Switzerland to the northwest. The rock shelter is located in a prominent position above a brook, near an active water source, and at the place where the valley becomes narrower (fig. 2). As a result of weathering of the sandstone ceiling and continuous influx of allochthonous sediments from above throughout the Late Pleistocene and Holocene periods, a sedimentary sequence – 3 m thick – has been deposited during this time span. Therefore, this rock shelter offers a longer and more diversified stratigraphic record.

This location was first recognised as an archaeological site during our regional field surveys in 1999. The first test trench exposed a stratigraphic sequence up to 70 cm thick, with a recent darkish forest soil, followed by whitish sandy layers containing pottery and charcoal, and whitish and yellowish sand with two lithic artefacts and charcoal. A subsequent trench dug in 2003 revealed a more complex stratigraphy, 2 m deep, with intensive Mesolithic occupation at the base (Svoboda 2003, fig. 17, 2). In 2011, an area of 2.5 m × 2.5 m was excavated completely and reached solid bedrock at a depth of 3.2 m.

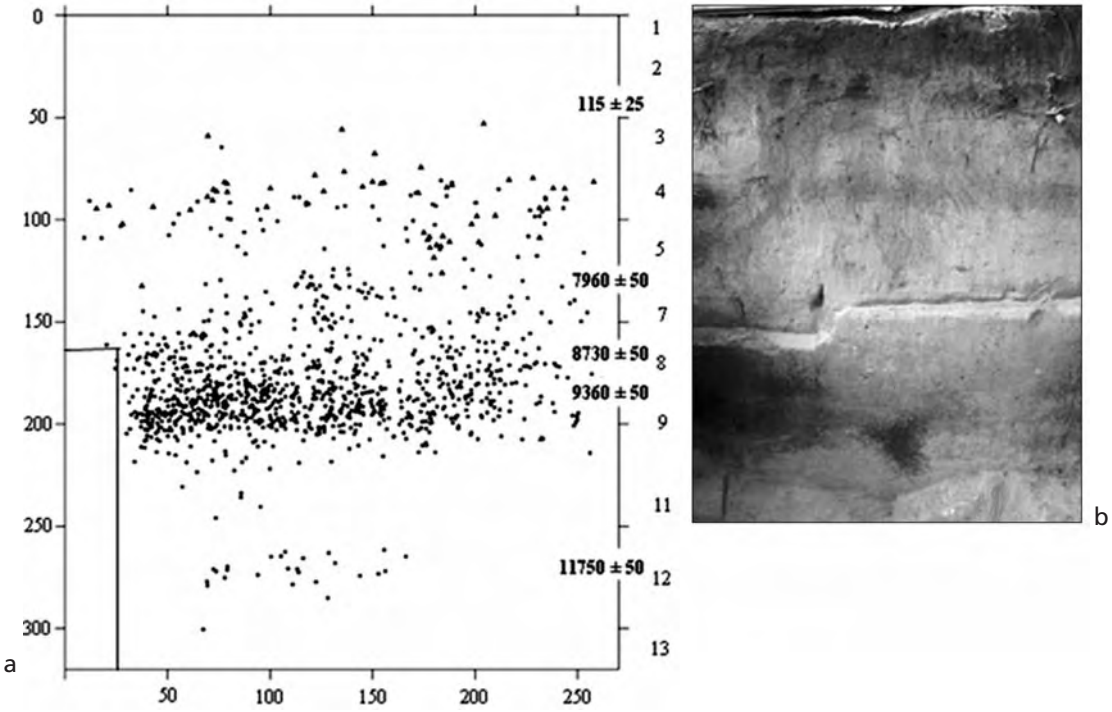

Fig. 3 Údolí samoty (okr. Česká Lípa). Stratigraphic section. – **a** distribution of lithic artefacts (●) and ceramic fragments (▲) in the layers 1-13. – **b** photodocumentation of the same section (before excavating the layers 11-13). – (a graphic M. Novák; b photo J. Svoboda).

Stratigraphic section

This massive sedimentary sequence formed relatively rapidly due to both local weathering and influx of allochthonous material. Effects of bioturbation are visible on the boundaries between the layers, as small dots caused by edaphon activity. A fissure in the central part of the rock shelter ceiling allows continuous water seepage, which has resulted in the formation of two deep longitudinal pits in the sediments below, marked by light-coloured infill bordered by rusty-coloured margins. These pits also served as natural traps for the archaeological material.

Generally, the sequence of the layers can be characterised as follows (fig. 3):

1. Darkish forest soil, with needles, depth 0-20 cm;
2. Light-greyish sandy layer, with subrecent disturbances and features (pits), depth 20-30 cm (in depressions 40 cm), ^{14}C dated 100-150 BP;
3. Whitish coarse-grained sand, with charcoal, depth 30-70 cm;
4. Brown-to-greyish sandy/loamy sediments, with effects of edaphon activity (4a – dark brown; 4b – greyish, fine-grained, with charcoal), depth 70-110 cm;
5. Whitish sand, with charcoal, depth 110-120 cm (maximum 130 cm);
6. Yellow, coarse-grained weathered sand (only along the rear wall of the rock shelter);
7. Dark yellowish sand, with charcoal and effects of edaphon activity, depth 120-160 cm (maximum 170 cm), ^{14}C dated 7960 ± 50 BP;
8. Sublayers of orange burnt sand, with charcoal and burnt bone fragments (locally at the base of 7 and inside 9);
9. Dark greyish, sandy/loamy layer, with charcoal, effects of edaphon activity, and depression features at the base, depth 160-200 cm (in depressions 220 cm), ^{14}C dated 8730 ± 50 BP and 9360 ± 50 BP;
10. Light greyish sand, with charcoal, depth 200-220 cm;

11. Whitish-to-yellowish coarse-grained sand, with undulated rusty bands, depth 220-270 cm, ^{14}C dating failed;
12. Dark greyish sandy location, with charcoal, depth 270-280 cm, ^{14}C dated 11 750 ± 50 BP;
13. Whitish coarse-grained sand, with undulated rusty bands, depth 280-320 cm;
14. Cretaceous sandstone bedrock.

The excavation record, including 3D recording of artefacts and additional material from sieving or floating the sediments, makes it possible to reconstruct the individual archaeological horizons in greater detail. In this preliminary study, we present a coarse-grained separation of the 3 m deep section into seven basic material units, including two units containing ceramics (Late Bronze Age to Aeneolithic periods, with Mesolithic admixture at the base), followed by four Mesolithic units and a Late Palaeolithic unit at the base.

Anthracological analysis and vegetation reconstruction

Unit 1, 0-70 cm, predominantly Late Bronze Age period
The upper part of the section is characterised by low species diversity with a high proportion of *Pinus sylvestris*. The low species diversity is probably due to the anthropogenic activities affecting the surrounding vegetation.

Unit 2, 70-120 cm, predominantly Bronze Age/Aeneolithic
Species present in this unit include a high proportion of scots pine and a low proportion of spruce, beech, oak, birch and aspen/willow. Low species diversity is often associated with the Late Bronze Age environmental collapse (Ložek 1998). The layer at a depth of 100-120 cm has a high proportion of oak charcoal. The occurrence of scots pine, spruce, hazel, birch and beech charcoal indicates an increase in species diversity. Hazelnut shells are found in this layer.

Unit 3, 120-160 cm, Mesolithic
The layer at a depth of 120-140 cm has a high proportion of oak charcoal. The occurrence of scots pine, spruce, hazel, birch and beech charcoal indicates an increase in species diversity. Hazelnut shells are increasing in quantity. A layer at a depth of 140-160 cm contains a large amount of oak charcoal. *Pinus sylvestris* and *Corylus avellana* are still very frequent, *Tilia* sp. and *Populus*/*Salix* are still commonly represented and *Acer* sp. occurs for the first time.

Unit 4, 160-180 cm, Mesolithic
This unit is characterised by a high proportion of *Pinus sylvestris*, accompanied by lime and hazel. Oak and spruce/larch charcoal are rare. Hazelnut shells are very common. The species composition is similar to the overlying layer (140-160 cm).

Unit 5, 180-200 cm, Mesolithic
This unit is characterised by high quantities of charcoal. The layer is distinguished by a high proportion of hazelnut shells. *Pinus sylvestris* dominates and *Corylus* charcoal is widespread. The occurrences of oak, spruce/larch, lime and aspen/willow charcoal were recorded at similarly low proportions as in unit 4.

Unit 6, 200-240 cm, Mesolithic
This unit shows a significant decrease in species composition. *Pinus sylvestris* was dominant and hazelnut shells were frequent. Spruce/larch and oak occurred rarely. A layer at a depth of 220-240 cm did not contain any charcoal. It is not known if the absence of charcoal was indicating reduced anthropogenic activity or the rapid sedimentation of sandy material.

Unit 7a, 240-260 cm, Late Palaeolithic/Mesolithic
The species composition of the layer at a depth of 240-260 cm is similar to the species composition of the 200-220 cm layer. *Pinus sylvestris* was widely spread, the abundant presence of spruce/larch charcoal has been documented, and hazelnut shells are occasionally present. The species composition indicates the deterioration of environmental conditions.

Unit 7b, 260-300 cm, Late Palaeolithic
This unit is noticeable for its small quantity of charcoal. *Pinus sylvestris* was a dominant species and hazelnut shells were rare. The layer at a depth of 260-280 cm contained smaller amounts of charcoal and the species diversity is quite low. Only charcoal of coniferous species (*Pinus sylvestris, Larix*/*Picea*) were found here.

Unit 7c, 300-320 cm, Late Palaeolithic
This unit is characterised by low amounts of charcoal. The surrounding vegetation can be described as a sparse pine forest. *Pinus sylvestris* is a dominant species and spruce/larch and birch were common. Hazelnut charcoal is very rare and a very small charcoal fragment of a deciduous tree (cf. *Frangula* sp.) was also found (**fig. 4a**).

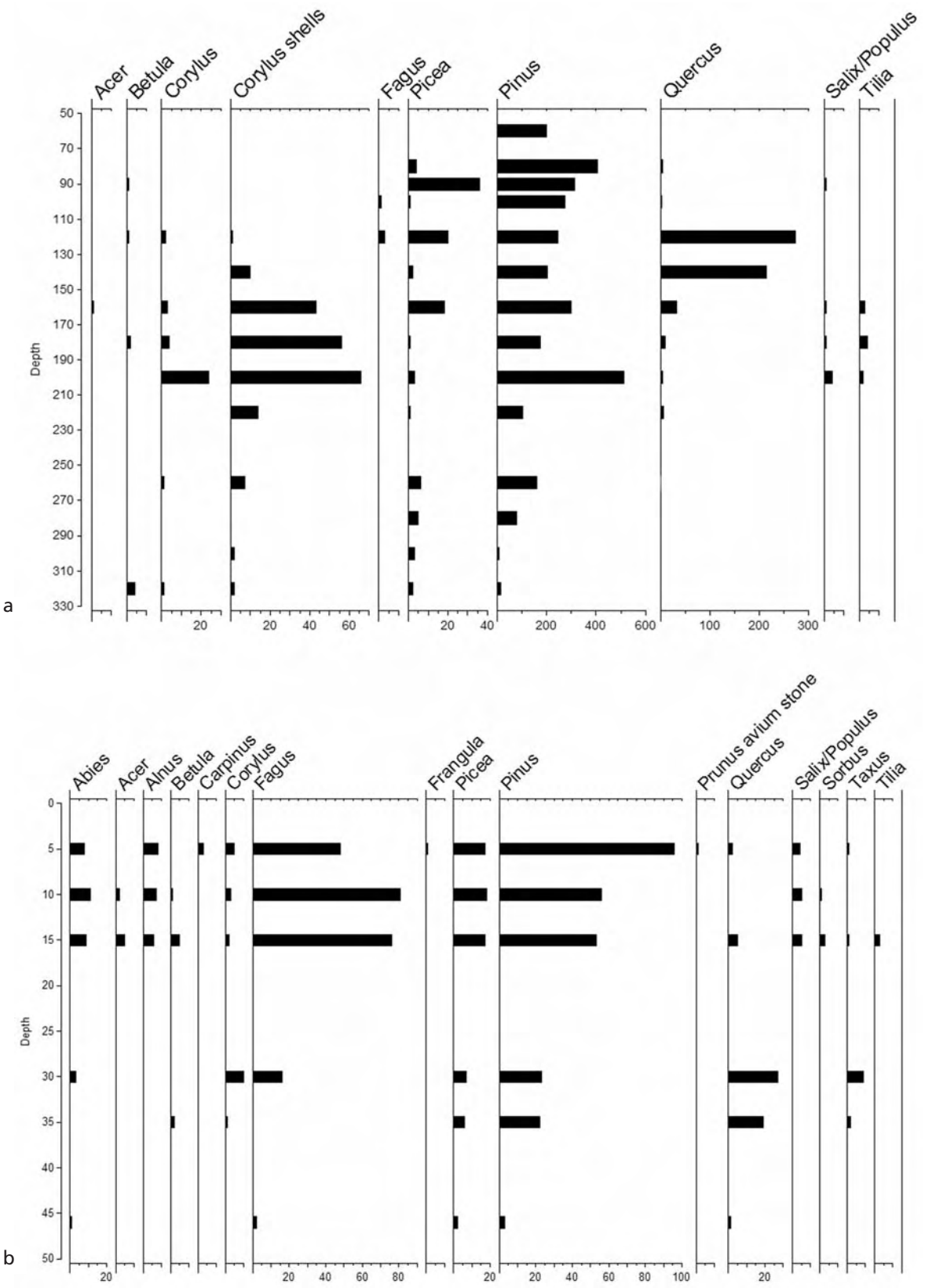

Fig. 4 Údolí samoty (**a**) and Janova zátoka (**b**): palaeobotanical spectra, based on macroremains. – (Illustrations J. Novák).

	5-3 cm				3-2 cm								
	unit 3	unit 4		unit 5	unit 3		unit 4		unit 5			unit 6	
	C	CS	C	CS	CS	C	CS	C	S	CS	C	CS	C
stage 0 (unburnt)												1	
stage I (<50 % carbonised)											1		
stage II (>50 % carbonised)	3							1		2	1		
stage III (fully carbonised)								4			1		
stage IV (<50 % calcined)	2					4		2			1		1
stage V (>50 % calcined)	1	1		1	8	24	2	5	1		2		2
stage VI (fully calcined)	1		2		6	13	4	5			1		
total	7	1	2	1	14	41	6	17	1	2	7	1	3

Tab. 2 Indeterminate bone elements from Mesolithic units at Údolí samoty in relationship to their burning stages (after Cain 2005;

Vertebrate remains

Unit 1, 0-70 cm, predominantly Late Bronze Age period
Two indeterminate bone fragments were found during sieving. Both were compact bone segments which had undergone the burning stage V (on the scale used in Cain 2005 and Bosch et al. 2012), which means that more than 50 % of the organic composition was calcined.

Unit 2, 70-120 cm, predominantly Bronze Age/Aeneolithic
The bone and teeth assemblage of two fragments recorded during excavation and 94 fragments discovered during sieving could not be determined with the exceptions of two diaphyseal pieces from a small-sized mammal (such as *Vulpes* sp. or *Lepus* sp.). The bone material is highly fragmented – bone pieces are usually smaller than 3 cm. We suspect that this fragmentation was caused by burning, because the majority of the fragments (84 pieces) belongs to the burning stages IV-VI (less than 50 % of organic composition calcined up to fully calcined bones). Almost all pieces are compact bones or combinations of compact and spongy bone.

Unit 3, 120-160 cm, Mesolithic
In this unit, 18 bones were recorded in 3D and 1225 bones during sieving. They are highly fragmented, mostly from burning. Fragments that were identified include five *Cervus elaphus* antler pieces and one *Sus scrofa* upper molar piece. Four tooth fragments were assigned to cervids, two tooth crown fragments probably belong to a boar (cf. *Sus scrofa*) and one distal part of a phalanx was from a small-sized mammal. Middle-sized mammals (such as *Cervus* sp. or *Sus* sp.) were represented by 19 pieces and small-sized mammals by 41 tooth and bone pieces. All fragments were identified as parts of skulls, diaphyses and ribs.

Unit 4, 160-180 cm, Mesolithic
In this unit, 105 bones were recorded during excavation and 738 bone and tooth fragments during sieving, again fragmented and mostly burnt. Pieces that were identified suggest a similar species and skeletal segment composition as in unit 3, but the species identification was only possible for mid-sized mammals (13 pieces) and small-sized mammals (10 pieces).

Unit 5, 180-200 cm, Mesolithic
The bone and tooth assemblage of twelve 3D recorded fragments and 137 fragments found during sieving are mostly unidentifiable, with the exception of one proximal part of a phalanx of a small-sized mammal. As in the previous units, all bones were highly fragmented and burnt.

Unit 6, 200-240 cm, Mesolithic
In this unit, 10 bone fragments were recorded and 47 bone and tooth fragments were found during sieving. As in the previous units, the assemblage is highly fragmented (smaller than 3 cm), burnt and mostly unidentifiable, with the exception of a part of an upper boar molar (*Sus scrofa*) and parts of teeth and diaphyses from a mid-sized mammal.

Unit 7, 240-300 cm, Late Palaeolithic
The bone assemblage of 3 recorded fragments and 17 fragments found during sieving is similar to the previous units. Almost all bone pieces represent compact bone and were burnt at the stages IV-VI (**tab. 2**).

2-1 cm									<1 cm								
unit 3		unit 4		unit 5			unit 6		unit 3		unit 4		unit 5			unit 6	
CS	C	CS	C	S	CS	C	CS	C	CS	C	CS	C	S	CS	C	CS	C
			1			1						3			1		
5	1		1			2			1	2	1	7					
	16		2					2	4	18	1	19		2	8		
2	8		1	2		1		2	1	17	1	37	5				1
10	26	6	21		2	5	1	2	25	95	14	65	2	2	14	3	4
37	68	20	32		2	8	2	4	110	203	61	110		13	31	2	6
37	80	4	38		2	1			77	250	58	226	2	7	54	35	12
91	199	30	96	2	6	18	3	10	218	585	136	467	9	24	108	40	23

Bosch et al. 2012). – Abbreviations: S spongy bone; CS compact-spongy bone; C compact bone.

Archaeological features and artefact assemblages

Unit 1, 0-70 cm, recent to Late Bronze Age period
Although this unit was largely affected by subrecent and recent disturbances and features (cf. the first two ^{14}C dates), no recent artefacts were found in association. Several predominantly recent pits were recorded to a depth of 70 cm, one of them filled with atypical pottery fragments. A small piece with a (probably) horizontal linear pattern dating to the Late Bronze Age period (Ha A-Ha B; depth 30-40 cm), was associated with 47 other, undatable pottery sherds, and two lithic artefacts.

Unit 2, 70-120 cm, predominantly Bronze Age/Aeneolithic
The ceramic assemblage of 63 fragments includes only a few ceramic sherds determinable in terms of chronology: a fragment with a parallel finger pattern dating to the Bronze Age (middle or late, depth 100 cm), and a funnel-shaped rim dating to the Bronze Age or Aeneolithic (later Funnelbeaker culture – Baden – Řivnáč, depth 100 cm). The other fragments allow only a general dating to ceramic prehistory. Most of the 53 artefacts recorded during excavation and 373 artefacts discovered during sieving are made from flint. Artefact types include flakes, chips, blades and microblades. The most typical objects are a bifacially flaked arrowhead, Bronze Age/Aeneolithic in age (with a concave base, depth 105 cm), and an admixture of some Mesolithic artefacts (a backed microblade and a geometric microlith at the base of this unit).

Unit 3, 120-160 cm, Mesolithic
Extensive areas covered by ash and red-burnt sand occur at the base of this unit, but no regular hearth came to light. In the centre, two deep pits created by water erosion from the ceiling fissure were unearthed, and on the sides, two larger sandstone blocks more than 1 m in size, weathered from the rock wall and ceiling, were documented. Smaller stones, especially volcanites, occurred in clusters. An assemblage of 133 artefacts recorded during the excavation and 1794 artefacts discovered during sieving are mostly made from flint. Other raw material types include Bečov-type quartzite, fossil wood, and, as a rare exotic import, a radiolarite bladelet (no. 123, determined by A. Přichystal). Artefact types include small flakes and chips, microblades and a few regular blades. Isosceles triangles appear in a series (some are made from Bečov-type quartzite). Other types present are pointed backed microblades, microburins, splittered pieces, and retouched blades. One blade has a lateral polish (**fig. 5a**).

Unit 4, 160-180 cm, Mesolithic
An assemblage of 226 artefacts recorded during excavation and 2341 artefacts discovered during sieving are mostly made from flint, several pieces from Bečov-type quartzite and a few individual objects from Tušimice-type quartzite and another bladelet of radiolarite (no. 242). The sieved material includes a large series of geometric microliths: predominantly isosceles and scalene triangles (some of them made from Bečov-type quartzite), some of them reaching extremely small dimensions of only a few millimetres, accompanied by a few narrow trapezoids on blades (intermediate triangle/trapeze forms). Other pieces include microlithic endscrapers, backed pointed microblades and notched blades (**fig. 5b**).

Unit 5, 180-200 cm, Mesolithic
An assemblage of 493 artefacts recorded during excavation and 451 artefacts discovered during sieving are mostly made from flint, with a low proportion of the Bečov-type quartzite, and others (partly burnt and form-

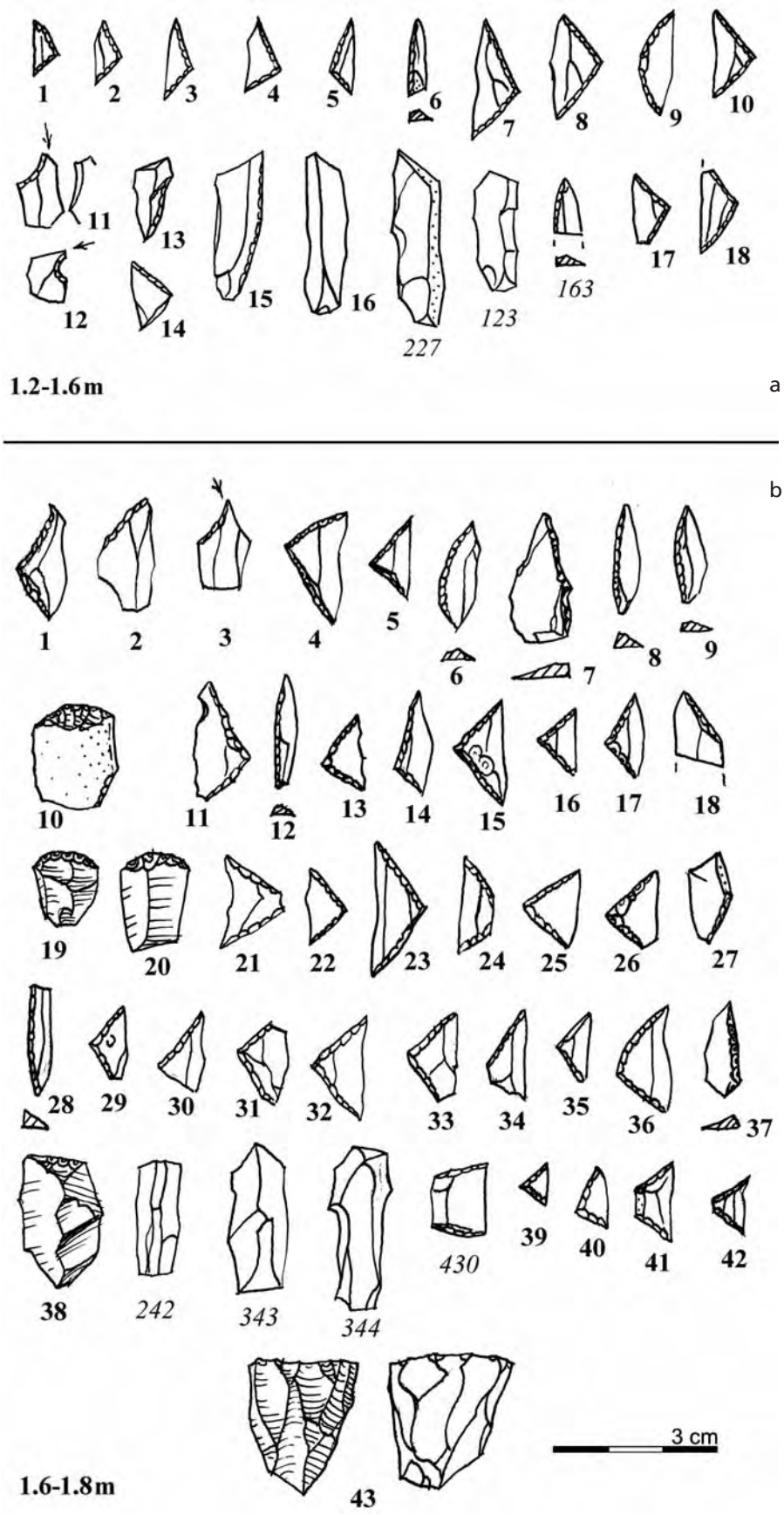

Fig. 5 Údolí samoty (okr. Česká Lípa). Lithic artefacts. – **a** unit 3 (1.2-1.6 m), recorded artefacts (*italics*) and sieved artefacts. Flint, quartzite, radiolarite. – **b** unit 4 (1.6-1.8 m), recorded artefacts (*italics*) and sieved artefacts. Flint, quartzite, radiolarite. – (Drawings J. Svoboda).

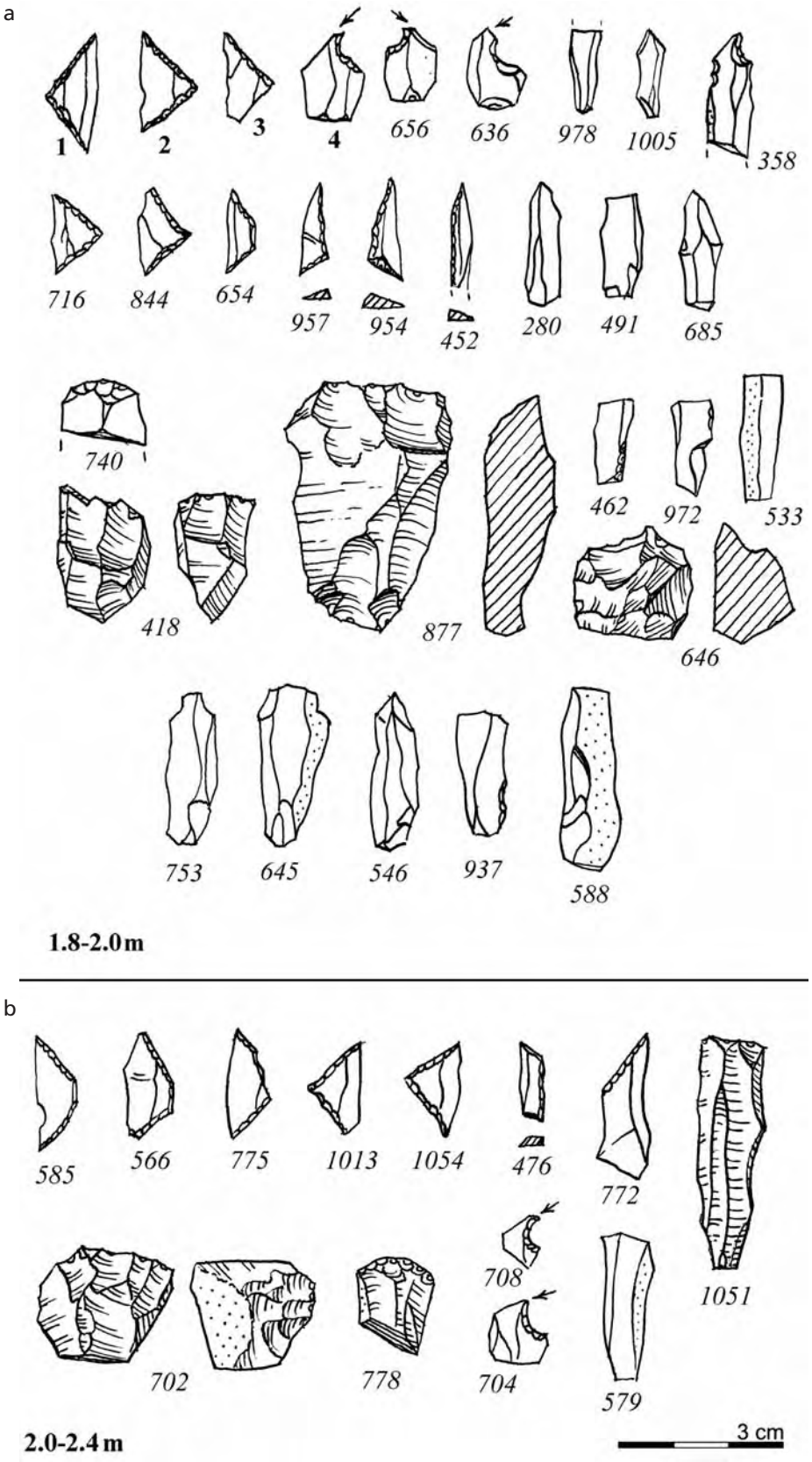

Fig. 6 Údolí samoty (okr. Česká Lípa). Lithic artefacts. – **a** unit 5 (1.8-2.0 m), recorded artefacts (*italics*) and sieved artefacts. Flint and quartzite. – **b** unit 6 (2.0-2.4 m), recorded artefacts (*italics*) and sieved artefacts. Flint. – (Drawings J. Svoboda).

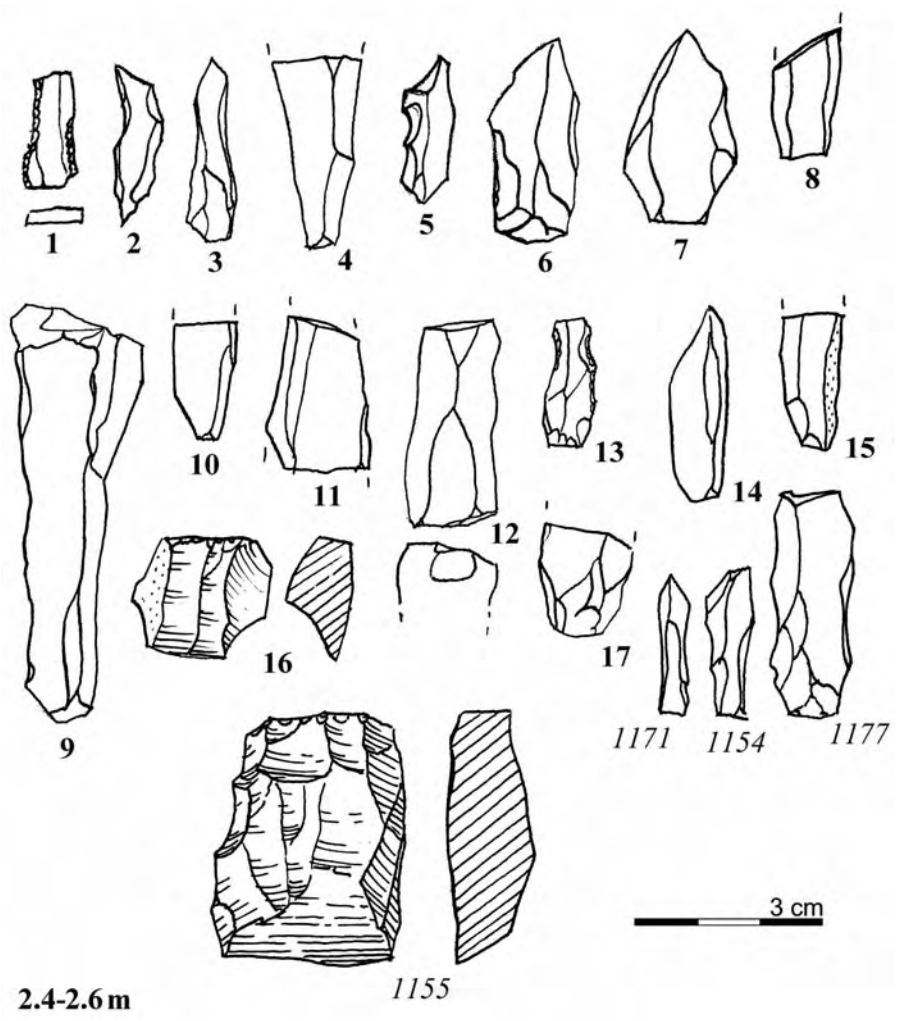

Fig. 7 Údolí samoty (okr. Česká Lípa). Lithic artefacts: unit 7 (2.4-2.6/3 m), recorded artefacts (*italics*) and sieved artefacts. Flint and porcellanite. – (Drawings J. Svoboda).

ing a cluster). Microblades were produced from cubical/conical microcores and flat cores. Typical are isosceles and scalene triangles accompanied by narrow trapezes, several microburins, a backed pointed microblade, and an endscraper (**fig. 6a**).

Unit 6, 200-240 cm, Mesolithic
An assemblage of 128 artefacts recorded during excavation and 124 artefacts discovered during sieving are mostly made from flint, with a few objects from Bečov-type and Stvolínky-type quartzites (cf. **fig. 1**). This is a blade and microblade industry produced from unipolar and bipolar cores. Typologically, this unit includes a series of isosceles triangles, narrow trapezes on blades, a truncated blade and a backed microblade, accompanied by an endscraper and two microburins (**fig. 6b**).

Unit 7, 240-300 cm, Late Palaeolithic
An assemblage of 27 artefacts recorded during excavation and 133 artefacts discovered during sieving are mostly made from flint, with about 20 % made from porcellanite. This is a blade and microblade industry, with one backed microblade and one with a notch. Three core fragments are made of porcellanite. Following A. Přichystal (pers. comm.) the porcellanite from this layer differs from the Bohemian key source at Kunětická hora (okr. Pardubice) and one may expect another, more local outcrop (**fig. 7**).

Typological comparisons

In the Central European context, the best comparable stratigraphic sequence to the units 3-6 at Údolí samoty is the Jägerhaus Cave near Beuron (Lkr. Sigmaringen) on the Upper Danube (Taute 1974; Holdermann 2006), which is characterised by a large variety of isosceles and scalene triangles. W. Taute (1974)

Fig. 8 Janova zátoka (okr. Děčín). Location of the cave in the wall of the canyon during excavation in 2010 (arrow). The river Kirnitz/ Křinice creates the national boundary between Germany and the Czech Republic. – (Photo J. Svoboda).

first noticed that symmetrical and asymmetrical trapezes and trapezoid points may also occur in Beuronian A of the Jägerhaus Cave and M. Heinen (2012) records their restricted presence at sites in Northern Germany. In contrast to the Late Mesolithic rhomboids, these Early Mesolithic trapezes are generally smaller and made on narrow blades (»irregular« after Taute); there are even transitional forms between trapezes and triangles. Údolí samoty and other Bohemian sites differ most notably in their absence of Tardenois points.

JANOVA ZÁTOKA (JOHN'S SHELF), K. Ú. JETŘICHOVICE U DĚČÍNA, OKR. DĚČÍN

The Janova zátoka rock shelter faces north-northwest in the southern rock wall of the Křinice river meander (fig. 8). The rock shelter is an ideal location for fishing. Due to the composition and morphology of the Křinice area sandstones, rock shelters in the solid rocks are deeper than elsewhere, thus fitting the definition of a cave rather than a rock shelter. The influx of allochthonous sediments from outside was restricted and the sedimentary filling is relatively shallow. In contrast to Údolí samoty which has a complex stratigraphic sequence, Janova zátoka is a representative example of a site with a shallow stratigraphy, where the Mesolithic occupation remains occur just below the surface, and the lower part was locally affected by post-depositional processes (cryoturbation and bioturbation).

Today, the river forms a national boundary, which prevented recent anthropogenic disturbances. However, during the last two decades the site was used for temporary camping. On August 8, 2007, V. Sojka collected twelve small flakes and flint blades, burnt flint and quartzite, together with six sherds of medieval pottery, fragments of sedimentary rocks and animal bones on top of the disturbed surface. Subsequently, a standard microtrench was excavated, 1 m × 1 m in size and 60 cm in depth. A systematic excavation was conducted in July 2010 (fig. 9).

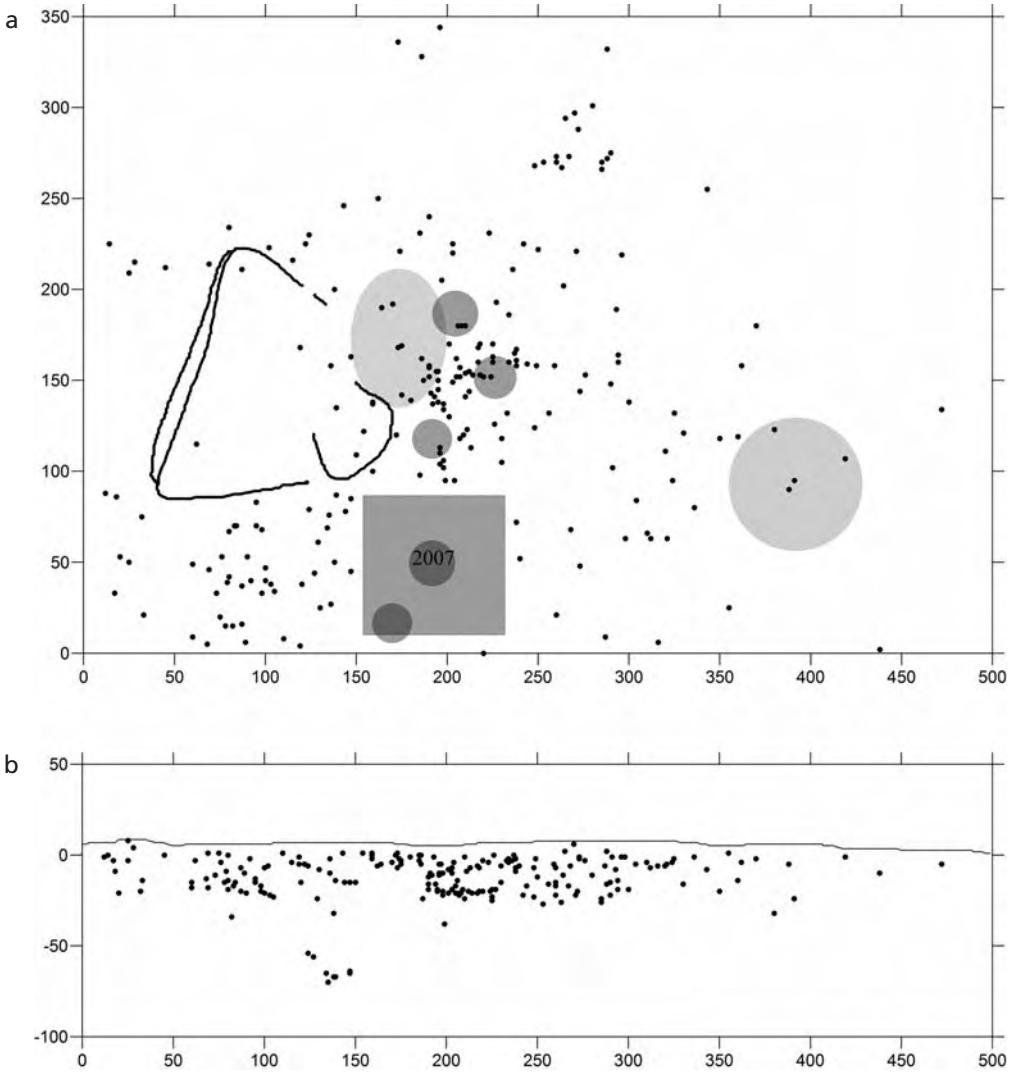

Fig. 9 Janova zátoka (okr. Děčín). Spatial distribution of lithic artefacts in the excavations 2007 (■) and 2010. – **a** horizontal distribution including a large boulder (left), an oval-shaped pit and five kettle-shaped pits (centre), and a circular hearth (right). – **b** vertical distribution of artefacts. – (Illustrations M. Novák / P. Hájková).

The occupied Mesolithic area of c. 5 m × 3.5 m in size in the centre of the rock shelter was completely unearthed, reaching a depth of 160 cm. Control trenches on the peripheries and inside the shelter exposed only a sterile sandy layer which became shallower deeper inside the shelter.

Stratigraphic section

The section is thin and the influx of allochthonous material was limited. Boundaries between lithological layers are irregular due to recent disturbance, archaeological features, cryoturbation, and occurences of larger sandstone blocks. The largest block (120 cm × 120 cm) was found in the left part of the excavated area (**fig. 9**).

Generally, the sequence of the layers can be characterised as follows (**fig. 10**):

1. Darkish, loamy-to-sandy soil (0-15 cm);
2. Sandy layer, locally red- or grey-burnt (15-25 cm), ^{14}C dated 9250 ± 60 BP;
3. Greyish-to-brownish, loamy-to-sandy layer, with charcoal, locally having the character of a podzol (15-30 cm);

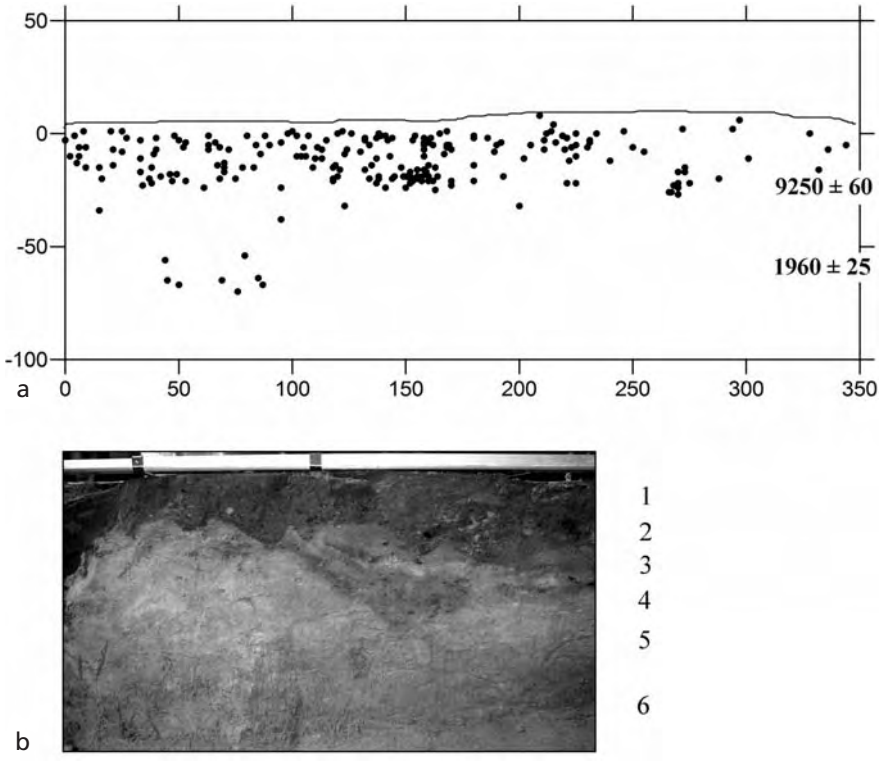

Fig. 10 Janova zátoka (okr. Děčín). Stratigraphic section. – **a** distribution of lithic artefacts in the layers 1-6. – **b** photodocumentation of the left and central part of the same section. – (a illustration M. Novák; b photo J. Svoboda).

4. Ochreous sandy layer, locally showing the effect of cryoturbation (20-40 cm);
5. Yellowish-to-ochreous sand with brownish bands, locally showing the effect of cryoturbation (30-60 cm);
6. Fine yellowish-to-whitish sand (60-160 cm), ^{14}C misdated 1960 ± 25 BP (probably due to local bioturbation), revision dating failed.

The excavation record, including 3D location of artefacts and additional material from sieving or floating the sediments, enables the reconstruction of four basic material units after approx. 15 cm intervals, separated into two Mesolithic and two Palaeolithic units.

Cryoturbation features in the layers 4-5

Cryoturbations are irregular structures occuring in loams and in regolith due to deep freezing and related frost processes, and they are characterised by undulated and dislocated layers and lenses. A precondition for their formation are stage-like changes of water/ice content which differentiate cryoturbation from the other earth movements. **Figure 11** shows a kettle-shaped frost pot. Fragments of rocks or gravels outlining margins of the feature are typical, frequently located diagonally or on the shorter edge and inserted during the frost heaving. There are two theories concerning the origin of frost pots: they are either an expansion of frost wedges or a depression resulting from heaving of fine-grained earths and sinking of the area between the above elevated earthy tongues. **Figure 11** shows a fine-grained layer below the frost pot, while cryoturbated earths are located above. Because permafrost is not a necessary precondition for its formation (if a sufficiently thick active layer was present; French 2007), the frost pot may have originated as late as the Late Glacial.

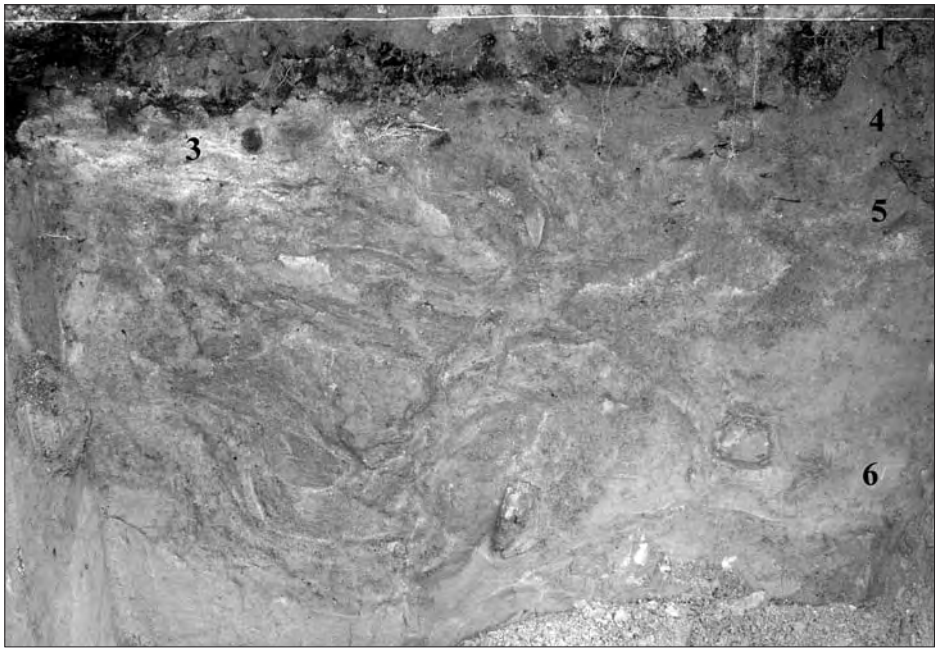

Fig. 11 Janova zátoka (okr. Děčín). Cryoturbation features. Numbers correspond to the layers in **fig. 10**. – (Photo J. Svoboda).

Anthracological analysis and vegetation reconstruction

Unit 1, 0-15 cm, Mesolithic with ceramic admixture
Beech and scots pine are the most common species in this unit. Spruce and silver fir occur frequently. The unit is remarkable for species-rich charcoal assemblages, as proved e. g. by the presence of *Acer* sp., *Alnus* sp., *Salix*/*Populus* sp., *Corylus avellana*, *Betula* sp., *Sorbus* sp., *Taxus baccata* and *Tilia* sp. charcoal.

Unit 2, 15-35 cm, Mesolithic
Two vegetation phases are documented in this unit. The younger phase (15-29 cm) shows an increase in species diversity. Oak and pine are still recognised as a forest dominant, but the expansion of beech and silver fir has already been reported here. The occurrences of hazel and yew have increased. An older phase (30-35 cm) is characterised by the presence of a sparse oak-pine forest with an occurrence of spruce, hazel and birch. Occasionally *Taxus baccata* charcoal was present.

Unit 3, 35-45 cm and deeper, Late Palaeolithic
This unit is characterised by an abundance of *Pinus sylvestris* charcoal, a common occurrence of *Picea*/*Larix* and a rare presence of *Quercus* sp., *Fagus sylvatica* and *Abies alba* charcoal. The ^{14}C date and the associated organic evidence suggest that the presence of oak, beech and silver fir in this basal layer is due to bioturbation (**fig. 4b**).

Leaving the evidence from the Pleistocene layer apart, it can be assumed that the Holocene vegetation near the site consisted of alluvial vegetation, a humid forest on the slopes and valley bottom and sparse pine forests in rocky areas and the edge of the plateau. The upper part of the section shows an increase in pine and a reduction in beech. The first occurrence of hornbeam in the section was found in this unit. Changes in the species composition are probably related to human impact on the vegetation communities.

Molluscs

Molluscs are rare and only terrestrial gastropod shells were identified. Most pieces are highly fragmented, which makes it very difficult to identify them, and their variability in section is low. Most fragments are sharply angular, the states of their surfaces preservations being variable.
Gastropod fragments were discovered only in the layers 1, 5 and 6. In the uppermost layer (1) one shell of *Discus perspectivus* and one shell fragment of *Clausiliidae* indet. have been identified. Generally, these

	5-3 cm	3-2 cm			2-1 cm				<1 cm					
	unit 2	unit 1		unit 2	unit 1			unit 2	unit 1			unit 2		
	CS	CS	C	C	S	CS	C	CS	S	CS	C	S	CS	C
stage I (<50 % carbonised)	1	1					1		2	2	3			
stage II (>50 % carbonised)		3	3	1		5	2			5	9			
stage III (fully carbonised)					1	2			1	4	1		2	1
stage IV (<50 % calcined)		5	4			5	5			19	29			1
stage V (>50 % calcined)		6	2			6	3	1	3	21	31	1	2	1
stage VI (fully calcined)					1		1		3	22	29	1	1	
total	1	15	9	1	2	18	12	1	9	73	102	2	5	3

Tab. 3 Indeterminate bone elements from Mesolithic units at Janova zátoka in relationship to their burning stages (after Cain 2005; Bosch et al. 2012). – Abbreviations: S spongy bone; CS compact-spongy bone; C compact bone.

gastropods are mostly silvicolous. The remaining material from this layer and all material from the layers 5 and 6 are unidentifiable. It is represented by shell fragments, probably mostly of the family Helicidae (owing to their general dimensions and subtle relics of their original colours – dark bands – perhaps they could be assigned to the proximity of *Cepaea* shells). The identified gastropods are presumably of local origin, but the presence of the Helicidae in the layers 5 and 6 is probably due to bioturbation.

Vertebrate remains

Unit 1, 0-15 cm, Mesolithic with ceramic admixture
In this unit, five bone fragments were recorded during excavation and 312 bone and tooth fragments were discovered during sieving. Almost all bones were fragmented and burnt at the stages IV-VI, thus the taxonomic determination was difficult. The few exceptions are the remains of cervids such as *Cervus elaphus* or *Capreolus capreolus* (part of astragalus, os triquetral) and suids *Sus* sp. (fragment of a lower incisor). Rodents were represented by *Clethrionomys glareolus* (1M1/, 2M/1), *Microtus* cf. *agrestis* (M/1) and *Sorex minutus* (fragment of humerus; a molar fragment, M12/), birds included Passeriformes cf. *Motacilla* (tarsometatarsus) and several very small fragments of indeterminate egg shells, amphibians by *Rana* cf. *arvalis* (ilium) and Anura cf. *Rana dalmatina* (cruris), and by several vertebrae from pisces (Piscea indet.). All these species are typical elements of a deep river canyon fauna. In addition, an admixture of recent or subrecent bones was determined during the excavation process on the basis of the absence of surface fossilisation and these were excluded from further examination (tab. 3).

Unit 2, 15-30 cm, Mesolithic
A bone assemblage of six bone and tooth fragments were discovered by sieving. As in the case of the unit 1, the bones represent small intederminate pieces with traces of burning. The exception is a rodent tooth, which was classified to *Microtus*? cf. *agrestis* (1M1/).

Unit 3, 30-45 cm, Late Palaeolithic
In this layer only two bone fragments were discovered by sieving: a piece of a long bird bone (Aves indet.) and one indeterminate burnt and calcined fragment (at the stage VI).

Unit 4, 45 cm and deeper, Palaeolithic
In this unit only seven compact bone or compact-spongy bone fragments were discovered by sieving, all burnt (at the stages V-VI).

Archaeological features and artefact assemblages

Unit 1, 0-15 cm, Mesolithic with ceramic admixture
This layer was largely disturbed by camping and other anthropogenic activities during the last few years and it also included eleven medieval pottery sherds (13th-15th centuries) and several iron sandstone fragments. An assemblage of 101 lithic artefacts recorded during excavation and 139 artefacts discovered during sieving were mostly made from flint. Several quartzite objects were

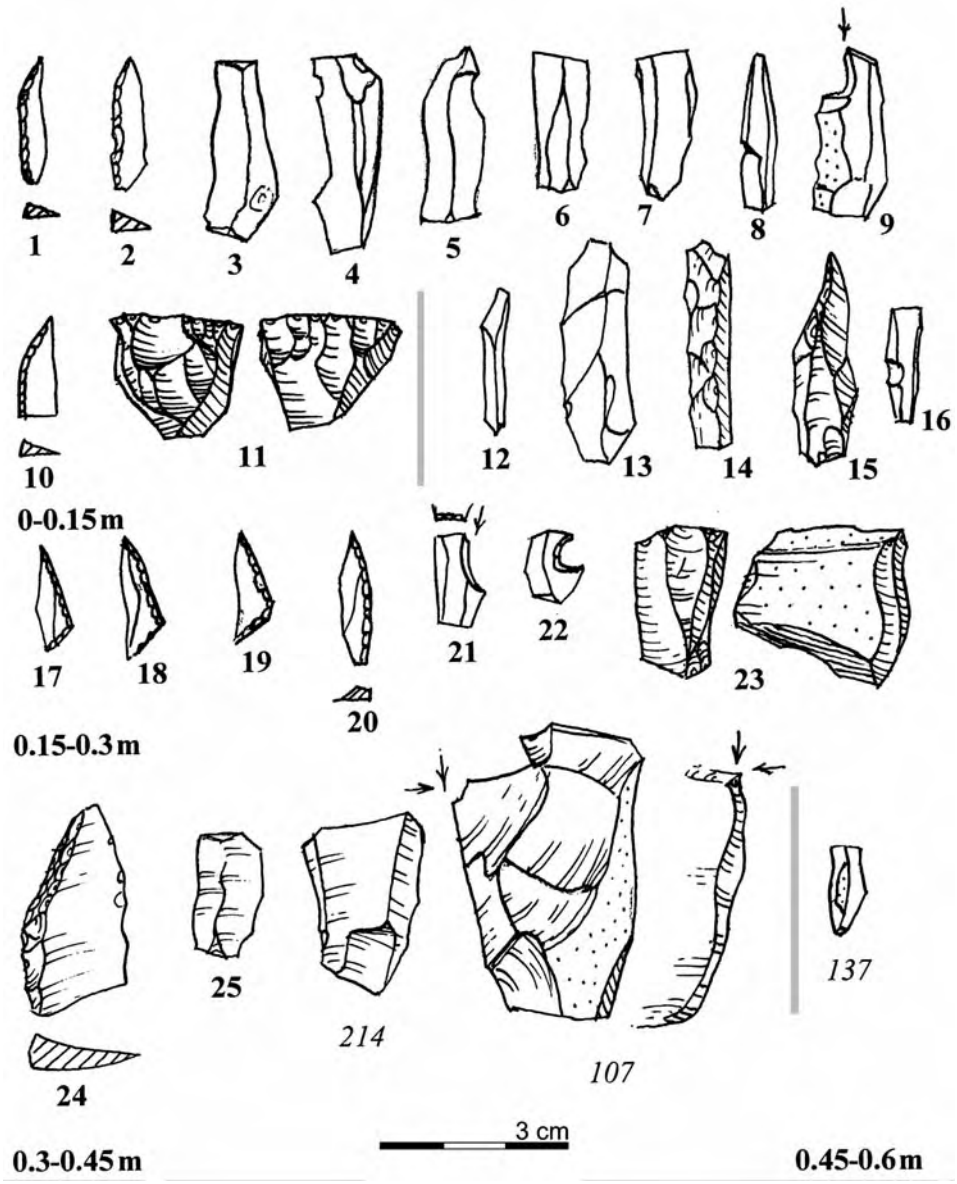

Fig. 12 Janova zátoka (okr. Děčín). Lithic artefacts: units 1 (0-0.15 m; **1-11**), 2 (0.15-0.3 m; **12-23**), 3 (0.3-0.45 m; ***24-107***), and 4 (0.45-0.6 m; ***137***), recorded artefacts (*italics*) and sieved artefacts. Flint, quartzite, white-patinated flint. – (Drawings J. Svoboda).

also present. Technological types include blades and microblades from unipolar and bipolar cores. Significant types are three backed pointed microblades and several burins, mostly on broken blades or fragments.

Unit 2, 15-30 cm, Mesolithic

At this depth, the layer was generally undisturbed. The base of the layer is covered by an extensive ashy and red-burnt area, and a regular circular hearth occurred in a shallow pan-shaped pit (diameter 70 cm, depth 10 cm) in the right section of the shelter. In the centre, aside from the largest sandstone block, an oval-shaped pit (70 cm × 45 cm, depth about 10 cm) and a group of at least five kettle-shaped pits were visible due to the dark humous filling and red-burnt margins (diameter 20-25 cm, depth about 15 cm); additional pits were not easy to see (**fig. 9**).

An assemblage of 67 artefacts recorded during excavation and 219 artefacts obtained from sieving includes a variety of raw materials such as flint, partly burnt, Bečov-type and other quartzites, and a few rare materials. It includes blades, crested blades, microblades and microcores. Significant microlithic types include elongated triangles and a backed pointed microblade associated with a microburin and a notched artefact (fish-hook?).

Unit 3, 30-45 cm, Late Palaeolithic

An assemblage of four artefacts recorded during excavation and 37 lithic artefacts discovered during sieving were made from flint, predominantly white-patinated. Significant types are an atypical backed pointed blade and a wedge-shaped burin.

Unit 4, 45 cm and deeper, Palaeolithic
An assemblage of six artefacts recorded during excavation and 13 lithic artefacts discovered during sieving were made from white-patinated flint. It includes a microblade and a series of small fragments and chips (fig. 12).

DISCUSSION ON HUMAN SUBSISTENCE

Lithic resources

The majority of the lithic raw materials is of local or regional origin (fig. 1). The southern boundary of glacial reposits with occurrence of erratic flint (*Feuersteinlinie*) lies a few kilometres north of both sites. Fine-grained quartzites of various colourations are present in adjacent Northwestern Bohemia (Bečov-type, Tušimice-type) and in Saxony (Profen/Zauschwitz-type), but one quartzite variety is also scattered as blocs over the Northern Bohemian plateaus (Stvolínky-type; cf. fig. 1). The porcellanite, described from Eastern and Northwestern Bohemian outcrops (Přichystal 2009), is expected to occur in Northern Bohemia as well, on contacts between the Cretaceous sediments and the volcanites. In contrast, the few pieces of radiolarite determined by A. Přichystal (pers. comm.) represent an exotic import either from the Czech/Slovakian borderland or from Austria, in both cases from several hundred kilometres distance.

Vegetational resources

In terms of vegetation (fig. 4), the Late Glacial layers at Údolí samoty are characterised by a low species diversity, anthracomass and only a low amount of hazelnut shells. The presence of hazel during this period is also supported by pollen diagrams from the nearby peatbogs of Mařeničky and Rozmoklá Žába in the Lusatian Mountains (Peša / Kozáková 2012, figs 3-4). The surrounding vegetation best corresponds to an open pine forest where the species composition indicates unfavourable enviromental conditions. In the Middle Mesolithic, the hazelnut shells and anthracomass show the highest quantity. The high amount of hazelnut shells probably correlates with the frequency of human occupation in the rock shelters. The same layers also show the highest species diversity. Surrounding vegetation can be reconstructed as a mosaic with the presence of sparse pine forests, species-rich oak forests (so-called *Quercetum mixtum*), hazel shrubs and early successional vegetation with aspen and birch. The highest amount of oak charcoal is recorded from the Upper Mesolithic period to the beginning of the agricultural period. During this transition time the presence of hazelnut shells is significantly reduced. In the post-Mesolithic layers, a significant decline of species diversity and an increasing representation of scots pine is recorded.
In sum, the almost continuous record of hazelnut shells at Údolí samoty, with a remarkable culmination during the Middle Mesolithic, differs from the hazel curves in the pollen diagrams from the nearby peatbogs. It may be interpreted as an evidence of human activity at the site.

Hunting and processing of the faunal remains

Hunting strategies at Janova zátoka and Údolí samoty were oriented on mid-sized (boars, roe deer or red deer) and small-sized mammals (hare or fox). In case of small animal remains such as birds, amphibians and rodents, we cannot decide whether they were collected by humans or whether they originate from bird's pellets, namely of falcon (*Falco peregrinus*), horned owl (*Bubo bubo*) or lesser spotted eagle (*Aquila pomarina*). Nesting of these species in the vicinity of both sites is highly probable.

As in other rock shelters in the Northern Bohemian region (cf. Horáček 2003; Svoboda et al. 2007), the largest proportion of animal bone and tooth assemblages from Janova zátoka and Údolí samoty are very small fragments, mostly smaller than 3 cm. Moreover, the majority of them was burnt (mainly at the stages IV-VI), although hearth structures were detected at Janova zátoka only. This high and noticeable degree of bone and tooth fragmentation and burning might result from targeted human activities which lead to the almost complete disintegration of animal tissues (cf. Delpech / Rigaud 1977; Lauwerier / Deeben 2011).
Several interpretative hypotheses can be proposed:

a) If bone was used as fuel, than we would expect the dominance of spongy bones;
b) If the aim was extraction of bone marrow or grease procurement, than the highly fragmented bone assemblage might not be associated with *in situ* burning. Even in this case we would expect the presence of spongy bones and a dark brown colouration (stage I/II) resulting from indirect heating;
c) If waste removal was the aim, than the high bone fragmentation, the presence of calcined bones, the presence of bones in a variety of burning stages, and the occurrence of other organic fuel (wood charcoal in this case) will support these hypotheses.

In sum, we suggest that the bone assemblages at both sites were most probably the final products of waste removal, although the previous stages such as bone marrow or grease procurement are not excluded.

Fishing

The location of the Janova zátoka rock shelter directly above the Křinice river (**fig. 8**) is optimal for fishing, but only several unidentified fish vertebrates from unit 1 may support this hypothesis. However, the preliminary reexamination of the fish remains from Dolský Mlýn (okr. Děčín), another rock shelter situated in a similar position above the adjacent Kamenice river, by L. Lõugas (pers. comm.) showed that some vertebrae come from some larger salmonid fish.
The find list at Dolský Mlýn according to the depths was as follows:

– 95-115 cm (post-Mesolithic) *Salmo* sp. – *vertebrae praecaudales* I (3 specimens), *vertebrae praecaudales* (6 specimens), *vertebrae caudales* (16 specimens) (expected body length c. 10-15 cm);
– 115 cm (Mesolithic) *Salmo* sp. – *vertebra caudalis* (expected body length c. 35 cm);
– 145-165 cm (Mesolithic) *Salmo* sp. – *vertebra caudalis* fragment (expected body length c. 50 cm), *vertebra praecaudalis* (expected body length c. 15-20 cm);
– 180-190 cm (Mesolithic) *Salmo* sp. – *vertebra caudalis* (expected body length c. 50 cm).

Thus in the Mesolithic layers, two caudal vertebrae come from c. 50 cm individual(s), one caudal vertebra from a c. 35 cm individual and one praecaudal from an individual smaller than c. 20 cm. Still after L. Lõugas, Atlantic salmon (*Salmo salar*) and sea or river trout (*Salmo trutta*) could be considered as representatives for such fish in the given area. Both the Kamenice river and the Křinice river are parts of the Elbe river drainage area. In the Elbe, salmonid fish have always been a part of the fish fauna, with the exception of a few decades of pollution at the end of the 20th century. Recently, the salmon spawning in the small tributaries of the upper part of the Elbe river was restored.

Although the new sites provided for the first time continuous stratigraphic and environmental records from the Late Glacial to the Holocene, no significant changes in settlement and resource exploitation strategies could be recorded at the Late Palaeolithic/Mesolithic boundary. These foragers were optimally adapted to the versatile landscape of sandstone plateaus and canyons throughout the climatic change, in order to exploit its changing vegetational and faunal resources.

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Zusammenfassung / Abstract / Résumé / Resumé

Paläolithische/Mesolithische stratigraphische Abfolgen in den Abris Údolí samoty und Janova zátoka (Nordböhmen)

Dieser Beitrag ergänzt die Reihe von Veröffentlichungen zu den mesolithischen Forschungen unter Sandsteinabris in Nordböhmen (Tschechische Republik). Während der letzten Grabungen von 2007 bis 2011 wurden an zwei Stellen unter mesolithischen Horizonten erstmals auch (spät)paläolithische Fundschichten erreicht, die hier kurz vorgestellt werden. Unter dem Abri Údolí samoty kam eine mächtige und komplexe Sedimentfolge zutage, während das Abri Janova zátoka nur eine geringmächtige Sedimentüberlieferung aufwies. Trotz des Übergangs vom Spätglazial zum Holozän, der hier für diese Region erstmals innerhalb einer kontinuierlichen Sedimentfolge überliefert wurde, sind für die spätpaläolithischen und mesolithischen Fundhorizonte keine signifikanten Veränderungen in Siedlungsweise und Landschaftsnutzung feststellbar. Die Jäger und Sammlerinnen waren jeweils gut an die abwechslungsreiche Umwelt der Sandsteinplateaus und Canyons angepasst und nutzten die sich leicht verändernde Flora und Fauna optimal aus.

Übersetzung: M. Baales

Palaeolithic/Mesolithic stratigraphic sequences
at Údolí samoty and Janova zátoka rock shelters (Northern Bohemia)
This paper adds to a series of previous publications discussing the Mesolithic discoveries in the sandstone areas of Northern Bohemia (Czech Republic). During the 2007-2011 investigation, Palaeolithic occupation layers were discovered below the Mesolithic. At the Údolí samoty rock shelter we documented a thick and complex stratigraphy while at the Janova zátoka rock shelter we recorded just a thin sedimentary sequence. Although both sites provided for the first time a continuous stratigraphic and environmental record from the Late Glacial to the Holocene, no significant changes in settlement and resource exploitation strategies could be observed. These foragers were optimally adapted to the versatile landscape of sandstone plateaus and canyons throughout the climatic change, and able to exploit its changing vegetational and faunal resources.

Séquences stratigraphiques du Paléolithique et du Mésolithique
des abris Údolí samoty et Janova zátoka (Bohème du Nord)
Le présent article complète la série des publications précédentes concernant les abris mésolithiques situés dans les roches sableuses de la Bohême du Nord (République tchèque). Des couches paléolithiques ont été mises au jour dans le sous-sol mésolithique pendant la campagne de fouille 2007-2011. Pendant celles-ci, nous avons à la fois documenté une stratigraphie épaisse et complexe de l'abri Údolí samoty et découvert une autre, plus restreinte, dans l'abri Janova zátoka. Malgré une stratigraphie continue, allant du Tardiglaciaire jusqu´à l´Holocène, les changements observés dans les stratégies d´occupation humaine et l'exploitation des ressources paraissent minimes. L'adaptation aux paysages versatiles des plateaux sableux et canyons durant le changement climatique était dirigée vers une exploitation optimale des ressources végétales et fauniques. Traduction: M. Polanská

Stratigrafické sekvence paleolitu a mezolitu
pod skalními převisy Údolí samoty a Janova zátoka (severní Čechy)
Tato studie navazuje na sérii předchozích publikací, které se týkaly mezolitického osídlení v pískovcové oblasti severních Čech (Česká republika). V letech 2007-2011 se podařilo objevit pod souvrstvími mezolitu rovněž paleolitické vrstvy. Zatímco převis Údolí samoty poskytl poměrně mocnou a komplexní stratigrafii, v převisu Janova zátoka byla sedimentární výplň mělčí. Přestože byl získán poměrně kontinuální stratigrafický a environmentální záznam od pozdního glaciálu po holocén, zásadní zlom v sídelních a potravních strategiích zaznamenán nebyl. Lovci a sběrači se adaptovali na pestrou krajinu pískovcových plošin a kaňonů napříč klimatickou změnou, s cílem maximálně využít dostupných rostlinných i živočišných zdrojů.

Schlüsselwörter / Keywords / Mots clés / Klíčová slova

Tschechische Republik / Spätpaläolithikum / Mesolithikum / Sandsteinregion / Abris
Czech Republic / Late Palaeolithic / Mesolithic / sandstone / rock shelter
République tchèque / Paléolithique final / Mésolithique / région du grès / abri
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