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CACHING AND RETOOLING IN POTOČKA ZIJALKA (SLOVENIA)

IMPLICATIONS FOR LATE AURIGNACIAN LAND USE STRATEGIES

The high alpine cave of Potočka zijalka (1630 m above sea level; obč. Solčava, reg. Koroška/SLO) has played an important role in the discussion about the Early Upper Palaeolithic in Central and Eastern Europe (**fig. 1**). The site is best known for the large collection of bone points with massive base or Mladeč (or Lautsch or Olševa) points. The cave has been the type site for a specific but disputed cultural tradition, the Olschewian (named after the Olševa mountain ridge), described as a regional variant of the Aurignacian characterized by assemblages rich in bone points from cave sites dating around 40-30 ka BP (Bayer 1929; Montet-White 1996; Karavanić / Smith 1997; Karavanić 2000). The stratigraphy and typology of bone points from Potočka zijalka have served as a reference for the interpretation of other key sites in the region such as Vindija (Varaždinska županija/HR), Velika Pećina (Varaždinska županija/HR) and Divje Babe (reg. Goriška/SLO) (Kozłowski 1996; Karavanić 2000; Turk 2002; Zilhão 2009). The specific composition of the assemblage has been variously interpreted as indicating a hunters' camp with a living area at the entrance and a sleeping area in the back of the cave (Brodar / Brodar 1983), a kill-site with an activity-specific tool inventory (Albrecht / Hahn / Torke 1972; Hahn 1977), or a place of symbolic significance (Svoboda 2006).
The importance of projectile technologies in the Aurignacian provides another reason to take a closer look at Potočka zijalka. Teyssandier / Bon / Bordes (2010) and Bon (2005) amongst others have argued that

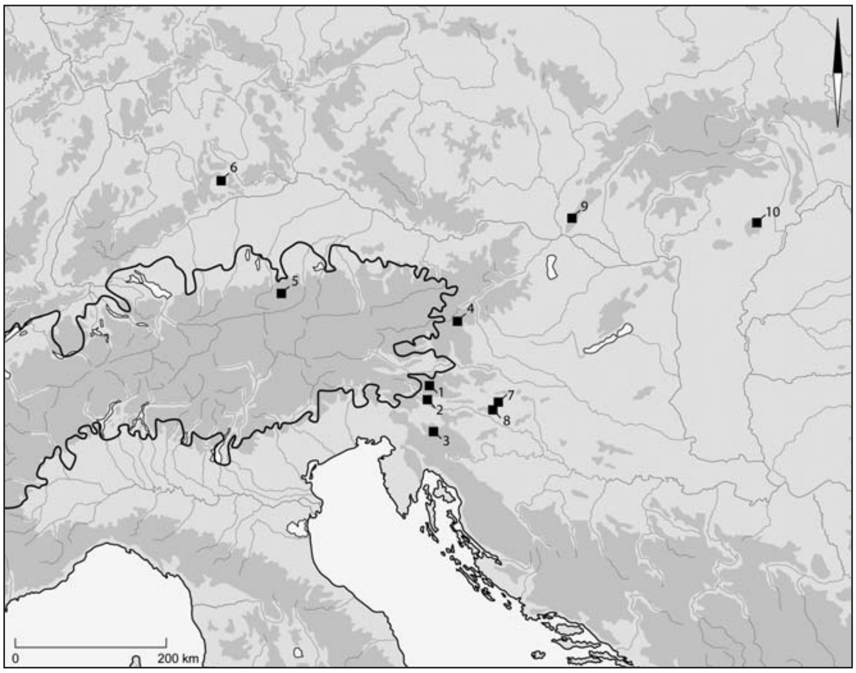

Fig. 1 Location of Potočka zijalka (reg. Koroška/SLO) and selected sites with bone points. The black line indicates the extent of ice during the Last Glacial Maximum (after Ivy-Ochs et al. 2008): **1** Potočka zijalka. – **2** Mokriska jama. – **3** Divje Babe I. – **4** Große Badlhöhle and Mixnitz-Drachenhöhle. – **5** Tischofer Höhle. – **6** Vogelherdhöhle. – **7** Vindija. – **8** Velika Pećina. – **9** Dzerava skala. – **10** Istállóskö. – (Map J. Porck).

technical solutions for arming projectile weapons was one of the driving forces behind technological changes in the Early Upper Palaeolithic. Their emphasis is on the development of bladelet production, but they also note changes in the production of bone and antler points. Moreover, stone and bone projectile tips are complementary and/or alternative strategies in projectile technologies. Stone and organic points have different characteristics such as manufacturing time, durability, maintenance and cutting ability (e. g. Ellis 1997; Knecht 1993; 1997a; 1997b; Villa / d'Errico 2001). The weapon of choice will be balancing such properties with the needs in terms of the specific projectile technology (spearthrower, bow-and-arrow) and the type of game (large game, birds, etc.).

Despite a number of studies of the collection (Albrecht / Hahn / Torke 1972; Brodar / Brodar 1983; Hahn 1988; Turk 2002), there is one informative aspect of the assemblage that has not received much attention yet: the pattern of breakage and its implications. The interpretation of breakage patterns of hafted points makes use of a very basic theory of discard. In general, basal parts of projectile points are expected to be carried back in the haft to a habitation site or hunting camp where they are either resharpened, repaired or replaced. Distal parts are expected to be embedded in the hunted prey or lost in the field when broken due to a miss (Keeley 1982; Torrence 1989; Knecht 1997a, 9). Therefore, the breakage patterns will give us information on the activities that were conducted in the cave.

In this paper I will discuss the function of Potočka zijalka on the basis of the breakage patterns of the bone points. The interpretation is largely based on the extensive descriptions, drawings and photographs of the points published in the monograph about the cave by Brodar / Brodar (1983). I will argue that the breakage patterns show the archaeological signatures of caching as well as retooling activities. Further I will discuss the implications for the technological organization of the Aurignacian in Central Europe and the use of mountainous environments in the Early Upper Palaeolithic.

THE SITE

Location and research history

The cave is located at an altitude of 1630 m on the southern slope of the Olševa mountain ridge on the border of Slovenia and Austria. The size of the cave is considerable: approximately 115 m in length, between 20 and 40 m wide and 4-10 m high. The back of the cave is located about 12 m higher than the entrance and is separated by a vast rockfall (**fig. 2**).

Potočka zijalka was unearthed in several campaigns. The first excavations were carried out by J. C. Gross from Graz (Austria) between 1926 and 1928 when he was informed about finds of cave bear (Pacher 1998). In 1928, the cave was bought by the Pokrajinski muzej Celje (Slovenia). S. Brodar got permission to carry out the first official excavations until 1935. Between 1929 and 1935, he excavated up to a quarter of the deposits, mainly in the entrance area of the cave. Black-and-white photographs document how terraces were dug with shovel and pick to depths of several meters (Brodar / Brodar 1983). The majority of the bone points were discovered during Brodar's excavation. Unfortunately, many finds including the large collection of cave bear remains as well as soil and charcoal samples were destroyed by the bombardment of the Pokrajinski muzej Celje at the end of World War II. Most bone points, however, survived the war, though some have been missing since (Brodar / Brodar 1983). The collection of new cave bear remains was the main objective of new, small-scale excavations by M. Pacher, V. Pohar and G. Rabeder between 1997 and 2000 (Pacher / Pohar / Rabeder 2004). The most recent fieldwork was sampling by I. Turk and B. Odar in 2004 of the heap left by the early excavations in the rear of the cave (Odar 2008).

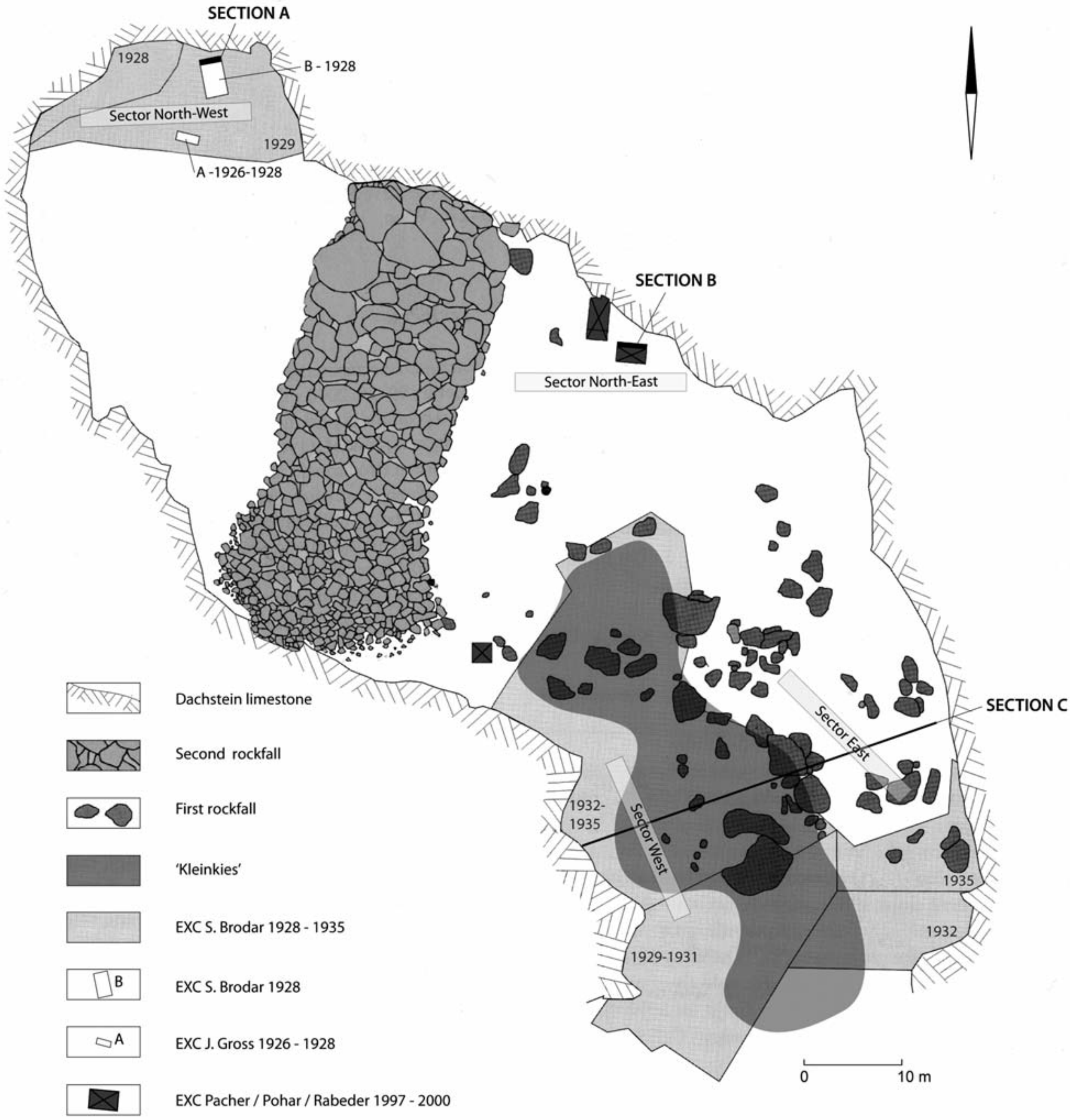

Fig. 2 Plan of Potočka zijalka (reg. Koroška/SLO). Indicated are the main excavation areas and several geological features (after Pacher / Pohar / Rabeder 2004). Sections A, B and C refer to geological sections shown in **figures 3-4**. – (Illustration J. Porck).

Geology and stratigraphy

Since the Miocene, the cave formed in Upper Triassic thick bedded Dachstein limestone (Buser 2004). The cave infill, as documented by Brodar / Brodar (1983) and Pacher / Pohar / Rabeder (2004), consists of endogenous weathering products (rock boulders, limestone debris, loams and flowstones or Olševa milk) and exogenous sediments (Miocene small gravels or *Kleinkies* and Palaeozoic shales). The generalized stratigraphic sequence can be described as follows (from top to bottom):

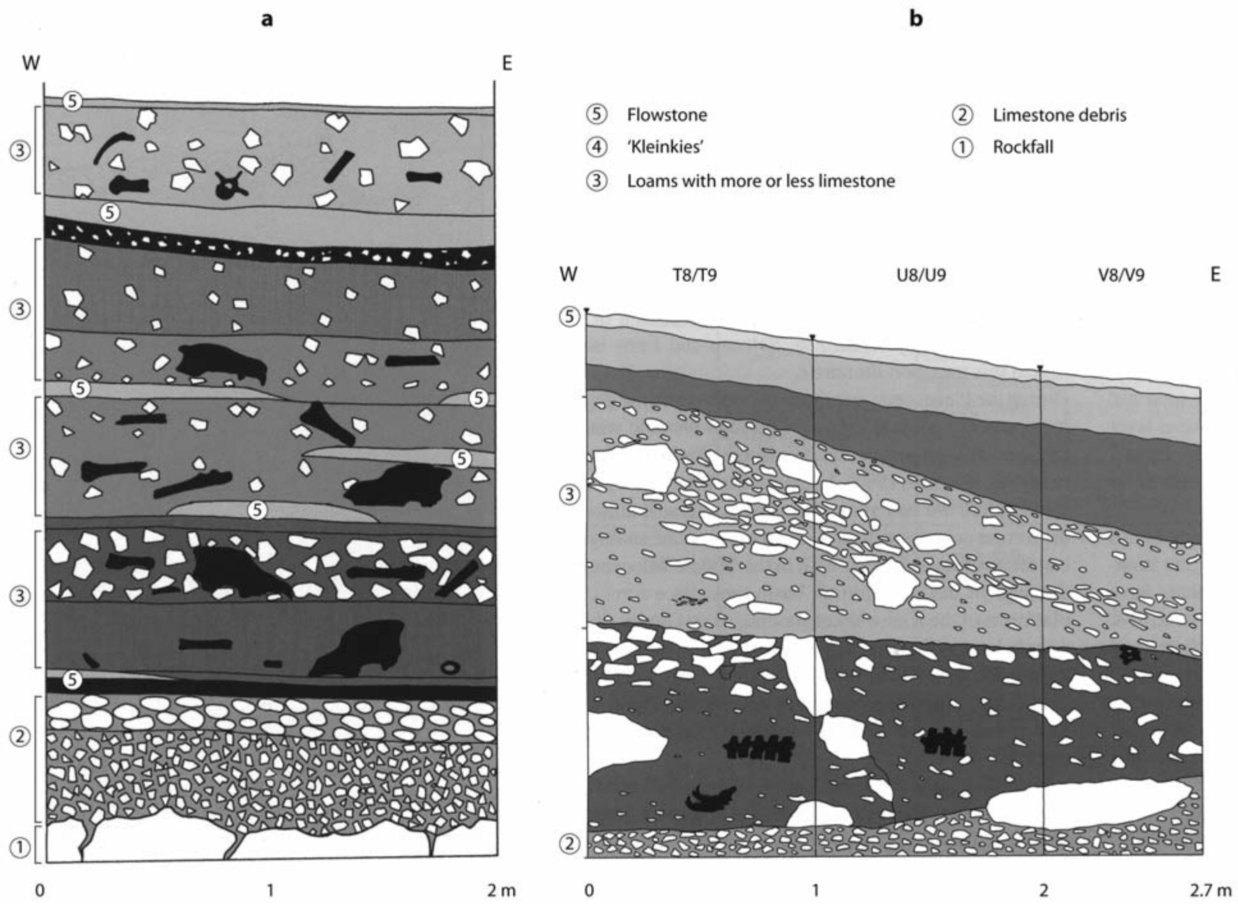

Fig. 3 Geological section of Potočka zijalka (reg. Koroška/SLO): **a** schematic geological profile based on the 1928 excavation by Gross in sector north-west in the back of the cave. – **b** geological section from sector north-east in the middle of the cave. – (After Pacher / Pohar / Rabeder 2004).

– loam mixed with Olševa milk covering the entire cave area;
– rock boulders resulting from a Late Glacial or Early Holocene rockfall and separating the front and the back of the cave;
– loams with more or less limestone debris, including artefacts and bones;
– limestone debris;
– rock boulders resulting from a large rock collapse and dividing the front part of the cave in an eastern and a western sector.

The actual stratigraphic sequence varies between the main parts of the site. The north-western sector in the back of the cave is characterized by red coloured loams with several layers of flowstone or Olševa milk (**fig. 3a**). In the north-eastern sector in the middle of the cave, the loamy sediments containing articulated cave bear remains were capped by redeposited layers of loam and debris (**fig. 3b**). The front of the cave forms the most complex stratigraphy (**fig. 4**). Sector east is dominated by deposits of Olševa milk or flowstones. The rock boulders at the base of sector west are partly covered by a layer of small gravel (*Kleinkies*) with some weathered Miocene marine shells as well as pellets with Late Pleistocene micromammal remains. On top of the *Kleinkies*, there is a sequence of loamy layers with mainly cave bear remains as well as artefacts and charcoals.

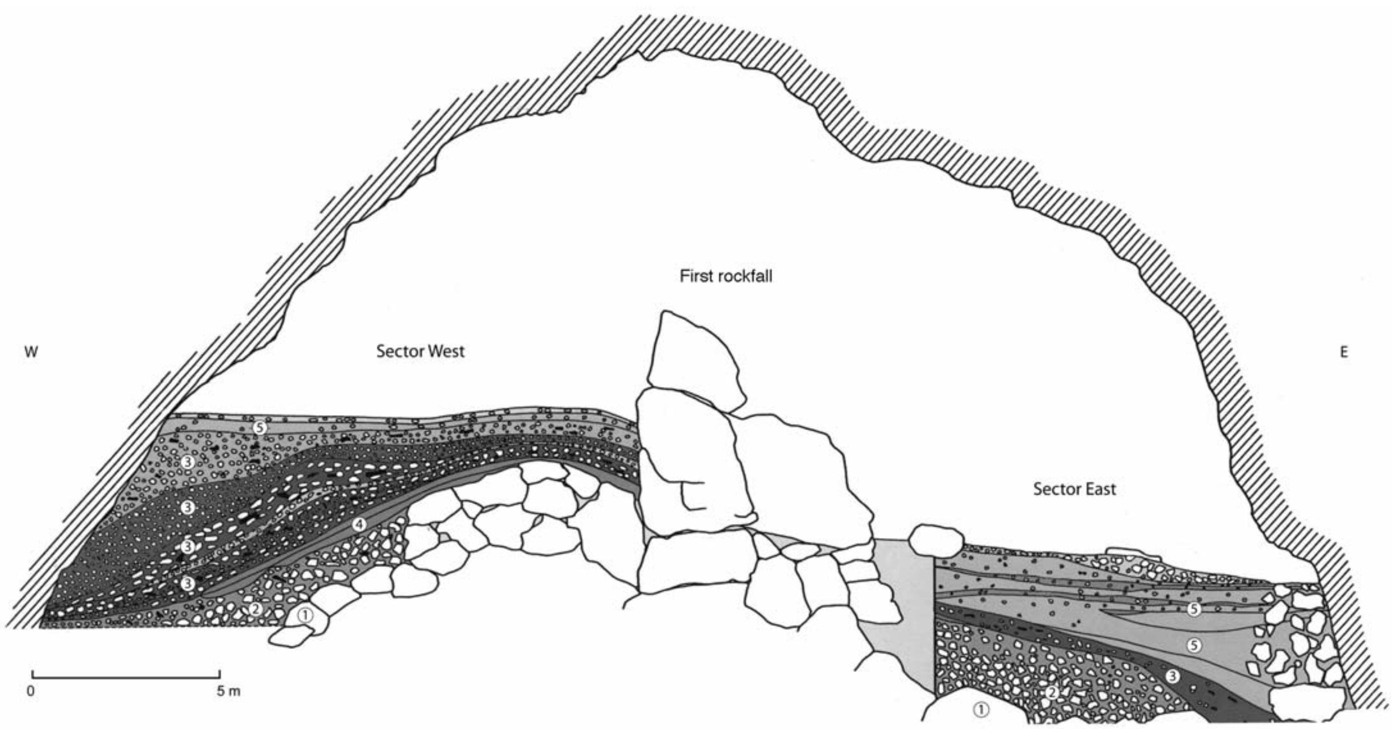

Fig. 4 Main geological section of the front of Potočka zijalka (reg. Koroška/SLO). The numbers refer to the legend in **figure 3**. – (After Pacher / Pohar / Rabeder 2004).

Environmental information

Information about the environment of the cave is mainly based on mammal remains. Other than cave bear, Pacher (2008; Pacher / Pohar / Rabeder 2004) and Brodar / Brodar (1983) mention the presence of carnivores such as wolf, wolverine and cave lion, herbivores such as mountain goat, red deer, roe deer, aurochs and muskox, and small mammals such as alpine marmots in the Potočka zijalka fauna. The small mammals (from the lower layer in the sector west) probably accumulated by owls (or other birds of prey) indicate relatively warm, interstadial conditions. The six bird species have broad climatic tolerances, but are mostly found in forested mountainous areas. Pollen and charcoal analyses indicate a herbal vegetation with small patches of coniferous trees. The evidence suggests that the cave was located close to the treeline during marine isotope stage (MIS) 3.

Further the evidence indicates that the valleys, hills and mountains near Potočka zijalka were largely free of large glaciers during MIS 3. This is consistent with reconstructions of the glaciers in the Eastern Alps. According to Döppes / Rabeder / Stiller (2011), the Middle Würmian (the alpine equivalent of MIS 3) was as warm as or even warmer than today based on the evidence for a viable cave bear population in the High Alps. Data presented by Monegato et al. (2007) for the Tagliamento glacier moraines and by van Husen (1987; 2000) for Austria show that after 30 ka cal BP the glaciers in the Southeastern Alps quickly advanced down in the valleys to the maximum ice extent between 25 and 20 ka cal BP (see **fig. 1**, based on Ivy-Ochs et al. 2008).

Dating evidence

A series of 16 radiocarbon AMS-datings on bone allows a chronological interpretation of the sedimentation and habitation of Potočka zijalka. The oldest date is 35,720 + 650/–600 BP (GrN-23335) for a cave bear

bone from the back of the cave at a depth of –140/150 cm. Cave bear remains have been found below this depth in layers covered by flowstone indicating that the use of the cave by cave bears started before 35.7 ka ^{14}C BP. The youngest date for cave bears comes from a bear tooth from the north-eastern section with a date of 26,840 ± 110 BP (Beta-143240). It is close to the extinction date for cave bear (Pacher / Stuart 2008). A marmot ulna provides the youngest proof for Potočka zijalka: 23,300 ± 125 BP (VERA-2763). The dates on the faunal elements indicate use of the cave by hibernating cave bears, wolves and marmots before 35.7 ka until 23 ka ^{14}C BP (>41.6-28.1 ka cal BP).
Estimation of human use of the cave is based on direct dates on six bone points from both the back and the western entrance area. The dates range between 31,490 + 350/–340 BP (VERA-2523) and 29,560 ± 270 BP (VERA-2526) (36.5-33.9 ka cal BP). They indicate human presence on the assumption that the manufacture and discard of the bone points are close in time to the death of the animal whose bones were used to produce the bone points. The oldest as well as the three youngest dates derive from samples from the entrance area. The dated bone points all come from the lower layer (layer 7 according to Brodar / Brodar 1983). The two other ones are on bone points from layer 5 (following Brodar / Brodar 1983) in the back of the cave. The dates imply a Late Aurignacian age for human occupation of the back and the front of the cave.

THE POINTS

A total number of 131 points have been described from Potočka zijalka. Almost all were found during the excavations between 1926 and 1935. 82 points were discovered in the north-western sector (estimated 200 m²) in the back of the cave (**fig. 5**). Most of them can be assigned to layers 4 and 5 according to Brodar / Brodar (1983). Except for traces of a fireplace, no other archaeological remains have been documented in the back of the cave. But Odar (2008) recently described a retouched, twisted bladelet (Dufour, subtype Roc-de-Combe) from the refuse heap from the early excavations. 47 points come from the sector west (estimated 1000 m²) of the entrance area (**fig. 6**). Most of the specimens are assigned to layers 5 and 7 according to Brodar / Brodar (1983). They are associated with patches of charcoal interpreted as fireplaces as well as stone tools of non-local raw material probably derived from gravels in the Drau/Drava valley some 80 km to the east. In 1997 two fragments of bone points were discovered in layer E in sector north-east (15 m²) in the middle of the cave (Brodar 2000; **tab. 1**).

Raw materials

It is common use to refer to the »bone« points from Potočka zijalka. A recent study of the raw material of 114 points has demonstrated that bone is indeed the most common raw material (n = 69; 60.5%), but also antler (n = 13; 11.4%) and ivory points (n = 3; 2.6%) have been identified (Pacher 2010). The raw material of the remaining specimens (n = 29; 25.5%) could not be determined. It has been suggested that cave bear bones were used to manufacture the points, but the DNA extracted from two bone points was not conclusive due to possible contamination (Hofreiter / Pacher 2004).

Shapes and sizes

All points have a massive base, mostly ogival in shape. One exemplar has been described as a split-based point, but it is likely to be a naturally split distal fragment (Brodar / Brodar 1983, 195; Zilhão 2009). The

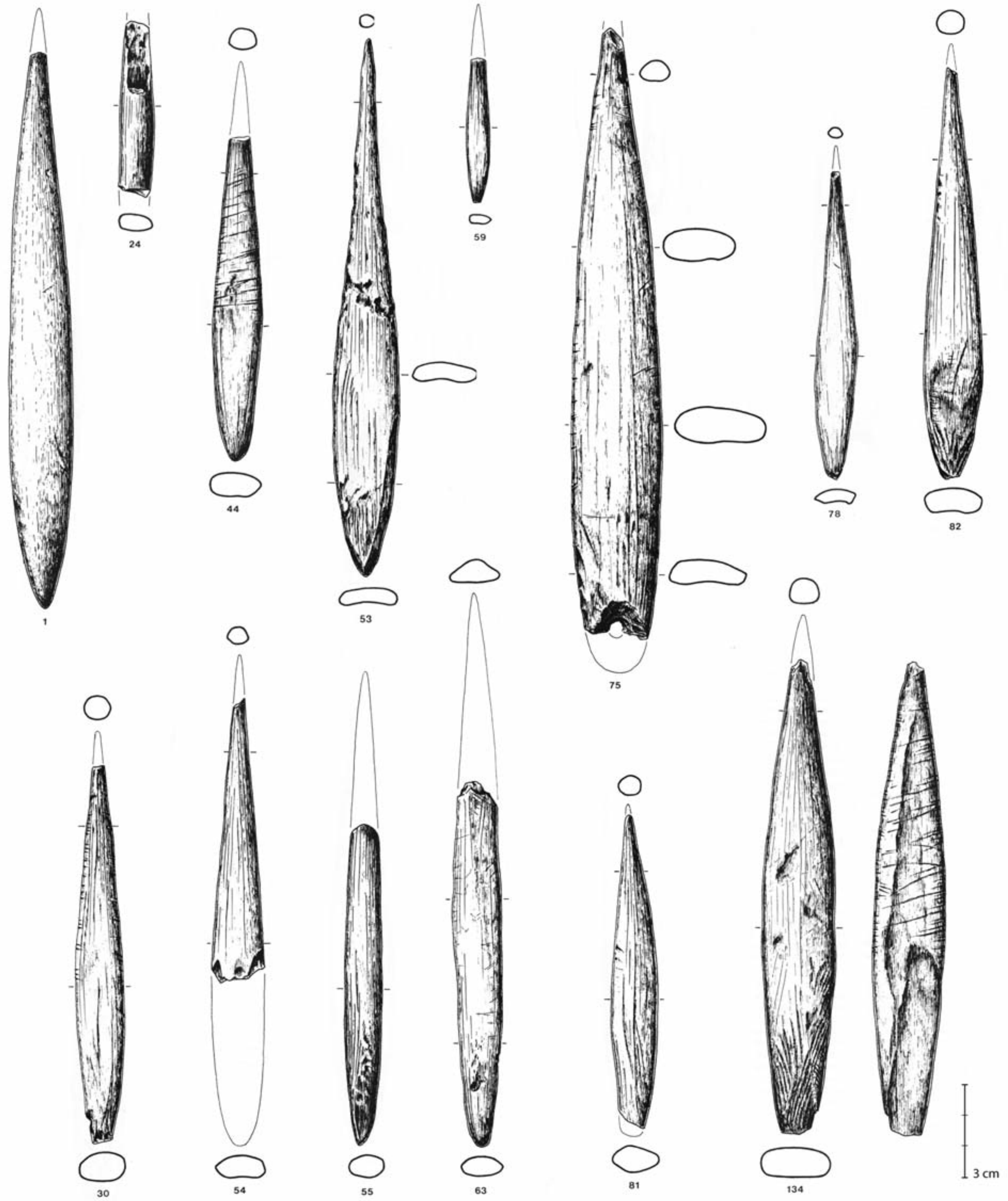

Fig. 5 Selection of »bone« points from sector north-west in the back of Potočka zijalka (reg. Koroška/SLO). – (Drawings and numbers after Brodar / Brodar 1983).

collection is dominated by lanceolate shapes with several examples of fusiform and lozenge shapes. The basal and mesial cross-sections are usually convex-concave to plano-convex or ellipsoid. The average dimensions of the complete points are: length = 112.4 ± 25.8 mm, width = 14.8 ± 3.3 mm, thickness = 8.3 ± 1.9 mm (Hahn 1988). Some specimens have series of striations and one exemplar has a perforated base.

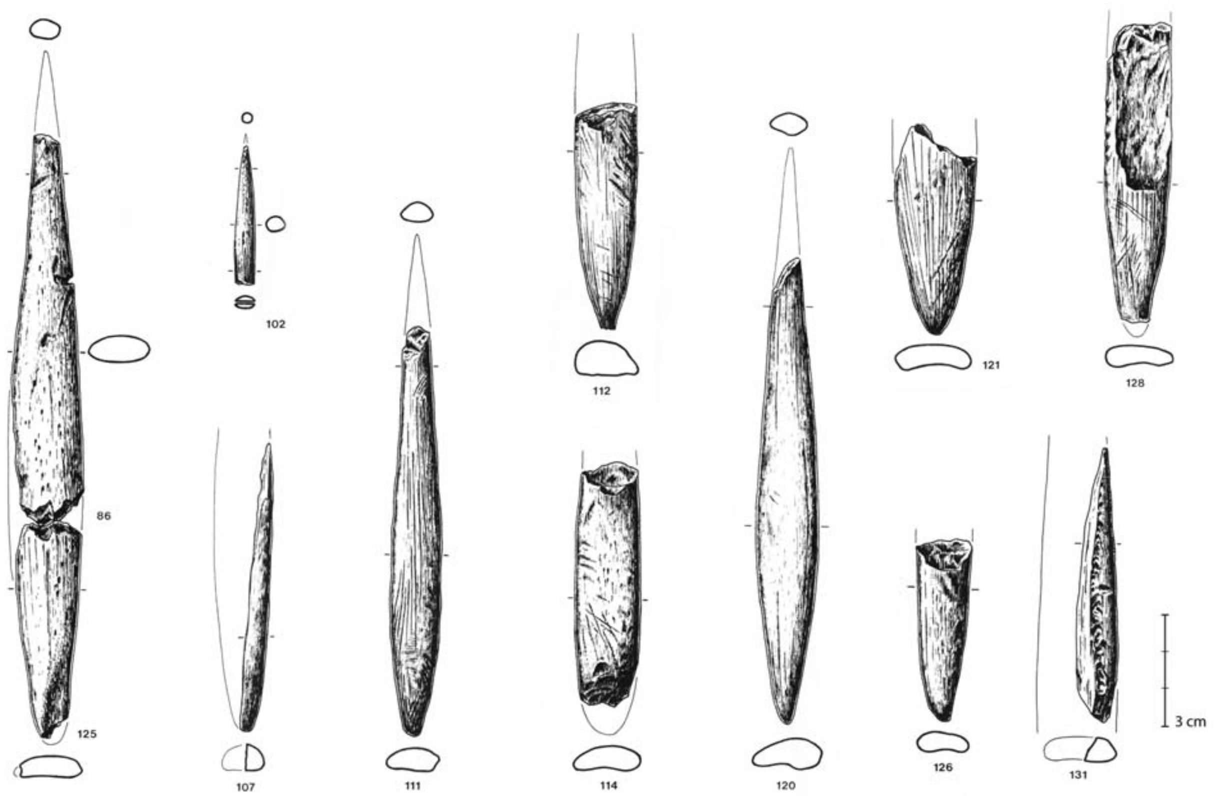

Fig. 6 Selection of »bone« points from sector west in the front of Potočka zijalka (reg. Koroška/SLO). – (Drawings and numbers after Brodar / Brodar 1983).

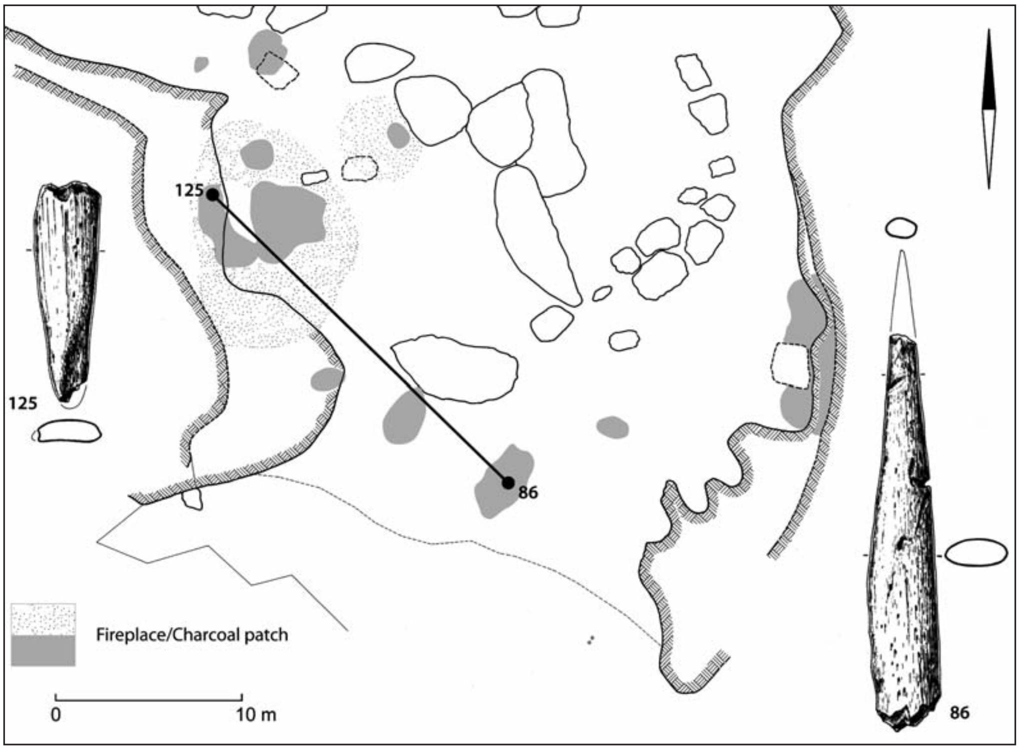

Fig. 7 Detail of the front of Potočka zijalka (reg. Koroška/SLO) with distribution of fireplaces/charcoal patches and a refit of two point fragments. – (Illustration J. Porck).

sector west (c. 1000 m²)		sector north-west (c. 200 m²)		sector north-east (15 m²)	
layer	n	layer	n	layer	n
3	1	4	22	E	2
5	12	5	32		
7	33	?	28		
8	1				
total	47		82		2
density/m²	0.047		0.41		0.13

Tab. 1 Stratigraphic position of the points in Potočka zijalka (reg. Koroška/SLO). – (Numbering of layers for the sectors west and north-west is based on Brodar / Brodar 1983 and for sector north-east on Pacher / Pohar / Rabeder 2004).

	category						
	front		back		NE	total	
	n	%	n	%	n	n	%
complete	1	2.1	7	8.5	0	8	6.1
complete with apical fracture	5	10.6	39	47.6	0	44	33.5
complete with basal fracture	0	0	2	2.4	0	2	1.5
complete with fractures at both extremities	4	8.5	5	6.1	0	9	6.9
basal part	16	34.0	14	17.1	1	31	23.7
basal part with basal fracture	6	12.8	3	3.7	0	9	6.9
mesial part	5	10.6	3	3.7	0	8	6.1
distal part	3	6.4	2	2.4	0	5	3.8
distal part with apical fracture	7	14.9	7	8.5	1	15	11.5
apical fragment	0	0	0	0	0	0	0
total	47	99.9	82	100	2	131	100
longitudinal break	3	6.4	1	1	0	4	3.1

Tab. 2 State of fragmentation of points in Potočka zijalka (reg. Koroška/SLO).

Breakage patterns

The points were coded for breakage patterns based on the drawings and photographic documentation in Brodar / Brodar (1983). An overview of the fragmentation is presented in **table 2**. Of all points, 48% are complete or nearly complete and 52% are fragmented. Basal parts form 31%, distal parts 15% and mesial parts only 6% of the total assemblage. Four points show longitudinal breaks – the presence of these fractures is in accordance with bone as dominant raw material (Knecht 1997b). Midsection breaks are also common (cf. Knecht 1997b). Apical fractures – breaks of the tip of the point – are frequent on complete points (84%) as well as distal ends (75%). Basal fractures are less common (21.5%). Different fracture types are present such as oblique and transverse bevelled breaks and bending breaks (Arndt / Newcomer 1986). One point was refitted – the mesiodistal part was found near fireplace B2 and the basal part was found near fireplace B5, 22 m apart (Brodar / Brodar 1983, fig. 7).
Three groupings of points were distinguished on the basis of the horizontal distribution: points located in the back (n = 82), points situated in the front (n = 47), and points coming from the north-eastern sector (n = 2). Brodar / Brodar (1983) already described the difference in the size range of the points and point fragments between the front and the rear part. But they did not describe the major discrepancies in the breakage pattern that exist between the back and the front of Potočka zijalka.
The assemblage from the front of the cave is dominated by fragments (79%). The basal parts form 46.8%, distal parts 21.3% and mesial parts 10.6% of the collection. Seven out of ten distal parts have an apical

fracture. Six out of 22 basal parts have basal fractures. Of the ten complete points, nine have an apical fracture and four have both apical and basal fractures. The assemblage from the back of the cave, however, is dominated by complete points (65%). The majority of the complete specimens have apical fractures (53.7%). 17 out of 29 fragments are basal parts. It is not known from current publications whether there is a significant difference in raw material between the front and the back of the cave.

INTERPRETATION OF SITE FORMATION PROCESSES

The breakage patterns in Potočka zijalka indicate a marked difference between the formation of the point assemblage in the front and the back of the cave. The fractures of the points can be caused by several factors: postdepositional processes such as movement of sediment (slope movement, cryoturbation) and trampling, breakage during excavation, breakage during manufacturing and/or breakage due to use. Can we establish which factors explain the differences best?

The recent excavations by Pacher / Polar / Rabeder (2004) have made clear that parts of the sediments in the north-eastern section have been redeposited along the slope towards the entrance and the walls of the cave. Given the lay-out of the cave I hypothesize that the degree of redeposition of sediments is higher in the front part of the cave than in the back. This means that the larger degree of fragmentation in basal, mesial and distal parts in the entrance area is partly the result of redeposition of sediments including the points.

If redeposition differs, one can also expect a discrepancy in apical and basal fractures in the two parts of the cave. Basal fractures differ significantly between the back and the front of the cave: 14.9% and 31.3% respectively. Damage of basal parts is twice as frequent in the front part of the cave, consistent with a larger degree of redeposition and postdepositional fragmentation. However, the proportion of apical fractures on complete points and distal parts is equal: 80% in the entrance area and 82% in the back. Part of the apical breaks can be caused by the excavation methods used between 1926 and 1935.

No evidence for local production of points is presently available, but the lack of sieving during all excavations could be the cause for the current absence of production debris. The presence of antler and ivory points indicates that at least part of the specimens have been brought to the location. One bone point (PZ 88) has been described as unfinished (Brodar / Brodar 1983). As it was found in a layer of probably redeposited material (layer 3 of sector west in Brodar / Brodar 1983), it is more likely that the point is abraded and damaged by postdepositional processes.

The proportions of basal, mesial and distal parts indicate that depositional, behavioural aspects also play a role in the distinction between the front and the back of the cave. Breakage due to use, especially impact, is a likely cause for the main pattern in the fragmentation of the points. Aside from the complete specimens, the basal and mesial parts are vastly overrepresented in the entrance area (59.5% of all fragments). The breakage pattern in the front of the cave is consistent with retooling activities, defined as the act of replacing the hafted part of a tool in its haft (Keeley 1982; Caspar / De Bie 1996). Turk (2002) has demonstrated with a morphometric analysis that part of the variability in the shapes and sizes of the points is explained by resharpening the tip after breakage. It seems therefore that the entrance area of the cave has been used frequently for the maintenance of the hafted points including replacement and perhaps reworking and resharpening of tips (Knecht 1997b).

The point assemblage in the back of the cave is only partially consistent with retooling or other maintenance activities. The dominance of complete specimens is best interpreted as an insurance cache of implements (Binford 1979; Kornfeld / Akoshima / Frison 1990; also Davies 2001, 212). Complete and near-

complete points were stored in a strategic location in anticipation of future needs. The cache or caches were never recovered because sedimentary processes covered the hoarded artefacts. The raw material composition of the cache is not yet clear from the published exemplars.
Knecht (1997b) mentions that bone points break more frequently than antler points and also that the type of breakage is more often beyond repair in bone than in antler points. The use-life of antler specimens is probably substantially longer, leading to a lower discard rate. Therefore, the dominance of bone points in the assemblage can not be directly interpreted as a preference for bone to produce massive base points: it is first of all a reflection of the shorter use-life and higher discard rate of bone points.
The discrepancy in breakage patterning is interpreted mainly as a behavioural difference between a caching location in the back of the cave and an activity area in the front of the cave where retooling formed the majority of the archaeological remains.

DISCUSSION

Comparison with other »bone« point assemblages from caves in Central and Eastern Europe

Small and large collections of bone and antler points are known from many cave sites in Central and Eastern Europe. A selection of sites is presented in **table 3** for comparison. Three assemblage types can be distinguished based on breakage patterns. Type 1 consists of collections with more than 50% of basal and mesial parts. The breakage pattern indicates a dominance of retooling activities. Type 2 assemblages have more than 50% distal parts and are relatively small (less than ten pieces in the selected sites). Assuming that distal parts are embedded in hunted prey animals, these collections indicate field processing stations where prey was butchered for transport and possibly also for small food caches. Type 3 assemblages have more than 50% complete points. These collections are interpreted here as caches of points in anticipation of future needs.
The three assemblage types can be distinguished for massive base points as well as split-based points. Split-based specimens are an index for the Early Aurignacian, whereas massive base exemplars are indicative of the Late Aurignacian. Though the direct dates for split-based points and massive base points overlap to some extent, they are in general support of some chronological difference (Jacobi / Pettitt 2000; Bolus / Conard 2006; Higham / Jacobi / Bronk Ramsey 2006; Szmidt / Brou / Jaccottey 2010). The consistent pattern in both types of osseous points shows that no substantial difference exists between the Early and Late Aurignacian in this respect.

Aurignacian technological organization

The collection of Potočka zijalka provides a good insight into the technological organization of the Late Aurignacian. The assemblage shows the presence of specialized, well-designed, curated personal hunting gear in the form of projectiles with bone, antler and ivory points. The evidence for caching and retooling indicates the extensive use of insurance strategies in space and time in anticipation of future needs and potential risks. The strategy is consistent with logistical mobility as defined by Binford (1979; 1980), but in a less extreme form than, for example, the practice used by the Nunamiut. Compared to the Nunamiut, transport capacity in the absence of sleds was probably more limited during the Aurignacian and the diversity of Aurignacian hunted faunas also indicates less dependence on the seasonal migration of reindeer.

site	n	basal	mesial		distal		complete		type	reference
		n	n	%	n	%	n	%		
type 1										
Potočka zijalka (reg. Koroška/SLO) – front	47	22	5	**58**	10	21	10	21	massive	Brodar / Brodar 1983
Potočka zijalka (reg. Koroška/SLO) – northeast	2	1	-	-	1	-	-	-	massive	Brodar 2000; Pacher / Pohar / Rabeder 2004
Vindija (Varaždinska županija/HR)	23	7	9	**69**	4	17	3	13	massive + split- based (1)	Zilhão 2009
Dzerava skala (okr. Malacky/SK)	20	3	9	**60**	6	30	2	10	split- based	Albrecht / Hahn / Torke 1972
Istállóskö (Kom. Heves/H) – upper layer	21	1	15	**76**	3	14	2	10	massive	Albrecht / Hahn / Torke 1972
Istállóskö (Kom. Heves/H) – lower layer	85	15	37	**61**	18	21	15	18	split- based	Albrecht / Hahn / Torke 1972
Špehovka (reg. Koroška/SLO)	1	1	-	-	-	-	-	-	massive	Brodar 2009
Vogelherdhöhle IV (Lkr. Heidenheim/D)	6	2	2	**66**	-	-	2	33	massive	Albrecht / Hahn / Torke 1972; Niven 2007
type 2										
Mokriska jama (reg. Koroška/SLO)	9	-	-	0	8	**89**	1	11	split- based	Brodar 2009
Divje Babe I (reg. Goriška/SLO)	4	-	1	25	2	**50**	1	25	split- based	Brodar 2009; Turk 1997; Turk 2002
Velika Pećina (Varaždinska županija/HR)	4	-	1	25	2	**50**	1	25	massive	Karavanić / Smith 1997
Tischofer Höhle (Bz. Kufstein/A)	8	1	-	12.5	4	**50**	3	37.5	massive + split- based	Zotz 1964/1965; Mottl 1966
Große Badlhöhle (Bz. Graz- Umgebung/A)	3	-	-	-	2	-	-	-	-	Mottl 1966; Horusitzky 2006
Mixnitz-Drachenhöhle (Bz. Bruck a. d. Mur/A)	3	-	-	-	3	-	-	-	?	Neugebauer- Maresch 1999
type 3										
Potočka zijalka (reg. Koroška/SLO) – back	82	17	3	25	9	11	53	**64**	massive	Brodar / Brodar 1983
Vogelherdhöhle V (Lkr. Heidenheim/D)	19	5	1	32	1	5	12	**63**	split- based	Albrecht / Hahn / Torke 1972; Niven 2007

Tab. 3 Breakage patterns of selected sites ordered by assemblage type.

Instead, the Aurignacian mobility strategy would have to deal with a broader range of prey animals and their seasonal characteristics and with the need for a more frequent supply of food due to more limited storage for short time periods and/or on smaller scale.

Potočka zijalka can be interpreted as a special-purpose, short-term location for regular use. Caches of points anticipate the needs of future visitors of the cave. Site furniture was left at the location such as lithic raw material, some firewood and possibly some emergency food (Tillet 2008). Stones are locally available as seats, working stones or hearth stones. Some of the lithic artefacts and bone implements can be interpreted as »situational gear«, expediently made on available materials. This explains the so-called Mousterian features of some of the stone industries (Brodar / Brodar 1983; Montet-White 1996; Karavanić 2000). The »situational gear« includes recycling of broken points in response to local and immediate needs. Little production debris is expected at these sites; only debris from repair, resharpening or situational reuse is expected to be associated with mostly worn-out tools.

In this framework, the high percentage of apical fractures among the complete points could be explained in behavioural terms. Binford (1979) describes how tool-making schedules that stage the manufacture of gear in time and space are embedded in logistical mobility strategies. The hypothesis is that some cached points were partially unfinished and that the sharpening before use was »staged« in anticipation of »free time« in the field. The time spent waiting for game or a change of the weather could be used for maintenance activities such as finishing points and retooling. A detailed restudy of the points should clarify this issue.

Cave sites with small collections of mostly distal point fragments probably functioned as temporary butchery locations. They formed local shelters where hunted prey was processed for transport to a residential site or alternatively cached as emergency food for future visits.

The breakage patterns for both types of points indicate the presence of field processing stations, retooling activities and caches in both the Early and Late Aurignacian. No substantial difference in technological organization is evident on the basis of breakage patterns in split-based versus massive base points. There is certainly no need for a distinct cultural entity such as the Olschewian to describe the collections rich in bone points because they are an integral part of the assemblage variability within the Early and Late Aurignacian (see also Zilhão 2009; Pacher 2010).

Adaptation to mountainous environments by early modern humans

Gamble (1993) mentions the exploitation of highly fragmented, deeply incised mountainous terrain as a major challenge for human occupation. The region is hard to travel, weather conditions are unpredictable and risky, and resources are highly seasonal and peak in short periods (Gamble 1993; Grimaldi / Perrin / Guilaine 2008). The reasons for the use of the high mountains are diverse. In addition to typical mountain species such as chamois and marmots, the Alps provide a variety of plant foods and birds [1]. According to Moe et al. (2007) the treeline ecozone offered particular benefits for hunting herbivores such as red deer during the Early Mesolithic. The exploitation of seasonal plant resources may profit from the phasing in growth along the slopes from valley to high mountain. The build-up of fat reserves in marmot, cave bear and other mountain species could have been scheduled with respect to prey availability in the valleys and plains.

It has been suggested that systematic exploitation of mountainous environments becomes habitual practice only in the Late Upper Palaeolithic. Late Middle Palaeolithic and Early Upper Palaeolithic sites are known from the mountainous areas across Europe, but they are relatively rare compared to Late Upper Palaeolithic sites (Lequatre 1966; Bintz et al. 1997; Tillet 2001; Tillet et al. 2004; Bernard-Guelle 2002; Mourre et al. 2008). The Late Middle Palaeolithic and Early Upper Palaeolithic evidence seems to suggest rather opportunistic and sporadic use by Neanderthal and early modern human groups during MIS 3 (Gamble 1993; Phoca-Cosmetatou 2004; Phoca-Cosmetatou 2005).

The evidence for retooling, field processing and in particular caching from Potočka zijalka indicates, however, that the use of the higher mountainous regions was anticipated and scheduled and therefore a more regular aspect of Late Aurignacian subsistence strategies in the Eastern Alps. How the use of the mountainous terrains was organized in terms of Aurignacian settlement strategies is not clear. Mussi / Gioia / Negrino (2006) think that raw material transports on the Italian Peninsula make an interpretation of seasonal circuits linking coastal and mountainous regions a good possibility. Sites such as Fumane (prov. Verona/I) have been interpreted in terms of seasonal migration between upland summer hunting camps and residential winter camps in lowland areas (review in Phoca-Cosmetatou 2005). No such models are evident with regard to the Slovenian sites, but the evidence from cave sites across the mountainous regions of Central and Eastern Europe supports the regular use of these zones by logistically organized Aurignacian groups.

CONCLUSION

The study of the fragmentation of points from Potočka zijalka has made clear the following:

1. There is an important difference between the points from the rear and from the front of the cave.
2. The difference is partly due to fragmentation by postdepositional, geological processes.
3. The difference is largely the effect of various activities: caching of points in the back of the cave versus retooling activities in the front of the cave.

The comparison with other Aurignacian collections with bone points suggests the following:

4. The assemblages of osseous points in the Aurignacian of Central and Eastern Europe can be divided in three groups based on the proportion of complete points, basal/mesial fragments and distal parts.
5. The assemblage variability is similar for both Early Aurignacian split-based points and Late Aurignacian massive base points.
6. The presence of caching and retooling activities suggests more regular, anticipated use of the Eastern Alps during the Early Upper Palaeolithic than previously acknowledged.

Further study of the microscopic traces of manufacture, repair and use of the points themselves can provide more information about the *chaîne opératoire* of the points from Potočka zijalka and massive base points in general.

Note

1) Pohar (2004, 215) and Withalm (2004, 219) present data from Potočka zijalka in support of active cave hunting, but the evidence is scant and controversial. A flint projectile embedded in a cave bear vertebra from Hohler Fels (Alb-Donau-Kreis/D), dated to the Early Gravettian, and cutmarks on cave bear bones from the Aurignacian at Geißenklösterle (Alb-Donau-Kreis/D; Münzel / Conard 2004) demonstrate that cave bear was exploited in the Upper Palaeolithic.

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Zusammenfassung / Abstract / Résumé

Vorratshaltung und Gerätewartung in Potočka zijalka (Slowenien).
Schlussfolgerungen für spätaurignacienzeitliche Landnutzungsstrategien

Die hochalpine Höhlenfundstelle Potočka zijalka in Slowenien ist schon lange für ihre große Sammlung spätaurignacienzeitlicher Knochenspitzen mit massiver Basis (Typ Lautsch, Mladeč oder Olševa) bekannt. Sowohl die Funktion als auch die kulturelle Zuweisung des Fundortes wurden nach den ersten offiziellen Grabungen im Jahr 1928 immer wieder diskutiert. Die vorliegende Studie beschreibt zunächst die unterschiedlichen Bruchmuster der Knochenspitzen aus Potočka zijalka. Die daran anschließende räumliche Analyse legt nahe, dass im vorderen Teil der Höhle primär die Reparatur von Waffen erfolgte, während Knochenspitzen im hinteren Teil vor allem bevorratet wurden. Ein Abgleich mit anderen ost- und mitteleuropäischen Fundplätzen des älteren und jüngeren Aurignacien zeigt, dass vergleichbare Verhältnisse immer wieder zu erkennen, aber auch nur kurzzeitig genutzte Höhlenfundstellen vorhanden sind. Anhand der Nutzungsweise der Knochenspitzen und der Organisation mancher Fundorte lässt sich nachweisen, dass die Hochgebirgsregionen der östlichen Alpen durch den frühen modernen Menschen viel regelmäßiger aufgesucht wurden als bisher zumeist erwartet. *Übersetzung: M. Baales*

Caching and retooling in Potočka zijalka (Slovenia). Implications for Late Aurignacian land use strategies

The high alpine cave of Potočka zijalka in Slovenia is renowned for a large collection of Late Aurignacian bone points with a massive base. The function and cultural association of the site have been discussed since the first official excavations in 1928. This paper deals with the breakage patterns of the bone points. The study indicates that the front of the cave was mainly used for retooling activities whereas the rear part of the cave was used for implement caching. The comparison with other cave sites with bone points in Central and Eastern Europe shows a clear-cut pattern of assemblage variability with caches, retooling loci and small field processing sites in the Early as well as Late Aurignacian. The organization of the projectile technology suggests that the exploitation of mountainous regions in the Eastern Alps during the Early Upper Palaeolithic was more common than previously acknowledged.

Stockage et entretien d'outils à Potočka zijalka (Slovénie).
Réflexions sur les stratégies d'exploitation du terroir à la fin de l'Aurignacien

Située dans les hautes Alpes, la grotte de Potočka zijalka en Slovénie est connue depuis longtemps pour sa grande collection de pointes en os à base massive (type Lautsch, Mladeč ou Olševa). Depuis les premières fouilles en 1928, la fonction et l'attribution culturelle du gisement sont l'objet de discussions. L'étude présentée ici décrit les différentes cassures des poinçons de Potočka zijalka. L'analyse spatiale montre qu'une première partie de la grotte a surtout servi d'atelier de réparation des poinçons, alors que ce sont des pièces complètes qui étaient stockées dans le fond de la grotte. Une comparaison avec d'autres sites Aurignaciens d'Europe centrale et orientale montre que cette répartition se répète, mais uniquement dans des gisements utilisés de manière ponctuelle. Au vu de l'usure des poinçons et de l'organisation des sites, on peut démontrer que les zones montagneuses de l'Est du massif Alpin étaient bien plus fréquentées par les premiers hommes modernes que ce qui était admis jusqu'alors. *L. B.*

Schlüsselwörter / Keywords / Mots clés

Slowenien / Ostalpen / Aurignacien / frühe moderne Menschen / Knochenspitzen / Werkzeug
Slovenia / Eastern Alps / Aurignacian / early modern humans / bone points / tool
Slovénie / Alpes orientales / Aurignacien / premiers humains modernes / poinçons / outils

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L'utilisation de virement SWIFT avec le numéro IBAN et SWIFT supprime nos frais bancaires (IBAN: DE 08 5519 0000 0020 9860 14; SWIFT: MVBM DE 55); ils peuvent aussi être déduits en cas de réglement postal sur notre CCP (compte courant postal) ou par mandat postal international.
Le Römisch-Germanische Zentralmuseum n'est pas imposable à la taxe sur le chiffre d'affaires et ne facture aucune TVA (taxe à la valeur ajoutée).

Senden Sie diese Abo-Bestellung bitte per Fax an: 0049 (0) 61 31 / 91 24-199

oder per Post an:

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