

FIRST RESULTS OF USE-WEAR ANALYSIS OF THE LEAF POINTS FROM MORAVANY NAD VÁHOM-DLHÁ¹

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Abstract: In the last century, a big number of specific poplar-leaf shape points were obtained during the archaeological research at the Moravany nad Váhom-Dlhá. The assemblage contains numerous points of various sizes, methods of production at different stages of completion. The paper presents the results of use-wear analysis of the selected leaf points from Moravany nad Váhom-Dlhá. The study focuses on the relation between the morphology, raw material use, size of the points and the character of macroscopic and microscopic traces associated with their use and hafting, as well as the localization on the points. However, from the aspect of use-wear analysis, the collection is a bit problematic. It has been obtained a long time ago, mostly in 1943 and 1963. Instead of being packed separately, numerous leaf points were stored together only in few boxes. Many of them are damaged either by production, or as a result of post-depositional processes, lowering the visibility of the original use-wear traces. First microscopic analysis indicates that these types of tools were probably used as hunting equipment.

INTRODUCTION

The leaf point collection from Moravany nad Váhom-Dlhá is very important as regards a specific technocomplex of the Early Upper Palaeolithic (EUP) in Western Slovakia. The assemblage is renowned because it consists of a big number of triangular points shaped by bifacial retouch, with a slightly convex base (poplar-leaf shape). These specific leaf points were introduced by L. Zolt (1951, 183) as Moravany-Dlhá type points. F. Prošek (1953, 146) included the finds from Moravany nad Váhom-Dlhá in his detailed definition of the Szeletian culture in which leaf points represented the main *fossiles directeurs*. In recent years, opinions on Szeletian material concept have been changed and refined due to newly obtained results from excavations and lithic collections from central Europe, even though many new questions have arisen (Kaminská et al. 2017; Kaminská/Kozłowski/Škrdl 2011; Lengyel/Mester 2008; Markó 2016; Mester 2018; Neruda/Nerudová eds. 2009; 2013; Oliva 2008–2009; Škrdl 2017; Valoch 2012). The lithic collection from Moravany nad Váhom-Dlhá has a great potential to contribute to this discussion. The collection comprises of all elements within the *chaîne opératoire*, including rough pre-forms, production waste, final products – leaf points or reutilized pieces, due to what the site has been interpreted as a leaf point workshop (Freund 1952, 249; Zolt 1951, 181). The paper presents preliminary results of the use-wear analysis of selected leaf points, with the aim of determining whether these tools were used and what for, what could eventually contribute to identification of the site's function. This is a pilot study focusing only on selected leaf points from the site. This is why points in different stages of production (almost finished, finished, and reutilized), points made of different raw materials and of different quality, including even weathered pieces were selected for the analysis. In order to determine what specimen are suitable for the analysis in the future.

THE SITE

Moravany nad Váhom-Dlhá is located in Southwestern Slovakia, at the foothills of the Považský Inovec mountain range, on the left bank of the Váh River. The site is situated at an altitude of approx. 330 m, on a slope leaning northwards to the Váh River valley, about 3 km far from the river (Fig. 1).

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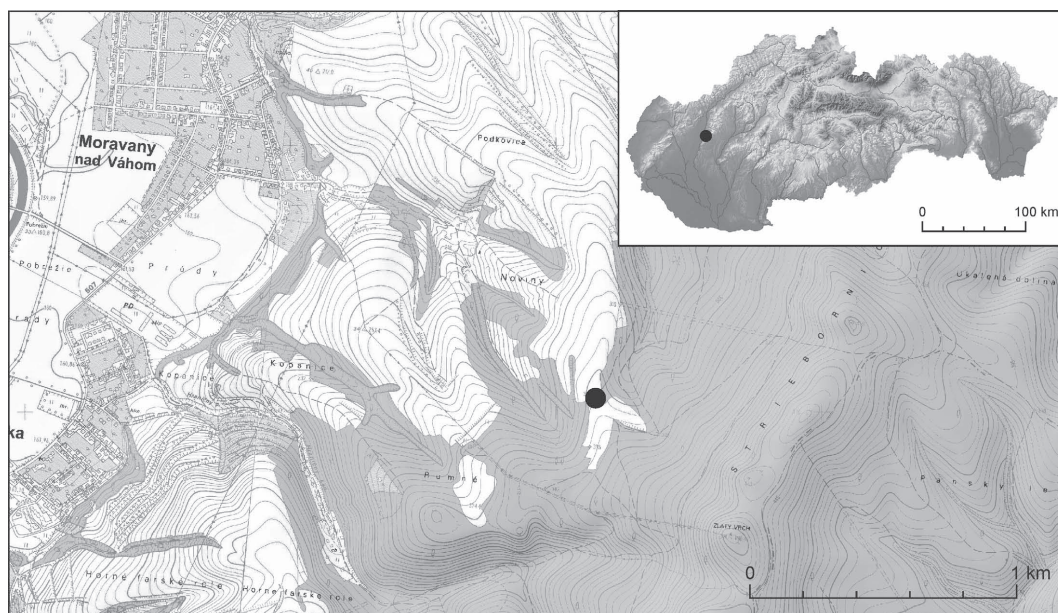


Fig. 1. Location of Moravany nad Váhom-Dlhá.

The site was first systematically excavated by L. Zotz (1951, 181) in the first half of the last century. Later, his work was followed up on by K. Absolon (Nerudová/Valoch 2009). Exact locations of the areas excavated by these researches remain unknown. More detailed information about the site was obtained during the excavations lead by J. Bárta in 1963 and 1990 (Bárta 1967; 1970). In 1963, 25 trenches spreading over a large area of about 150 m² were excavated (Nemergut 2010, 184). The artefacts were located in two superposing layers, as indicated by the profile drawings (Nemergut 2010, fig. 4). According to J. Bárta, the cultural layer was found mainly at the level of fossil soil, and rarely also in the layer of loess, which is why he believes that the finds were not found in their primary positions (Bárta 1970, 39). This was probably caused by extensive deflations and erosion of overlying loess layers. Revising archaeological excavation was carried out in 2008 (Kaminská/Kozłowski/Škrdl 2011, 39), during which three trenches were excavated. Lithic finds were discovered in Trench III, namely in the layer B horizon of fossil soil (Kaminská et al. 2017, 43).

The AMS dating (Poz-29011) of a fragment of *Picea* sp./*Larix* sp. from L. Zotz's 1943 excavation is 33,600 ±300 uncal BP (Kaminská/Kozłowski/Škrdl 2011, 40).

LITHIC INDUSTRY

Several big collections of lithic industry were obtained from the site. They are deposited in various institutions, even though some assemblages have been lost. The collections have been analysed by several researchers (Bárta 1960; Freund 1952; Kaminská et al. 2017; Nemergut 2010; Nemergut/Cheben/Gregor 2012; Nerudová/Valoch 2009; Zotz 1951). The most numerous finds come from the excavations of L. Zotz and J. Bárta. From J. Bárta's excavations, 5012 lithic artefacts were obtained (Nemergut 2010, 188). 4795 pieces coming from the excavations lead by L. Zotz (Nemergut/Cheben/Gregor 2012, 381) are deposited at the Institute of Archaeology of the Slovak Academy of Sciences (IA SAS). The latter number of specimen is probably not final, as the finds keep being discovered in misplaced/wrongly labelled boxes. Part of the collection, partially analysed by J. Bárta (1960), is still deposited in the Balneological Museum in Piešťany. As the finds were obtained during the excavations conducted a long time ago, the information regarding their contexts is very limited. The finds from the excavation led by L. Zotz in 1943 were packed in boxes with no context information (trenches, layers or depths). The finds from excavations led by J. Bárta were packed by individual trenches and depths, but information on layers and parts of the trenches or sectors is missing. Nevertheless, the assemblage seems to be homogeneous, which is why it is analysed as a whole.

As regards raw materials, most of the lithic artefacts (91%) were made of local radiolarite of different colours (Nemergut/Cheben/Gregor 2012, 382). Presence of pebble cortex indicates that radiolarite was

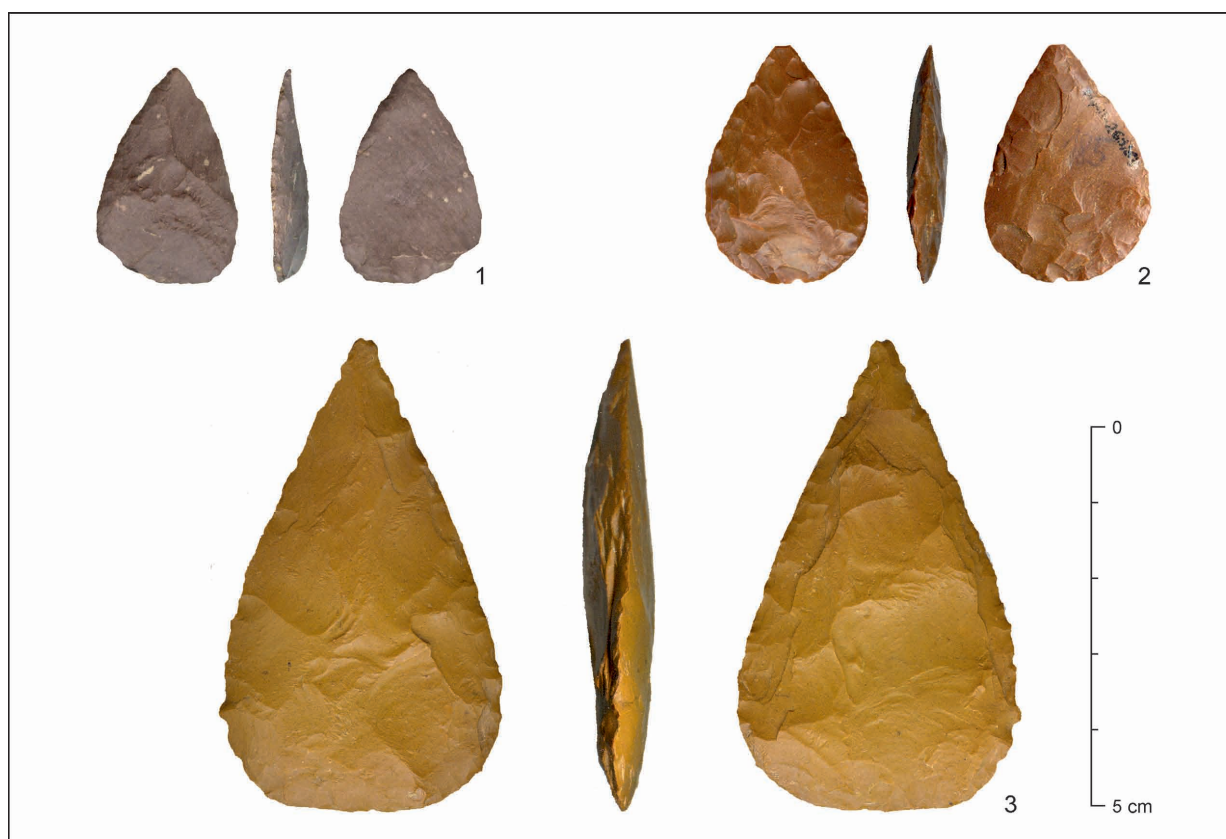


Fig. 2. Moravany nad Váhom-Dlhá. Variability of leaf points. 1 – unifacial, sometimes with lateral retouch (sample 9); 2 – partial bifacial (sample 8); 3 – bifacial (sample 58).

obtained from nearby gravel terraces of the Váh River. Quartz, opal-chalcedony, siliceous siltstone and sandstone were less frequent materials. Limnosilicite (approx. 70 km), felsitic porphyry (approx. 210 km) and obsidian (approx. 280 km) imported from more distant territories were used as well.

From technological aspect, flakes, their fragments and small flakes absolutely prevail in the collections. Only a small proportion of the assemblages comprises of blades, retouched tools and cores (Nemergut 2010, table 1; Nemergut/Cheben/Gregor 2012, table 1).

LEAF POINTS

Moravany nad Váhom-Dlhá site became famous for a finding of a large number of leaf points. L. Zotz (1951, 183) states that up to 200 pieces come from his excavation. 67 specimens come from the excavations led by J. Bárta, 23 of which represent complete artefacts (Nemergut 2010, 192). The remaining 44 pieces are fragmented, and include distal (15 pcs), lateral (14 pcs), proximal (6 pcs), mesial-distal (4 pcs), proximal-mesial (4 pcs), and mesial parts (1 pc) of leaf points. Some of the fragments fit together, and usually compose of mesial-distal and proximal-mesial parts (Nemergut 2010, pl. IV: 4, 6). Interestingly, in one case, a proximal-mesial fragment of a broken leaf point was re-retouched (Nemergut 2010, pl. IV: 8).

Almost all leaf points were made of local radiolarite (Nemergut/Cheben/Gregor 2012, fig. 2: 6, 8, 10), only some were made of local siliceous siltstone and sandstone (Nemergut/Cheben/Gregor 2012, fig. 2: 1–3). One asymmetrical point was even made of a poor-quality quartz. Exceptionally, the points were made of raw materials originating in more distant places, such as limnosilicite and felsitic porphyry (Nemergut/Cheben/Gregor 2012, fig. 2: 4, 5). G. Freund (1952, 249) even mentions obsidian, but it has not been directly documented in the collection deposited in the IA SAS. There is only indirect evidence, in the form of production waste – the bifacial thinning flakes (BTF).

The collection contains numerous finished leaf points but also various exemplars discarded at different production stages. There are two main methods of production (Nemergut/Klaric 2014, 16). First, the leaf points are produced by direct processing of raw material blocks, pebbles or pebble fragments, by discoid reduce strategy. This method is used for making bifacial samples of larger size (Fig. 2: 3). Second method is based on flakes with partial bifacial work (Fig. 2: 2), or unifacial work (Fig. 2: 1), sometimes even only using lateral retouch. The lengths of the leaf points from the collection of J. Bárta varies between 23 and 58 mm. Average length is 38 mm, with standard deviation of 9.6. Widths vary from 18 to 41 mm, with average width being 26 mm and standard deviation 6.8. The ratio of length to width varies from 1.1 : 1 to 1.8 : 1. Average ratio is 1.45 : 1, with standard deviation of 0.16 (Nemergut 2010, 192).

USE-WEAR ANALYSIS

Method

Microscopic analysis was conducted using Nikon LV150 metallographic microscope and Keyence VH-Z100R digital microscope. Before the examination, the artefacts were cleaned with warm water, detergent, and acetone. The leaf points were examined under the magnification of 50 x to 400 x, a common procedure in microscopic analysis (e.g. Juel Jensen 1988; Keeley 1980; Levi Sala 1996; Moss 1983; Rots 2010; Van Gijn 1990; Vaughan 1985). The observations were compared mainly with the macroscopic and microscopic traces and especially with the experimental reference dataset kept at the Faculty of Archaeology, University of Warsaw, Poland. This dataset consists of about 200 specimens originally used for hunting, and for processing hide, meat, bones, antler, wood, plant, shells, amber, and minerals. The dataset also includes about 80 blocks of lithic industry associated with technology, and a few hundred specimens linked to postdepositional aspects (like trampling, plowing). The experiments were conducted during the last few years and refer generally to the activities possibly performed in the Stone Age. It is important to emphasize that these experiments had been made before the microscopic analysis of Moravany-Dlhá leaf points, and so they are not directly related to the technology and the usage of leaf points.

Material

A detailed microscopic analysis was conducted on 64 artefacts. The analysed group consists of whole leaf points of Moravany-Dlhá type and their fragments (Table 1). The assemblage is rather challenging, as the leaf points were not packed separately. They were all deposited together in only few boxes. Much of the postdepositional damage of the specimens was probably caused by frequent manipulation with the boxes, resulting in poor visibility of the original traces of use-wear. In order to examine potential microscopic technological and usage traces, we have selected finished, almost finished and reutilized points differing in morphology, type, and size. The analysed group of artefacts comprises of: finished tools, symmetrical, bifacial, and very thin leaf points with a rounded base; partially bifacially retouched points representing finished or almost finished leaf points; unifacially or laterally retouched artefacts; or some reutilized points. The most common are the bifacial variants, which are also the largest, mostly made of radiolarite (Table 1; 2). As for the *chaîne opératoire*, finished points are the most frequent of all.

Table 1. Moravany nad Váhom-Dlhá. Variants of analysed leaf points in relation to fragmentation and *chaîne opératoire*.

	Whole and almost whole			Fragments		Total
	Finished	Almost finished	Reutilized	Mesio-basal/ mesio-terminal parts	Tips	
Unifacial	5	3	0	0	3	11
Partially bifacial	6	0	0	2	0	8
Bifacial	20	2	3	10	7	42
Unknown	0	0	0	0	3	3
Total	31	5	3	12	13	64

Table 2. Moravany nad Váhom-Dlhá. Types of macroscopic and microscopic traces observed on the leaf points. xx – the surface is badly damaged mostly due to the postdepositional processes, or the raw material was not fine-grained, causing problems with identification of use-wear traces.

Sample no.	Raw material	Variant of leaf point	Chaine opératoire	Size (mm)			Fragmentation	Postdepositional traces/not well preserved surface	Hafting/transporting traces	Breaks of tips	Linear traces	Photo
				length	width	thickness						
1	radiolarite	partially bifacial	finished	42.81	20.24	6.61	whole	x	x	–	–	–
2	radiolarite	bifacial	finished	47.98	22.81	6.64	whole	x	x	–	–	–
3	radiolarite	bifacial	finished	45.77	22.97	7.87	lateral break	x	x	x	–	Fig. 5: 2
4	radiolarite	partially bifacial	finished	47.97	22.98	6.37	whole	xx	–	–	–	–
5	radiolarite	bifacial	reutilized?	56.08	35.08	10.13	bilateral breaks	xx	–	–	–	–
6	radiolarite	bifacial	reutilized	54.88	34.69	9.95	almost whole	–	x	x	x	–
7	radiolarite	unifacial	finished	26.62	19.03	3.12	whole	xx	x?	–	x?	–
8	radiolarite	partially bifacial	finished	31.57	22.23	5.12	almost whole	xx	–	x?	–	Fig. 2: 2
9	unknown	unifacial	finished	32.07	23.18	8.57	whole	xx	–	–	–	Fig. 2: 1
10	radiolarite	partially bifacial?	finished?	22.78	18.38	3.52	mesio-basal part	–	x?	x?	–	–
11	radiolarite	partially bifacial	finished	36.56	27.31	4.21	almost whole	xx	–	x	x	Fig. 3: 3, 4
12	radiolarite	unifacial	finished?	23.64	18.74	2.97	almost whole	xx	–	x	–	Fig. 3: 1
13	radiolarite	unifacial	finished	22.55	20.32	3.95	almost whole	–	x	x	–	–
14	radiolarite	unifacial	finished	24.55	17.95	3.13	almost whole	x	x?	x?	x	Fig. 4: 2
15	radiolarite	unifacial	finished	34.64	18.89	2.95	lateral break	xx	–	–	x?	Fig. 4: 1
16	radiolarite	unifacial	unfinished?	30.08	21.46	6.55	whole	xx	–	–	–	–
17	radiolarite	unifacial	unfinished?	30.32	22.66	5.36	whole	xx	–	–	–	–
18	radiolarite	unifacial?	finished?	29.05	21.02	3.11	tip	xx	x?	x	–	–
19	radiolarite	bifacial	finished	38.68	31.03	8.98	mesio-basal part	xx	–	x	–	–
20	radiolarite	bifacial	finished	36.82	36.48	11.28	mesio-basal part	xx	x?	x	–	Fig. 3: 2
21	radiolarite	bifacial	finished?	53.43	35.37	13.95	almost whole	xx	–	x	–	Fig. 3: 5
22	radiolarite	bifacial	finished	35.21	25.15	5.98	almost whole	xx	–	x	–	–

Table 2. Continuation.

Sample no.	Raw material	Variant of leaf point	<i>Chaine opératoire</i>	Size (mm)			Fragmentation	Postdepositional traces/not well preserved surface	Hafting/transporting traces	Breaks of tips	Linear traces	Photo
				length	width	thickness						
23	radiolarite	bifacial	finished	33.82	20.14	5.19	whole	xx	–	–	–	–
24	radiolarite	bifacial	finished	37.25	25.65	6.77	whole	x	x	–	–	–
25	radiolarite	bifacial	finished	41.93	31.38	8.27	whole	xx	–	–	–	–
26	radiolarite	bifacial	finished	48.02	34.45	9.61	almost whole	xx	–	x?	–	–
27	radiolarite	bifacial	finished	47.44	34.4	8.33	whole	xx	–	–	–	–
28	radiolarite	bifacial	reutilized	56.75	39.21	9.91	tip (technological break) + reutilized mesio-basal part	xx	–	x?	–	–
29	radiolarite	bifacial	finished	36.27	24.54	4.58	whole	xx	–	–	–	–
30	radiolarite	partially bifacial	finished	61.8	32.84	4.93	whole	xx	–	–	–	–
31	radiolarite	bifacial	finished	37.86	52.69	8.95	basal part	xx	–	–	–	–
32	radiolarite	bifacial	finished	85.73	43.88	12.75	whole	x	x?	–	–	–
33	felsitic porphyry	bifacial	finished	44.53	26.61	5.94	lateral notch	x	x	–	–	Fig. 5: 3
34	radiolarite	?	?	19.85	10.19	3.23	tip	xx	–	x	–	–
35	radiolarite	?	?	13.01	12.84	3.17	tip	x	x	x?	–	Fig. 6: 5, 6
36	radiolarite	?	?	19.33	13.11	2.52	tip	x	x	x	–	Fig. 6: 3, 4
37	radiolarite	bifacial	finished	23.22	17.02	3.52	tip	xx	–	x?	–	–
38	radiolarite	bifacial	finished	18.13	22.58	5.25	tip	x	x	x	–	–
39	radiolarite	unifacial?	finished?	21.42	21.83	5.48	tip	xx	–	x?	–	–
40	radiolarite	bifacial	finished	25.47	29.33	8.67	tip	x	x?	x?	x	Fig. 4: 3
41	radiolarite	bifacial	finished	27.58	24.71	5.31	tip	xx	–	x?	–	–
42	radiolarite	bifacial	finished	19.4	22.86	5.23	tip	xx	–	x	–	–
43	radiolarite	bifacial	finished	36.38	26.13	7.91	mesio-terminal part	xx	–	x?	–	–
44	radiolarite	bifacial	finished	28.41	28.16	9.97	mesio-terminal part	xx	–	x?	–	–

Table 2. Continuation.

Sample no.	Raw material	Variant of leaf point	Chaine opératoire	Size (mm)			Fragmentation	Postdepositional traces/not well preserved surface	Hafting/transporting traces	Breaks of tips	Linear traces	Photo
				length	width	thickness						
45	radiolarite	partially bifacial	finished	27.04	25.55	4.54	mesio-basal part	x	x	x?	–	–
46	radiolarite	bifacial	finished	35.07	23.97	5.72	lateral break	xx	–	x	–	–
47	radiolarite	bifacial	finished	26.35	35.12	7.88	basal part	xx	–	x?	–	–
48	radiolarite	bifacial	finished	15.23	17.23	5.67	tip	xx	–	x	–	–
49	radiolarite	bifacial	finished	31.98	31.43	4.87	tip	x	x?	x?	–	–
50	radiolarite	bifacial	finished	24.72	42.67	7.38	basal part	x	x?	–	–	–
51	radiolarite	bifacial	finished	36.26	29.32	6.58	almost whole	x	–	x	–	–
52	radiolarite	partially bifacial	finished	43.76	30.24	5.25	whole	x	x?	–	x	–
53	radiolarite	bifacial	finished	37.79	47.96	7.56	mesio-terminal part	x	x?	x	–	Fig. 3: 6
54	radiolarite	bifacial	finished	41.39	39.61	8.74	mesio-terminal part	x	x	x	–	Fig. 5: 1
55	radiolarite	bifacial	finished	55.06	51.79	7.49	mesio-basal part	x	x	x?	–	–
56	unknown	bifacial	finished	54.38	35.63	6.22	lateral break	x	x	–	x	–
57	radiolarite	bifacial	finished	49.68	32.87	5.84	whole	xx	x?	–	–	–
58	radiolarite	bifacial	finished	61.83	37.35	7.08	whole	x	–	–	–	Fig. 2: 3
59	radiolarite, Sedmerovec-Kašnák type	bifacial	finished	79.78	51.42	9.86	whole	xx	–	–	–	–
60	limnosilicite	bifacial	finished	50.37	36.67	8.62	almost whole	xx	–	x?	–	–
61	siliceous siltstone	bifacial	finished	62.83	37.79	6.23	almost whole	xx	–	x	x?	–
62	radiolarite, Sedmerovec-Kašnák type	bifacial	finished	84.93	40.96	10.15	whole	xx	–	–	–	–
63	radiolarite	bifacial	unfinished?	74.48	46.96	18.41	whole	x	–	–	–	–
64	radiolarite	unifacial?	finished?	18.58	9.11	4.02	tip	?	?	x	?	Fig. 6: 1, 2

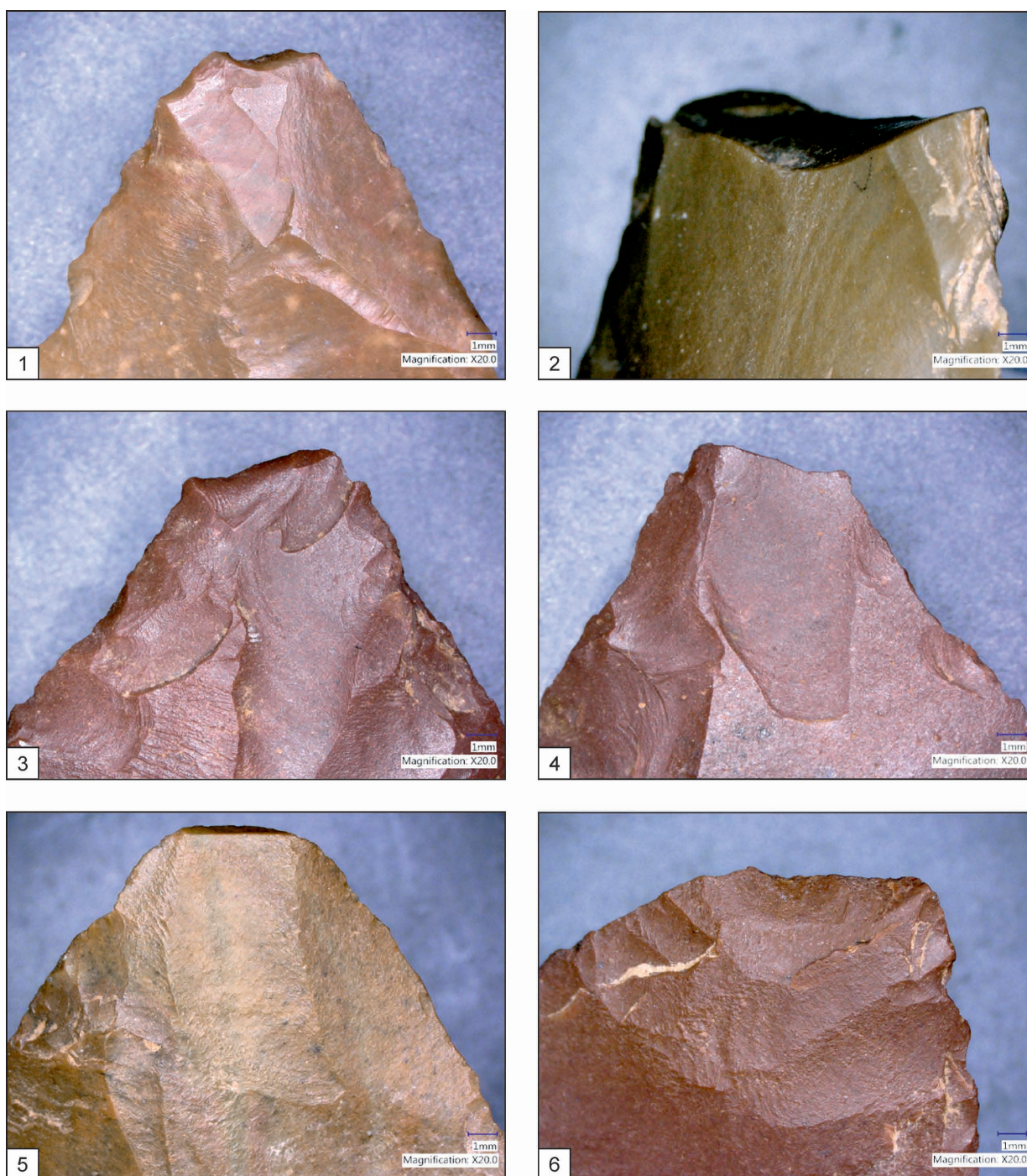


Fig. 3. Moravany nad Váhom-Dlhá. Details of use-wear traces on leaf points. 1 – spin-off fracture (sample 12); 2 – hinge terminating bending fracture (sample 20); 3, 4 – spin-off and hinge terminating bending fractures (sample 11); 5 – feather terminating bending fracture (sample 21); 6 – hinge terminating bending fracture (sample 53).

What is very important in the context of use-wear studies, analysed artefacts were made of various types of raw-material, and they are characterized by a different states of preservation. It can be concluded that the most important raw material was local one, i.e. radiolarite. Some of the artefacts were made of local quartz or siliceous sandstone. There are some specimens made of raw materials brought from further locations. In some cases, the type of raw-material limited the research. Microscopic analysis of other than “fine-grained” materials and/or those that were weathered was much more complicated. In such cases, diagnostic elements of polishing were poorly preserved and vague. These postdepositional factors limited the identification and

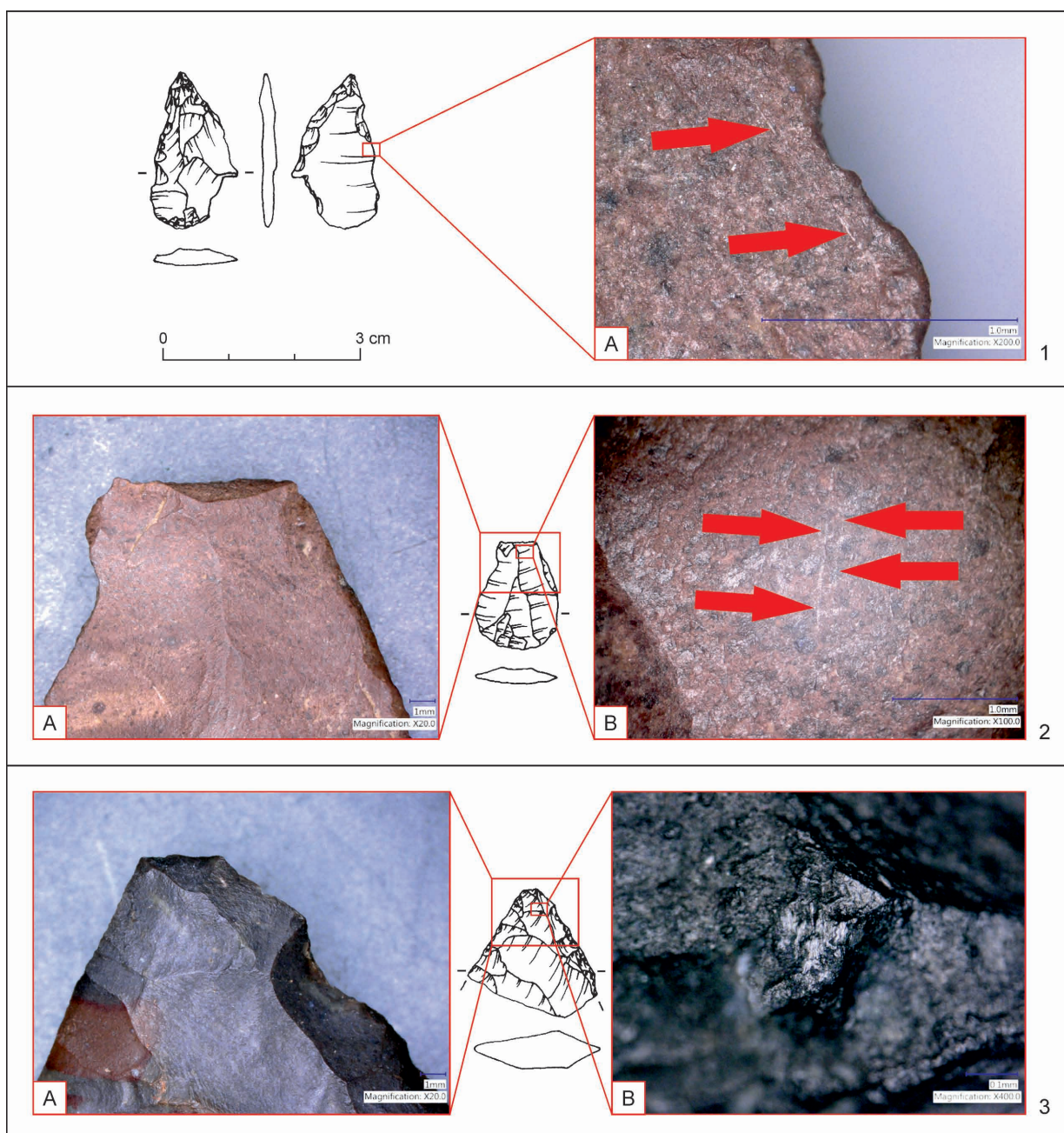


Fig. 4. Moravany nad Váhom-Dlhá. Details of use-wear traces on leaf points. 1 – linear trace (A) of sample 15; 2 – break of the tip (A) and linear traces (B) of sample 14; 3 – break of the tip (A) and polishing probably resulting from contact with a bone (B) of sample 40.

recognition of the origin of the traces on the artefacts (e.g. *Burroni/Donahue/Pollard 2002; Kamińska/Szymczak 1994; Levi Sala 1996; Plisson/Mauger 1988; Shea/Klenck 1993; Van Gijn 1990, 51–53*). Because of a bad state of preservation, the use-wear analysis of some leaf points was made only on the macroscopic level.

Results

Table 2 shows the results of the analysis. They were influenced by numerous postdepositional traces located on different parts of analysed points. For instance, breakings of the tips, microscopic linear traces, and polishing were detected (Fig. 3–6). Figures 7 and 8 show that the traces of use-wear can be seen on all types of points, regardless their variant or size.

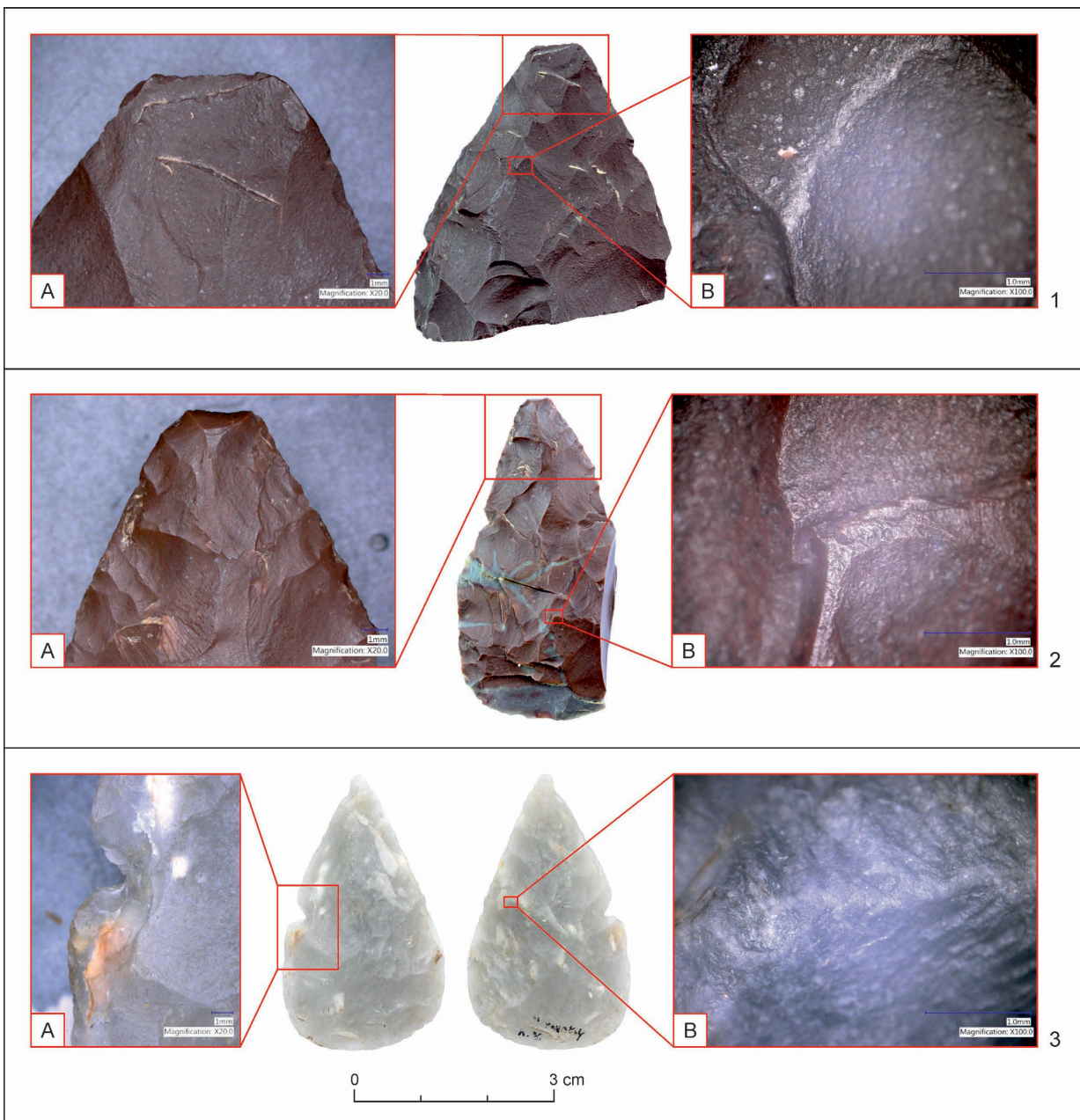


Fig. 5. Moravany nad Váhom-Dlhá. Details of use-wear traces on leaf points. 1 – step terminating bending fracture (A) and polished part (hafting or transporting traces?; B) of sample 54; 2 – hinge terminating bending fracture (A) and polished part (hafting or transporting traces?; B) of sample 3; 3 – notch (A) and polished part (hafting or transporting traces?; B) of sample 33.

Broken tips are the most common macroscopic traces. They were observed on many specimens, on finished, almost finished and reutilized specimens (Fig. 7: A). On all known variants, large broken bifacial tips were recognised, on both the partially retouched or on small unifacial forms (Fig. 7: B). These broken tips are characterized by specific morphology. There are some examples of impacts with a convex profile called “hinge” (Fig. 3: 2–4, 6; 5: 2), “step” (Fig. 5: 1) and “feather”, depending on fracture bending of the edge (Fig. 3: 5). Also, “spin-off” fractures were recognized (Fig. 3: 1, 3, 4), characterized by the breaks with straight profiles and some negatives of small chips, usually with hinged or step endings that were placed under the breaks. The morphology of the mentioned fractures indicates that some of them are probably related to tools such as projectiles, and these breaks were created during hitting the target. This is indicated by a series of different experiments (cf. *Bergman/Newcomer 1983; Coppe/Rots 2017; Fischer/*

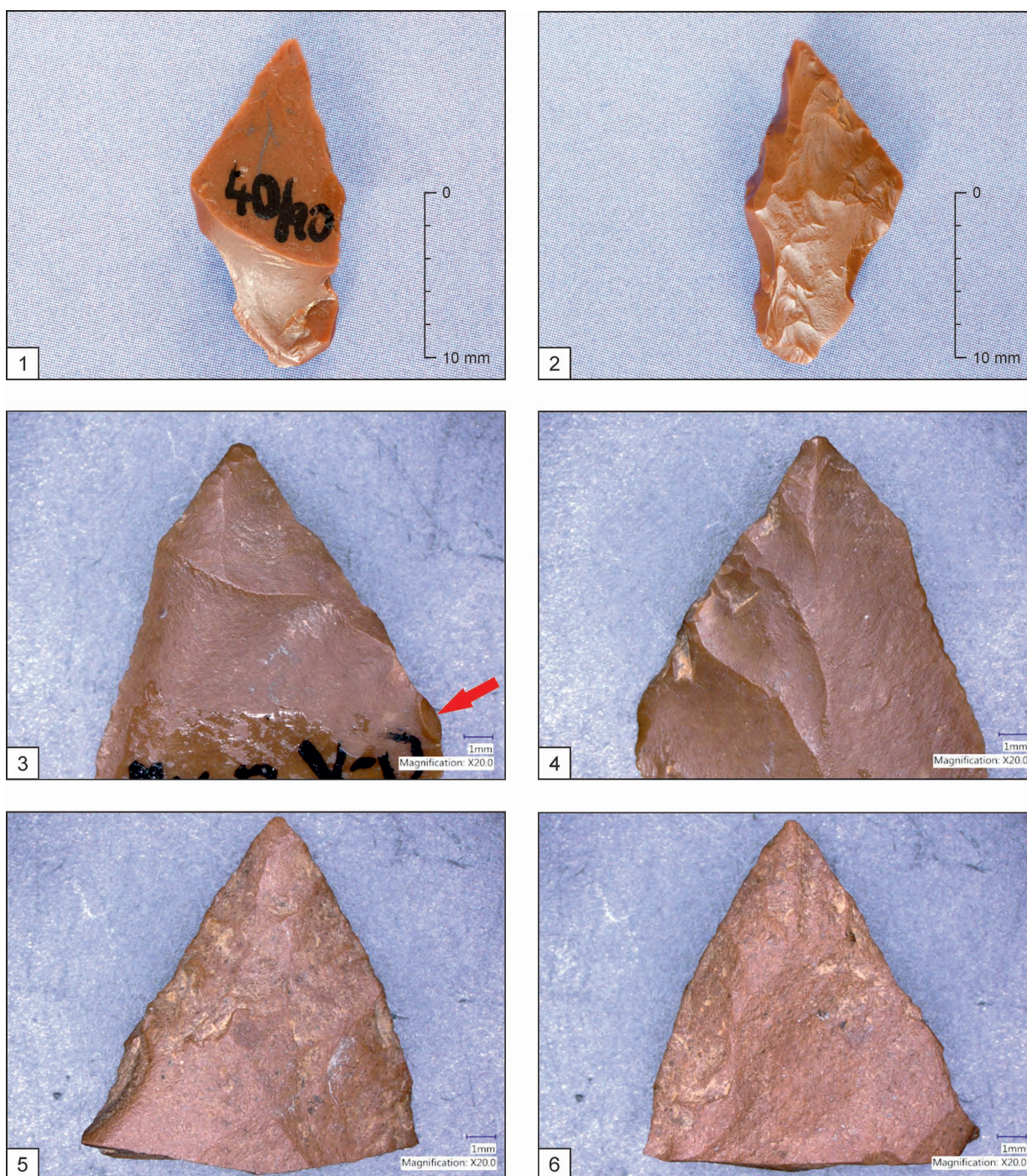


Fig. 6. Moravany nad Váhom-Dlhá. Details of leaf point tips. 1 – functional fracture (?); 2 – technological fracture (the arrow showing a butt); 3 – postdepositional fracture (?). 1, 2 – sample 64; 3, 4 – sample 36; 5, 6 – sample 35.

Vemming Hansen/Rasmussen 1984; Hutchings 2016; Lombard 2005; Odell/Cowan 1986; Rots/Plisson 2014; Sheal/Davis/Brown 2001). Additionally, some leaf points are broken in an unusual way – the breakages have only straight profiles. In such cases, it is not possible to answer the question if they were created during hunting, were formed during the production stage, or they are related to postdepositional factors (like for example trampling).

Among the group of analysed artefacts, tips of the leaf points were recognized. They represent positives of previously described traces. Some of them bear the negatives of hinged or step fractures – they have deep and concave profiles, and the one end of the breakage is much longer than the other

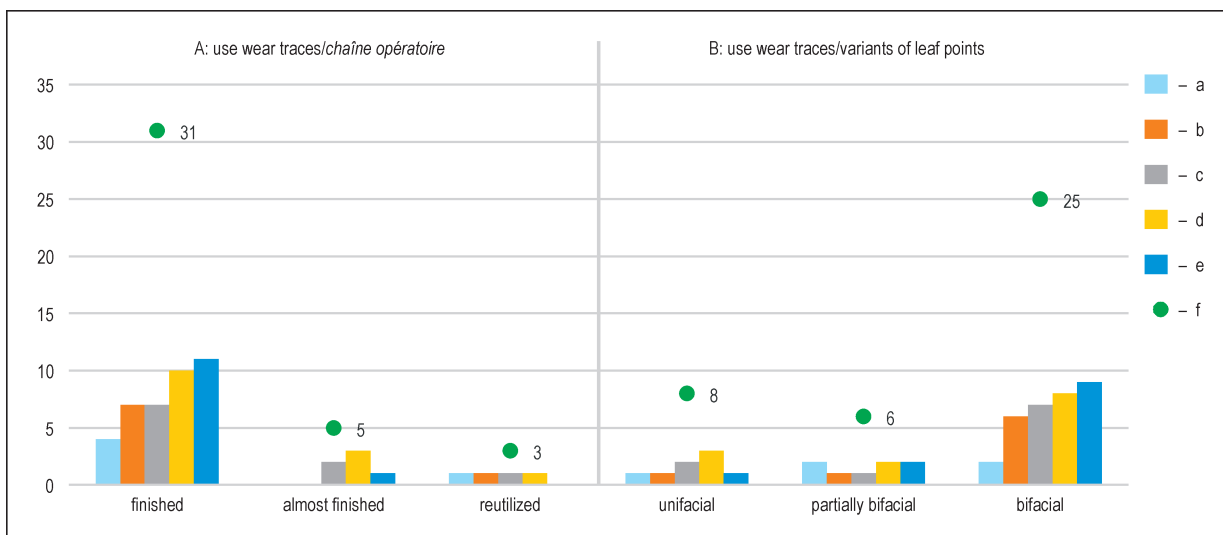


Fig. 7. Moravany nad Váhom-Dlhá. Use-wear traces on whole and almost-whole leaf points in relation to their variants and *chaîne opératoire*. Legend: a – linear traces; b – hafting/transporting traces; c – terminal break; d – without traces; e – postdepositional traces; f – total.

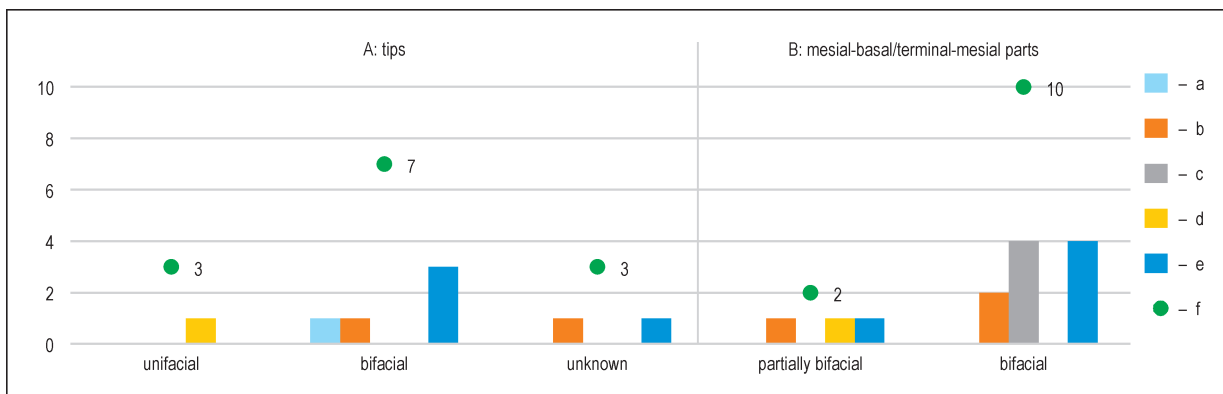


Fig. 8. Moravany nad Váhom-Dlhá. Use-wear traces on tips and leaf points fragments in relation to their variants. Legend: a – linear traces; b – hafting/transporting traces; c – terminal break; d – without traces; e – postdepositional traces; f – total.

(Fig. 6: 1, 2). It is possible that these fractures were formed during use or technical stage when the leaf points were made (cf. *Beyries/Jammy/Audouze 2005; Polanská 2018*), e.g., with visible butt on the edge (Fig. 6: 3) or postdepositional (probably Fig. 6: 5, 6). There are no tips from partially bifacial variants (Fig. 8: A), what is related with the poorer presence of terminal breaks on partially bifacial points (Fig. 7: B). On the tips, there are some traces that could be related to transporting or hafting (Fig. 8: A), but some of these traces can be related to postdepositional processes. Linear traces were detected exclusively on bifacial variants of tips, as they were statistically most numerous (Fig. 8: A).

On microscopic level, the leaf points are characterized by linear traces. These linear traces are visible on 10 leaf points. They are placed near the tips of the leaf points (Fig. 4: 1, 2), under the already-mentioned macroscopic fractures or near the negatives of the microchips. Linear traces are either multiple, parallel next to each other, or individual. They are parallel or slightly oblique to the tool's axis of symmetry. Possibly, some of them had been created during the penetration of the target by point, they could be a result of scratching of a surface by stone chips. In one case (Fig. 4: 3B), there are visible linear polishes whose morphology is similar to traces resulting from getting in contact with bone. So, possibly, they may have been created as a result of hitting an animal bone.

Some of the leaf points are covered by traces that could be related to some kind of hafts or transporting (Fig. 5: 1B, 2B, 3B). On protruding parts such as ridges or edges, rounded and polished margins are visible

(they are usually dull, slightly “greasy” and penetrating the microstructure; e.g. *Lombrad 2005; Rots 2003; 2008a; 2008b; 2009; 2010; 2011; 2015; Rots/Van Peer/Vermeersch 2011; Rots/Vermeersch 2004; Van Gijn 2010*). It should be added that these traces occur on large parts of artefacts and are not visible only on specific parts of the tools (for example, near the tip or at the base). Due to the insufficient level of distinction, it was impossible to identify the type of potential haft and the method of fixing the leaf points. Considering the issue of leaf point mounting, the appearance of small notches located on individual specimens edges, lateral (Fig. 5: 3A) or bilateral (distributed symmetrically), at 1/3 to 1/2 of the artefact, should be taken into consideration. However, in this case this observation is not supported by specific results of microscopic analysis. Additionally, on the surface of leaf points, there are clear bright spots - they appear individually or in group, and in a chaotic way. The formation of such traces is related to the activity of natural and mechanical factors (e.g. *Levi Sala 1993; 1996*) and with the use of hafts (e.g. *Rots 2010; Rots/Vermeersch 2004*).

DISCUSSION

Traces observed on the leaf points from Moravany nad Váhom-Dlhá are related to macroscopic breakages of the tips, microscopic linear traces, and some kind of polishing (see other experimental and use-wear analysis related to hunting weapons, e.g. *Barton/Bergman 1982; Bergman/Newcomer 1983; Coppe/Rots 2017; Crombe et al. 2001; Dockall 1997; Fischer 1990; Fischer/Vemming Hansen/Rasmussen 1984; Hutchings 2016; Iovita/Sano eds. 2016; Lombard 2005; Lombard/Parsons/van der Ryst 2004; Moncel et al. 2009; Moss/Newcomer 1982; Nuzhnyi 1990; Odell 1988; Odell/Cowan 1986; Plisson/Beyries 1998; Rots 2011; 2015; Rots/Plisson 2014; Shea 1988; 1990; 2006; Shea/Davis/Brown 2001; Villa/Lenoir 2006; Villa et al. 2009*).

Unfortunately, at the current stage of the research, there is still a lack of comprehensive use-wear studies related to Central European points belonging to transitional assemblages, including Szeletian. The only analysis was performed on the material from the Moravia region – the leaf points from Vedrovice V and Moravský Krumlov IV (*Nerudová/Dušková-Šajnerová/Sadovský 2010; Šajnerová-Dušková 2009*). Microscopic traces were recorded on 19 leaf points and several other tools. They were suggested to have been related to hide processing, scraping of soft and medium-hard material (possibly also hide), as well as drilling or piercing of medium-hard material. Some of them could have been used during hunting, the function of other tools was not specified. In general, the results show that these leaf points were used as multifunctional tools. In comparison, the data on selected leaf points from Siberia indicate that this type of artefacts was used to process soft organic material. These activities were undertaken using the side edges (*Shalagina et al. 2019*). Apart from single cases suggesting different function, latest microscopic studies of Jerzmanowice leaf points from Nietoperzowa Cave revealed that the majority of tools contain traces of use indicating a hunting weapon. The research showed that these tools were made indeed to be used in hunting areas (*Pyżewicz et al. 2020, 81*).

At the same time, it should be noted that in the camp area, other activities associated with animal carcasses were performed. These specimens were parts of composite tools, as potential traces of hafting were observed on their surfaces. Based on preliminary use-wear analysis of endscrapers it can be concluded that these types of tools were used for scraping hide. It can be assumed that if further analyses of the other groups of artefacts were undertaken, it would also be possible to identify other tools for other activities related to the processing of animal carcasses, such as functional knives. Additionally, it should be noted that, based on preliminary results of the use-wear analysis of artefacts from Moravany nad Váhom-Dlhá, there is some evidence of plant processing using the lithic tools. Two examples, one large flake, and the other retouched flake are covered by intensive, very bright and flat gloss, which has overlapping the inner surfaces.

CONCLUSION

Lithic collection from Moravany nad Váhom-Dlhá represents an important (probably homogeneous) assemblage crucial for EUP (Szeletian), as suggested by many finished leaf points, semi-finished products, BTF, etc. On the other hand, the collection is problematic because it was obtained during older

excavations, and the context of the finds is absent. It is also chronologically old assemblage and the authors are aware of the fact that they cannot expect such results as those obtained from the finds from younger periods cannot be expected. Studying other assemblages from surrounding countries show that it is possible to detect traces also on Middle Palaeolithic or transitional industries (Neruda/Nerudová/Šajnerová-Dušková 2010; Nerudová/Dušková-Šajnerová/Sadovský 2010; Šajnerová-Dušková 2009). The problem lies mainly in the deposition of analysed finds in the depository and the moving of the collection which has led to fresh traces on the finds and partial covering/removing of the original traces. The aim of the presented article was not to analyse all points, but rather a representative part of the assemblage. These are preliminary results which must be further validated on other points in the collection of the IA SAS. Analysis of assemblages stored in other institutions should also be attempted. Main preliminary results of this study can be summarised as follows:

- The analysis has clearly shown that significant number of fractures is associated with fresh fractures or with accidents production, which is logical, since the leaf points were massively produced at the site.
- Absence of traces on edges which might interpret the points as multifunctional tools. This is an interesting discovery, since it is remarkably different from, e.g., Szeletian points from Moravia (Nerudová/Dušková-Šajnerová/Sadovský 2010; Šajnerová-Dušková 2009). On the other hand, other activities on other tools (sidescrapers, endscrapers) were documented at the site of Moravany nad Váhom-Dlhá; thus, if the original users had wanted to use the points universally, they would have. It has not been confirmed so far that the points from the analysed site were used as multifunctional tools.
- Rarely, traces suggesting use during hunting, such as microscopic linear traces and diagnostic impact and spin-off fractures, were documented. The cases when a combination of such traces was discovered on a single specimen are interesting, as this cannot be considered a coincidence (e.g. samples 6, 14, 40; Table 2).

To sum up the use-wear analysis of artefacts from Moravany nad Váhom-Dlhá, it can be concluded that at the site activities related to hunting were performed. The leaf points were most probably specialized tools used during hunting activities. This preliminary conclusion should be confirmed by further research.

As a result of conducted microscopic analysis, some further questions associated with the recognition of microscopic traces have arisen. Conducting a series of experiments connected with production and using (cutting, throwing, hafting, etc.) would be helpful. We would like to know:

- if macroscopic and microscopic traces (technological, usage, hafting, transporting) observed on experimental leaf points made from analogical raw materials such as artefacts from Moravany nad Váhom-Dlhá could be similar;
- how the type of raw material influences the readability of microscopic technological, use-wear or hafting traces;
- if particular types of macroscopic breakages of tips of Moravany-Dlhá type leaf points should be associated with using or technological aspects during their creation.

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Prvé výsledky trasologickej analýzy listovitých hrotov z lokality Moravany nad Váhom-Dlhá

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Súhrn

Predložená štúdia predstavuje výsledky trasologickej analýzy listovitých hrotov z lokality Moravany nad Váhom-Dlhá s cieľom zistiť, či tieto nástroje boli používané a za akým účelom. Pri analýze bol využitý metalografický mikroskop Nikon LV150 a digitálny mikroskop Keyence VH-Z100R. Artefakty boli skúmané pri zväčšení od 50 x do 400 x. Zistené makroskopické a mikroskopické stopy sa porovnávali s experimentálnou porovnávacou zbierkou Katedry archeológie Varšavskej univerzity. Tá pozostáva z približne 200 exemplárov použitých počas lovu a spracovania kože, mäsa, kostí, parohu, dreva, rastlín, mušlí, jantáru a minerálnych materiálov. Žiaľ, absentujú v nej experimentálne výrobky listovitých hrotov. Obsahuje tiež 80 predmetov súvisiacich s technológiou a niekoľko stoviek exemplárov s postdepozíčnými procesmi. Mikroskopická analýza sa uskutočnila na 64 listovitých hrotoch typu Moravany-Dlhá a ich fragmentoch (tabela 1). Tie sa od seba líšili veľkosťou, tvarom a najmä typom suroviny použitej na ich výrobu (tabela 2). To čiastočne ovplyvnilo aj samotnú analýzu, nakoľko u hrubozrnnejších zvetraných a patinovaných surovín boli pracovné stopy zachované a viditeľné minimálne. V analyzovanej skupine sú príklady bifaciálnych (obr. 2: 3), čiastočne bifaciálnych (obr. 2: 2) a unifaciálnych listovitých hrotov (obr. 2: 1), niekedy retušovaných len na hranách. Ide o pilotnú štúdiu, ktorá neobsahuje všetky známe listovité hroty z predmetnej lokality, ale len reprezentatívnu vzorku. Z tohto dôvodu boli do analýzy vybrané takmer dokončené, dokončené a reutilizované hroty. Vybrané boli aj exempláre z rôznych surovín, horšej kvality, dokonca aj zvetraných kusov, aby sa z metodického hľadiska vedelo, aké kusy má zmysel analyzovať v budúcnosti.

Výsledky trasologickej analýzy sú obsiahnuté v tabele 2. Ide o problematickú kolekciu z hľadiska zachovania pracovných stôp, nakoľko listovité hroty neboli balené separátne, ale vo väčších množstvách boli uložené spolu v krabiciach. Zrejme kvôli častému prekladaniu krabíc sa na nich vytvorilo množstvo postdepozíčných poškodení, ktoré zapríčiňujú zlú viditeľnosť pôvodných pracovných stôp. Tie sa nachádzajú v rôznych častiach analyzovaných hrotov. Sledované stopy sa vyskytujú na všetkých typoch hrotov, bez výnimky na variant či veľkosť (obr. 7; 8; tabela 2). Zistené boli stopy ako makroskopické fraktúry špičiek hrotov a mikroskopické lineárne stopy. Makroskopické fraktúry špičiek boli zistené na mnohých listových hrotoch, na bifaciálnych aj na čiastočne retušovaných variantoch (obr. 7: B). Negatívy šikmo ulomených špičiek sa vo viacerých prípadoch vyznačujú špecifickou morfológiou. Tieto fraktúry boli vytvorené zrejme pri zasiahnutí cieľa počas použitia hrotov ako projektílov. Existuje niekoľko príkladov impaktov ukončených ohybom (obr. 3: 2–4, 6; 5: 2), schodíkom (obr. 5: 1) a s perovitým ukončením (obr. 3: 5). Boli tiež rozpoznané tzv. „spin-off“ fraktúry (obr. 3: 1, 3, 4), ktoré sa vyznačujú fraktúrou s priamym profilom a negatívmi malých úštepov umiestnených pod lomom (*Fischer/Vemming Hansen/Rasmussen 1984*). Špičky niektorých listovitých hrotov sú zlomené odlišným spôsobom, čoho výsledkom sú iba lomy s priamym profilom. V takýchto prípadoch je ťažké identifikovať, či boli vytvorené počas lovu, alebo vznikli v rôznych technologických fázach ich výroby, prípadne v dôsledku postdepozíčných procesov (napr. pri zašliapnutí). Mimoriadne dôležitý bol objav mikroskopických lineárnych stôp (obr. 4: 1, 2). Jedná sa o ryhy, ktoré sú zvyčajne výsledkom použitia nástrojov formou projektílov. Lineárne ryhy sú umiestnené v blízkosti špičiek. S najväčšou pravdepodobnosťou boli vytvorené pri zasiahnutí, resp. preniknutí do cieľa a následným poškriabaním povrchu kamennými trieskami alebo zrnkami piesku (ktoré sa napríklad nachádzali v srsti zvierat). Nemožno ani vylúčiť, že boli vytvorené v dôsledku nárazu, kontaktu s povrchom fragmentu kosti zvierat. V kolekcii sa nachádzajú aj samotné ulomené špičky listových hrotov (obr. 6). Sú prakticky pozitívom vyššie opísaných makroskopických fraktúr špičiek. Z prítomných exemplárov nebolo možné jednoznačne určiť, ako boli ulomené. Na analyzovaných hrotoch boli na výčnievajúcich častiach viditeľné ďalšie stopy, rôzne zaoblenia (obr. 4: 3B; 5: 1B, 2B, 3B). Ide o stopy, ktoré sa mohli teoreticky interpretovať ako výsledok umiestnenia v násadách alebo ich prepravy (*Lombrad 2005; Rots 2003; 2008a; 2008b; 2009; 2010; 2011; 2015; Rots/Vermeersch 2004; Rots/Van Peer/Vermeersch 2011; Van Gijn 2010*). Je potrebné dodať, že tieto stopy sa vyskytujú na veľkých častiach artefaktov a nie sú viditeľné iba v konkrétnej časti nástrojov (napr. v blízkosti hrotu alebo v bazálnej časti). Z dôvodu nízkej úrovne rozlíšenia nebolo možné určiť typ potenciálnej násady, prípadne spôsob upevnenia listovitých hrotov.

Predložený súbor predstavuje na jednej strane veľmi dôležitú kolekciu, zrejme homogénnu, ktorá je kľúčová pre staršiu fázu mladého paleolitu a szeletien. Poukazuje na to množstvo hotových listovitých hrotov, polotovarov, odpadov z ich výroby a pod. Na druhej strane je problematická kvôli tomu, že bola získaná počas starších výskumov, nálezy sú tak bez kontextu. Ide taktiež chronologicky o starú kolekciu a uvedomujeme si, že nemožno od nej

očakávať výsledky, ako z nálezov z mladších období. Problematické bolo hlavne uloženie nálezov v depozitári, resp. jeho prekladanie, vďaka čomu vznikli recentné stopy na nálezoch a časť pôvodných stôp bola prekrytá alebo odstránená. Štúdie iných súborov poukazujú, že je možné zistiť stopy aj na starších artefaktoch zo stredného paleolitu, prípadne staršej fázy mladého paleolitu (Neruda/Nerudová/Šajnerová-Dušková 2010; Nerudová/Dušková-Šajnerová/Sadovský 2010; Šajnerová-Dušková 2009).

Predložená práca reprezentuje predbežné výsledky, ktoré treba ďalej validovať na ostatných hrotoch v kolekcii Archeologického ústavu SAV a pokúsiť sa o analýzu kolekcií z iných inštitúcií. Za hlavné predbežné výsledky považujeme:

- Analýza jednoznačne poukázala, že značné množstvo zlomenín súvisí s ich výrobou, resp. s nehodami, prípadne s recentnými zlomeninami, čo je logické, keďže sa na predmetnej lokalite listovité hroty vo veľkých množstvách vyrábali.
- Absencia stôp na hranách, ktoré by hroty interpretovali ako multifunkčný nástroj. Ide o zaujímavé zistenie, keďže sa odlišuje od záverov napr. moravských hrotov zo szeletien (Nerudová/Dušková-Šajnerová/Sadovský 2010; Šajnerová-Dušková 2009). Na druhej strane na lokalite Moravany nad Váhom-Dlhá boli doložené iné aktivity na iných nástrojoch (škrabadlá, driapadlá), takže ak by boli využívané hroty univerzálne, tak by to bolo viditeľné aj na predmetnej kolekcii. Nateraz sa však nepotvrdilo, aby hroty z analyzovanej lokality boli využívané ako multifunkčné nástroje.
- Ojedinele boli doložené stopy, ktoré naznačujú použitie počas lovu, ako napr. línie a ulomené terminálne časti. Zaujímavé sú exempláre, keď sa na jednom hrote zistila kombinácia týchto stôp, čo nemožno považovať za náhodu (napr. vzorky 6, 14, 40; tabeľa 2).

Z hľadiska interpretácie listovitých hrotov z Moravian nad Váhom-Dlhey možno skonštatovať, že mohlo ísť o špecializované nástroje používané počas lovu. Zároveň je potrebné poznamenať, že v areáli tábora sa vykonávali ďalšie činnosti spojené so spracovaním mŕtvych zvierat. Predbežná analýza škrabadiel poukázala, že sa používali na oškrabávanie kože. V niektorých ďalších prípadoch kamenných nástrojov boli zistené dokonca dôkazy o spracovaní rastlín.

Do budúcnosti by bolo zaujímavé rozšíriť trasologickú analýzu aj na ostatné typy artefaktov a identifikovať ďalšie nástroje súvisiace so spracovaním tiel zvierat, akými sú napr. nože. Prezentovaná analýza otvorila aj mnoho otázok, ktoré súvisia najmä s rozpoznávaním mikroskopických stôp. K ich jednoznačnejšej identifikácii by určite pomohlo uskutočniť sériu experimentov spojených s výrobou a použitím hrotov (rezanie, vrhanie, umiestnenie v násade a pod.), na základe čoho by sme sa mohli dozvedieť:

- aké makroskopické a mikroskopické stopy (technologické, po použití, po umiestnení v násade, pri transporte) boli zistené na experimentálnych listových hrotoch vyrobených z analogických surovín v porovnaní s artefaktmi z Moravian nad Váhom-Dlhey;
- ako druh suroviny ovplyvňuje čitateľnosť mikroskopických technologických stôp, stôp po opotrebovaní alebo po umiestnení v násade;
- aký je rozdiel medzi makroskopickými fraktúrami špičiek listových hrotov odlomených počas lovu a pri ich výrobe.

Obr. 1. Situovanie lokality Moravany nad Váhom-Dlhá na mape.

Obr. 2. Moravany nad Váhom-Dlhá. Variabilita listovitých hrotov. 1 – unifaciálny, ojedinele retušovaný len na hranách (vzorka 9); 2 – čiastočne bifaciálny (vzorka 8); 3 – bifaciálny (vzorka 58).

Obr. 3. Moravany nad Váhom-Dlhá. Detaily negatívov šikmých fraktúr špičiek listovitých hrotov. 1 – „spin-off“ fraktúra (vzorka 12); 2 – fraktúra ukončená ohybom (vzorka 20); 3, 4 – „spin-off“ a fraktúra ukončená ohybom (vzorka 11); 5 – perovito ukončená fraktúra (vzorka 21); 6 – fraktúra ukončená ohybom (vzorka 53).

Obr. 4. Moravany nad Váhom-Dlhá. Detaily stôp na listovitých hrotoch. 1 – lineárna stopa (A) vzorky 15; 2 – fraktúra špičky hrotu (A) a lineárna stopa (B) vzorky 14; 3 – fraktúra špičky hrotu (A) a vyhladená časť pravdepodobne po kontakte s kosťou (B) vzorky 40.

Obr. 5. Moravany nad Váhom-Dlhá. Detaily stôp na listovitých hrotoch. 1 – fraktúra ukončená schodíkom (A) a vyhladená časť (výsledok umiestnenia v násade prípadne transportu; B) vzorky 54; 2 – fraktúra ukončená ohybom (A) a vyhladená časť (výsledok umiestnenia v násade prípadne transportu; B) vzorky 3; 3 – vrub (A) a vyhladená časť (výsledok umiestnenia v násade prípadne transportu; B) vzorky 33.

Obr. 6. Moravany nad Váhom-Dlhá. Detaily ulomených špičiek listovitých hrotov. 1 – funkčná fraktúra (?); 2 – technologická fraktúra (šípka ukazuje na pätku); 3 – postdepozíčná fraktúra (?). 1, 2 – vzorka 64; 3, 4 – vzorka 36; 5, 6 – vzorka 35.

Obr. 7. Moravany nad Váhom-Dlhá. Stopy na celých a takmer celých listovitých hrotoch vo vzťahu k ich variantom a vyhotovenia v rámci operačného reťazca. Legenda: a – lineárne stopy; b – umiestnenie v násade/transport; c – fraktúra špičky; d – bez stôp; e – postdepozíčné stopy; f – spolu.

Obr. 8. Moravany nad Váhom-Dlhá. Stopy na ulomených špičkách a fragmentoch listovitých hrotov vo vzťahu k ich variantom. Legenda: a – lineárne stopy; b – umiestnenie v násade/transport; c – fraktúra špičky; d – bez stôp; e – postdepozíčné stopy; f – spolu.

Tabela 1. Moravany nad Váhom-Dlhá. Varianty listovitých hrotov vo vzťahu k ich fragmentácii a vyhotovenia v rámci operačného reťazca.

Tabela 2. Moravany nad Váhom-Dlhá. Makroskopické a mikroskopické stopy na listovitých hrotoch. xx – problém s identifikáciou stôp z dôvodu vážne poškodeného povrchu vplyvom postdepozičných procesov alebo hrubozrného povrchu suroviny.

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