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Use-wear analysis of the lithic assemblage from LGM Mohelno-Plevovce site (southern Moravia, Czech Republic)

Analyse fonctionelle de l'assemblage lithique du site de Mohelno-Plevovce LGM (Moravie méridionale, République tchèque)

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ABSTRACT

The Mohelno-Plevovce site, located in Moravia (Czech Republic), has yielded two stone structures that represent the remains of two different short occupations. The chronology of these occupations situates them in the midst of the Last Glacial Maximum, and the techno-typological features of the lithic assemblages link them with the recently defined 'Epi-Aurignacian with Sagaidak–Muralovka-type microliths'. High power use-wear analysis of representative lithic samples from the two stone structures has been carried out to understand site function and the particular uses made of the different tool types represented at the site. The results of the use-wear analysis are used to test whether these occupations represent the archaeological signatures of pioneer populations that reoccupied the Moravia region, which had previously been abandoned by human populations due to the climatic hardships of the Last Glacial Maximum.

RÉSUMÉ

Le site de Mohelno-Plevovce localisé en Moravie (République tchèque) a fourni deux structures de pierre qui représentent les restes de deux occupations courtes différentes. La chronologie de ces occupations les situent au milieu du dernier maximum glaciaire et leurs traits technotypologiques les relient à l'« Épi-Aurignacien avec des microlites de type Sagaidak–Muralovka ». L'analyse fonctionelle de haute puissance d'échantillons lithiques représentatifs des deux structures de pierre a été entreprise pour tenter de comprendre la fonction du site et les utilisations particulières des différents types d'outils représentés sur le site. Les résultats de l'analyse fonctionelle ont été utilisés pour tester si ces occupations représentent les signatures archéologiques de populations pionnières qui ont réoccupé cette région de Moravie, précédemment abandonnée en raison des épreuves climatiques dues au dernier maximum glaciaire.

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1. Introduction

During the Last Glacial Maximum (LMG), the British-Irish, the Scandinavian, and the Alpine Ice Sheets reached their maximum extension ca. 26.5–19 ka (Böse et al., 2012; Clark et al., 2009); in most of Europe climatic conditions were very harsh although there was some degree of variation (Monegato et al., 2017). Above latitude 45° N the mean temperatures throughout the year were below 0 °C (Jost et al., 2005). These conditions, together with an expansion of the periglacial environment, gave rise to a number of polar deserts where human presence was very difficult. As a result, wide areas of Europe were progressively abandoned, including present-day England, northern France, Belgium, the Netherlands, northern Germany, most of Poland, Czech Republic and Slovakia (Jochim et al., 1999). Recently, several sites in eastern and central Europe bearing the same non-Gravettian/non-Epigravettian Early Late UP industry have been grouped under the 'Epi-Aurignacian with Sagaidak–Muralovka-type microliths' (EASMM) label (Demidenko et al., 2017, 2017b; see also Demidenko, 2008). Some of these sites (Sagaidak I, Muralovka in eastern Europe, and Rosenburg, Mohelno-Plevovce in Central Europe) have been dated between ca. 25.5–23 ka (Demidenko et al., 2017, 2017b; Škrdla et al., 2016), which coincides with the harsher climatic moments of the LGM (Böse et al., 2012). In the Moravian region there is a Gap between Gravettian and this EASMM industry (Škrdla et al. 2016). We interpret this gap as an abandon of the region during the harshest moments of the LGM.

The site of Mohelno-Plevovce, situated in parallel 49 (Fig. 1), presents two assemblages, originating from two clearly-separated occupation areas, and represented by stony structures KSA and KSB (Fig. 2), which perfectly fit into the EASMM assemblage definition. The two units corresponding with short human occupations are separated only by a 3–4-meter distance. Moreover, the two stony structures were apparently disjointed as no refits were found between the lithics from the two find spots, whereas many pieces could be refitted inside each individual area. The two occupation areas have been directly dated to 22,830 ± 159 cal BP (18,970 ± 110, Poz-76195) for KSA, and 23,013 ± 175 cal BP (19.100 ± 110 BP, Poz-76196) for KSB (calibrated using CalPal, ver. 2016.2 on IntCal13 curve; Demidenko et al., 2017, 2017b). At that time, the ice sheet was located ca. 300 km north (Böse et al., 2012) from the site.

The KSA lithic assemblage is composed of ~1000 items, while ~5000 items do constitute the KSB lithic assemblage. Both assemblages are characterized by a variable use of

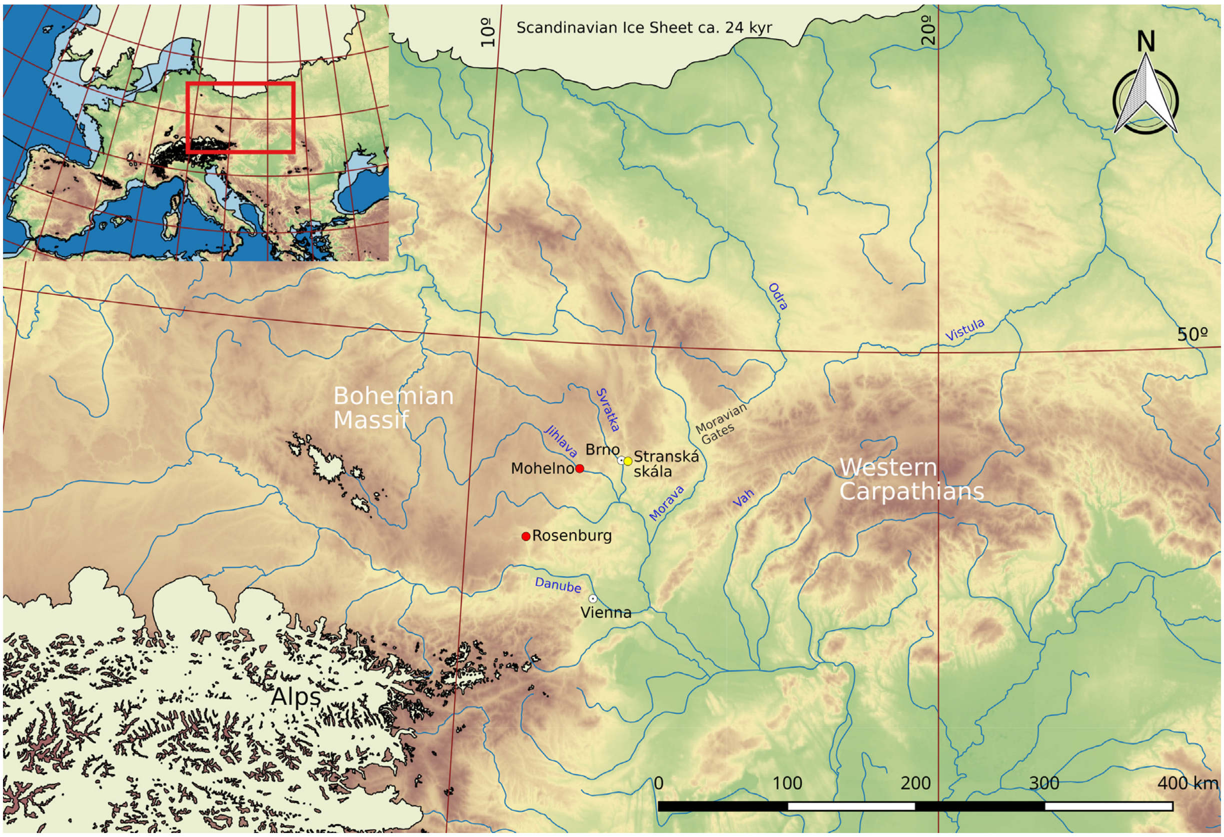


Fig. 1. Location map. Base cartography obtained from the European Environment Agency. Rivers and bathymetry obtained from Natural Earth. Alpine and LGM glacial sheets obtained from Becker et al., 2015.

Fig. 1. Carte de localisation. Carte basique de l'Europe fournie par l'European Envrionment Agency. Rivières et bathymétrie obtenus de Natural Earth. Extension des inlandsis et glaciers alpines pendant le LMG obtenus de Becker et al., 2015.

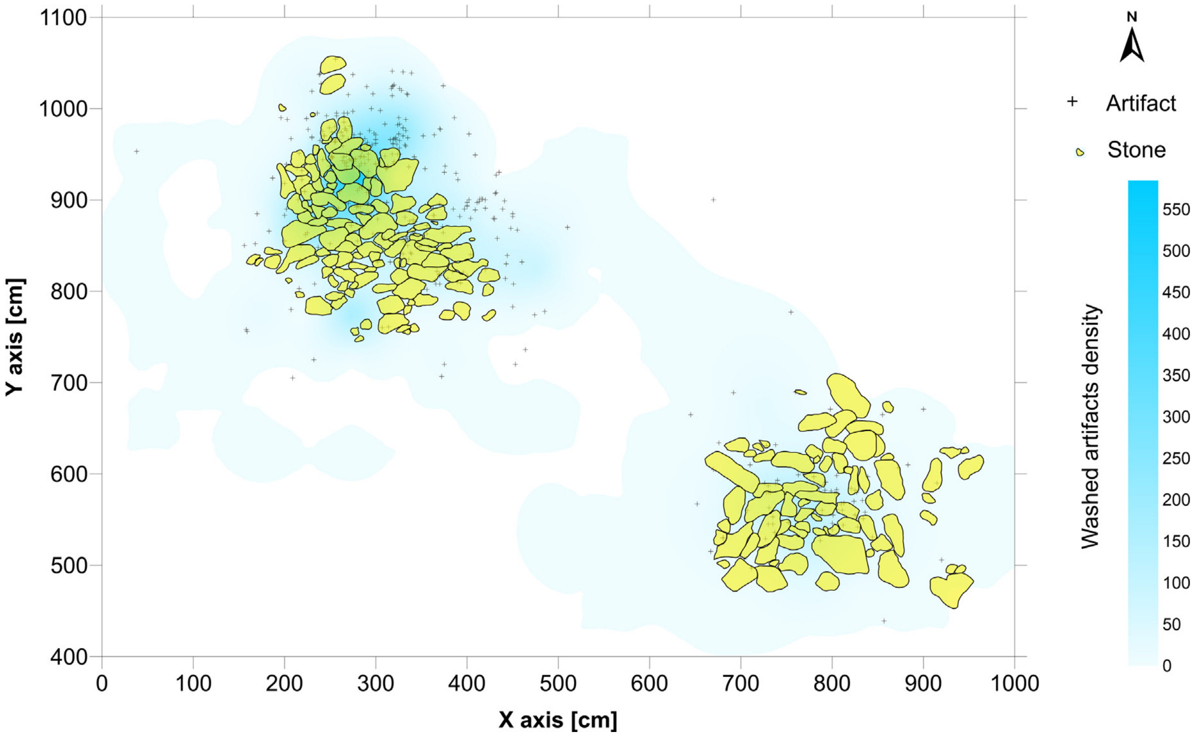


Fig. 2. Excavation plan. Stone structure KSA (right) and stone structure KSB (left) (Škrdla et al., 2016).
Fig. 2. Plan d'excavation. Structure de pierre KSA (à droite) et structure de pierre KSB (à gauche) (Škrdla et al., 2016).

local (mainly, rock crystal and quartz) and imported (basically, erratic flint and radiolarite) raw materials. In KSA imported raw materials compose the ∼70% of the material, while in KSB it is only the ∼10%. The long distance transport of lithic raw materials (erratic flint: 150–200 km to the northeast; and radiolarite: 250 km to the southeast) has been attested at Mohelno-Plevovce, in this case combined with some local resources found less than 1 km from the site. Other close raw materials, like for example the Stránská Skála Jurassic chert (∼30 km), commonly used in the regional MP and Early UP (Přichystal et al., 2003), were not used at all.

Both assemblages are characterized by the microlitization of the toolkit, and are especially significant given the presence of marginally retouched elongated chips within them (Demidenko et al., 2017, 2017b). Despite the differences in the raw material composition both assemblages are quite similar. The most remarkable particularity is the use, in KSB, of bipolar anvil core technology on quartz and rock-crystal for the production of chips some of them transformed into Sagaidak–Muralovka-type microliths. In both assemblages the proportion of micro-chips and micro-fragments is very high > 80% (Škrdla et al., 2016, Table 1). Retouched tools are very scarce in KSA microliths, which represent more than 60% of the total while microliths represent a little less than in KSB 50% (Škrdla et al., 2016, Table 2).

The lithic assemblage of Molheno-Plevoce is characterized by the small size of artefacts and by the simplicity of the production system (Demidenko et al., 2017, 2017b; see also Demidenko, 2008). It can be described as having a non-blade, flakey technology, oriented towards the serial production of elongated chips (no more than 1.5 cm long) and microblades. The majority of the cores are carinated atypical endscrapers, accompanied by a few bladelet/microblade cores. This 'micro-debitage' was oriented towards the production of tiny 'pseudo-Dufour'/'Sagaidak–Muralovka'-type microliths. These tools are defined by the presence of lateral/bilateral dorsal fine marginal abrasion retouch and by their slightly curved, non-twisted profiles. Other typical Upper Paleolithic tool

Table 1
Summary of the analyzed pieces from KSA.
Tableau 1
Résumé des pièces analysées de KSA.

KSA				
Type	Flint	Rock crystal	Total	Preserved use-wear
Endscraper	1		**1**	1
Carinated end-scraper	3		**3**	1
Burin	2		**2**	2
Truncation	1		**1**	0
Borer	1		**1**	1
Microlith	38		**38**	10
Retouched chip		1	**1**	1
Elongated chips and bladelets	15		**15**	5
Burin spall	1		**1**	0
Splint	1		**1**	1
Total	**63**	**1**	**64**	22
Preserved use-wear	21	1	22	

Table 2
Summary of the analyzed pieces from KSB.
Tableau 2
Résumé des pièces analysées de KSB.

KSB						
Type	Flint	Plasm	Radiolarite	Rock crystal	Total	Preserved use-wear
Endscraper				1	**1**	1
Carinated endscraper	5	1		2	**8**	4
Notched blade				1	**1**	1
Retouched blade			1		**1**	0
Splintered Piece	5			1	**6**	5
Microlith	20	1	2	11	**34**	17
Elongated chips and bladelets	3			6	**9**	4
Total	**33**	**2**	**3**	**22**	**60**	32
Preserved use-wear	**15**	**1**	**0**	**16**	**32**	

types are also present here (e.g., simple endscrapers, and various rather rare non-multifaceted burins), with the presence of a specific type of burin on lateral retouch representing one of the assemblage's most distinctive features. In addition, the Mohelno-Plevovce KSA and KSB assemblages are characterized also by the use of an additional bipolar anvil core technology, used to exploit rock crystal and some erratic flint and radiolarite objects.

The chronology of these occupations, and the fact that they represent an *ex novo* industry type in the region suggest that these are the remains left behind by pioneer populations that started exploring the Moravian region during the LGM, maybe as a result of a temporary amelioration of climatic conditions. The archaeology of pioneer populations in the Paleolithic is a complex issue due to the usual low degree of resolution of the archaeological records and sequences left behind by these groups. The incursions into unknown territories are always risky so human groups decide to do this either forced by special circumstances or because they expect a great return. Entering these new lands means that landscapes are not well known and that available resources are less predictable. One of the closest models discussed about the occupation of territories where the presence of the ice sheets was less of a deterrent is that of the colonization of southern Scandinavia (Riede, 2009). According to this model, several of the following features should be expected: a limited knowledge of the landscape; a focus on a few resources; high residential and logistic mobility; low regional variation; short-term, multi-task and redundant occupations; adapted technological features, comprising a few highly portable, good quality raw materials; long use-life tools, or a simple technology comprising a few tool types and small-medium sized tools (Riede, 2009: 4). Within this context, microlithic production and use represent a strategy against the risks associated with unknown territories because they provide a reliable technology that requires fewer amounts of raw material and transportation costs (Kuhn and Elston, 2002).

Based on these criteria, it appears the site of Molheno-Plevoce fits perfectly within the above model. Therefore, the primary aim of this paper is to explore, through a use-wear analysis of the lithic assemblages, the function of the two occupations at (KSA and KSB), and to assess whether they fit into a specialized camp (logistic) or a multi-task camp (residential) model (following Binford, 1980). We will also investigate the function of microlithic tools to better understand their role and adaptive value for high-mobility populations. Previous use-wear analyses of the flints at the eastern European site of Muralovka have proposed that these microliths were mainly parts of composite 'domestic tools' used for scraping and piercing (Filippov, 1977). This proposal, however, created a paradox, because if we exclude these microliths as possible hunting technology elements these industries contain no good lithic candidates to fulfil this specific need.

2. Material and methods

The Mohelno-Plevovce lithic pieces were softly cleaned with water and soap, in case they presented soil deposits, and with alcohol (70°) applied with a cotton swab. This alcohol cleaning was repeated as many times as was necessary. The analysis was carried out using Nikon SMZ1500 stereomicroscope, and incident light microscope Nikon LV100 up to 200x magnifications. Images were captured with a CCD camera Nikon DSFI1 with NIS software, and then processed with GIMP and Inkscape image. The identification of the activities was made using a well-established procedure for flint analysis (González Urquijo and Ibañez Estévez, 1994). Extensive literature on use wear-analysis on flint (see Marreiros et al., 2015 and the references therein), and personal experimental reference and image database collection have been used for wear identification following the same criteria established for other use-wear analyses carried out for Middle and Upper Paleolithic lithic collections (Ortega et al., 2006; Rios-Garaizar, 2008, 2010, 2012; Rios-Garaizar and Ortega, 2014; Rios-Garaizar et al., 2003; Normand et al., 2008). No specific experiments have been made on erratic flint wear formation since, in previous works, we have not observed significant differences in wear formation among different flint types. For the identification of wear traces in rock-crystal we used archaeological and experimental references (Fernández-Marchena and Ollé, 2016; Pignat and Plisson, 2000).

The identification of diagnostic impact fractures (DIF) and other impact-related micro-wear was done following the classic works by Fischer et al. (1984), Moss (1983),

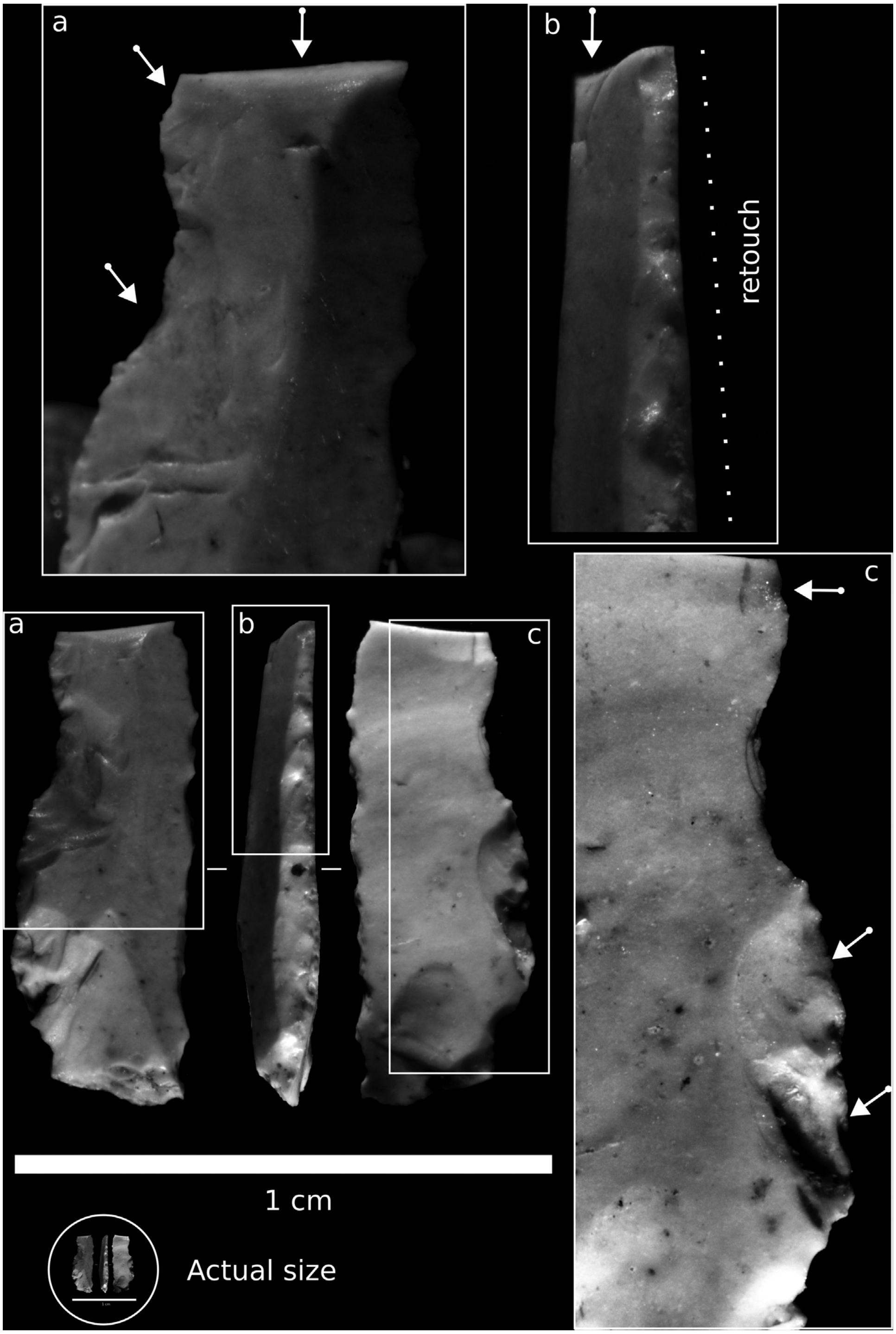


Fig. 3. Example of impact traces identified in a microlith from KSB. Distal bending fracture with hinge termination and lateral oblique scarring (a). Distal bending fracture cutting the retouched back (b). Lateral oblique scarring and lateral burinations (c).

Fig. 3. Exemple de traces d'impact identifiées dans un microlite de KSB. Fracture en flexion distale avec terminaison en charnière et écaillement oblique latéral (a). Fracture en flexion distale recoupant le dos retouché (b). Écaillement oblique latéral et burinage latéral (c).

and Dockall (1997). We have also considered the cautions mentioned by Rots and Plisson (2014) in order to avoid a misinterpretation of fractures, and follow the terminology proposed by Coppe and Rots (Coppe and Rots, 2017; Tomasso et al., 2018). The number and combination of impact traces have been used as criteria for establishing the degree of confidence in the interpretation of the pieces as armatures. In Mohelno-Plevovce collections the most common DIF are burinations and distal bending fractures. Also, in this collection, the presence of lateral oblique crushing is remarkable, but only those associated with DIFs have been recorded as possible impact related fractures. Also, when considering retouched microliths, the fractures affecting the retouch were considered as being more diagnostic, because this way we exclude possible confusion with fractures developed by knapping (Fig. 3).

The interpretation of identified wear traces in terms of site function and settlement dynamics is a complex issue given the fragmentary nature of the archaeological record. Models derived from ethnographic record have been used, with some limitations, for the interpretation of archaeological assemblages (Binford, 1978, 1979, 1980; Ibañez and González, 1996). This study follows the integral lithic analysis approach (Nelson, 1991; Perles, 1992; Rios-Garaizar, 2007), which has been already applied to different Middle Paleolithic and Upper Paleolithic assemblages (Ortega et al., 2006; Rios-Garaizar, 2008, 2011, 2012; Rios-Garaizar and Ortega, 2014).

Samples from the KSA and KSB collections were analyzed (Tables 1 and 2, respectively). An extensive macroscopic analysis of the whole collection was done in order to identify major alteration processes that could compromise the use-wear analysis, and to select pieces with potential use-wear. After this initial observation, the major technological and typological features of the collection were considered. The sampling procedure was oriented towards obtaining a good representation of both assemblages. Tools made on different raw materials (flint, rock crystal, plasm, radiolarite) were selected for analysis. Also, special attention was paid to retouched tools, particularly microliths, but non-retouched flakes, blades and elongated chips were also analyzed. As a result, a sample comprising 64 pieces from KSA (Table 1) and 60 pieces from KSB (Table 2) was selected for the macro and micro-wear analyses. Considering that the size of both assemblages, after taking out the micro fragments and chips (according to the numbers published in Škrdla et al., 2016), is quite small (KSA: 177; KSB: 592), and that the number of formal tools is also low (KSA: 37; KSB: 80) the samples analyzed here are representative of the assemblage composition.

Table 3
Activities identified in KSA, according to the lithic raw materials.
Tableau 3
Activités identifiées en KSA, d'après les matières prémieres lithiques.

KSA			
Activities	Flint	Rock crystal	Total active zones
Cutting soft	1		**1**
Cutting antler	2		**2**
Cutting medium organic	2		**2**
Cutting indeterminate	2		**2**
Scraping dry hide + ocher	1		**1**
Scraping antler	3		**3**
Grooving hard organic	1		**1**
Boring hard	1		**1**
Boring indeterminate		1	**1**
DIF	11		**11**
Used indeterminate	1		**1**
Total active zones	**25**	**1**	**26**

The lithic assemblages from KSA and KSB are relatively well preserved. In both occupation areas there are signs of chemical alteration, such as weathering or patina, and a few pieces exhibit even more severe alterations, for example a radiolarite core and a splintered piece from KSB with signs of corrosion caused by a chemical attack. This chemical alteration, when present, affects the preservation of use-related traces, which, in turn, hampers the degree of confidence of the wear observations and interpretation. Mechanical alterations causing the abrasion of the edges, ridges and surfaces of some of the pieces have also been observed mostly in KSA, where also post-depositional fractures have been identified in four pieces from the selected sample. The overall good preservation of the surfaces of the analyzed pieces reinforces the validity of the observations and interpretations made.

3. Results

KSA: The activities noted in KSA (Tables 3 and 4) through the use wear analysis are quite varied and include cutting,

Table 4
Activities identified in KSA, according to the tool types.
Tableau 4
Activités identifiées en KSA, d'après les types d'outils.

KSA									
Activities	Endscraper	Carinated endscraper	Burin	Borer	Microlith	Retouched chip	Elongated chips and bladelets	Splint	Total active zones
Cutting soft							1		**1**
Cutting antler			1				1		**2**
Cutting medium organic				2					**2**
Cutting indeterminate							1	**1**	**2**
Scraping dry hide + ochre		1							**1**
Scraping antler			2				1		**3**
Grooving hard organic			1						**1**
Boring hard				1					**1**
Boring indeterminate						1			**1**
DIF					10		1		**11**
Used indeterminate	1								**1**
Total active zones	1	1	**2**	**1**	**10**	**1**	**5**	**1**	**26**

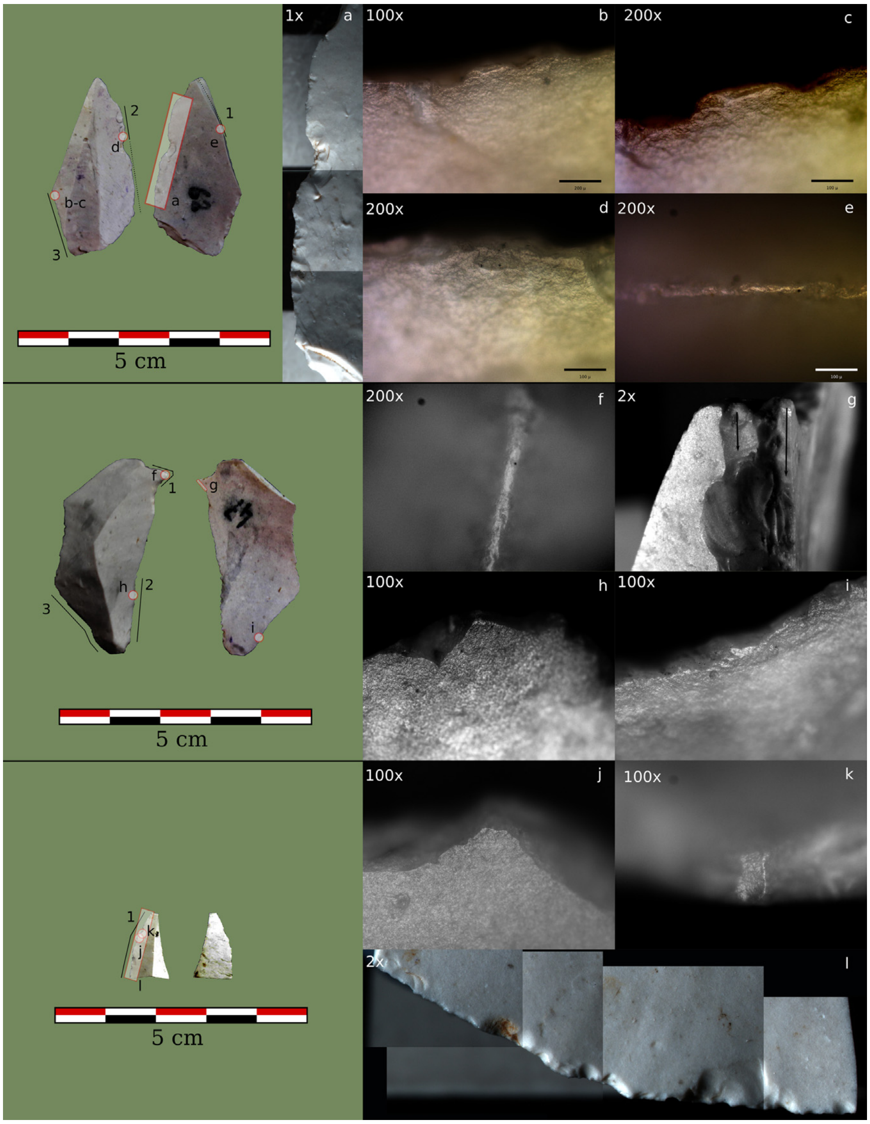


Fig. 4. KSA pieces used in medium-hard organic materials (bone, antler). Top: burin on lateral retouch. 1. Scraping medium-hard organic material: e: compact polish restricted to the very edge of the burin facet. 2. Cutting medium-hard organic material: a: bifacially distributed trapezoidal and semi-circular scars, with step terminations; d: poorly developed polish with some compact undulated patches around the scars. 3. Scraping medium-hard organic material: b and c: unifacial scars, compact polish restricted to the edge. Middle: borer. 1. Boring hard material: f: compact and bright polish developed on a ridge; g: Axial fractures cutting the retouch located on the very tip of the borer. 2–3. Cutting medium organic material: h: Isolated compact and rather undulated polish patches located in detached points of the edges. Bottom: non-retouched bladelet distal fragment. 1. Cutting medium-hard organic material: j and k: compact and undulated polish patches located in detached points of the edges, usually in the ridges between scars; l: bifacially distributed semi-circular scars with feather and step terminations.

Fig. 4. Outils de KSA utilisés dans des matériaux moyennement durs (os, bois de cervidé). Sommet : burin sur retouche latérale. 1. Grattage du matériau organique moyennement dur, poli compact limité au tranchant de la facette du burin. 2. Découpe du matériau organique moyennement dur : a : écaillures trapézoïdales et semi-circulaires réparties bifacialement avec terminaisons abruptes ; d : poli peu développé, avec quelques taches ondulées compactes autour des écaillures. 3. Grattage du matériau organique moyennement dur : b et c : écaillures unifaciales, poli compact limité au tranchant. Milieu: perçoir. 1. Perforation du matériau dur ; f : poli brillant et compact développé sur une arête : g : fractures axiales coupant la retouche à léxtremité du perçoir. 2–3. Découpe du matériau organique moyennement dur : h : taches isolées de poli compact et plutôt ondulé, localisées sûr les arêtes. Bas : fragment distal du lamelle non retouché. 1. Découpe du matériau organique moyennement dur : j et k : taches de poli ondulé et compact, localisées sûr les arêtes, en général sur les arêtes entre les écaillures ; l : écaillures semi-circulaires réparties bifacialement avec des terminations afinés or en escalier.

scraping, grooving and boring of different materials, and also pieces with traces related to projectile use. Most of the pieces were used for medium-hard organic (bone and antler) material working, except the microliths with DIF, a carinated atypical endciescraper with indeterminate use, a chip used for cutting soft material and a carinated atypical endscraper with dry hide scraping traces.

Medium-hard organic work includes cutting, scraping, grooving and probably boring. Five pieces were used in these activities. There are two complex pieces with

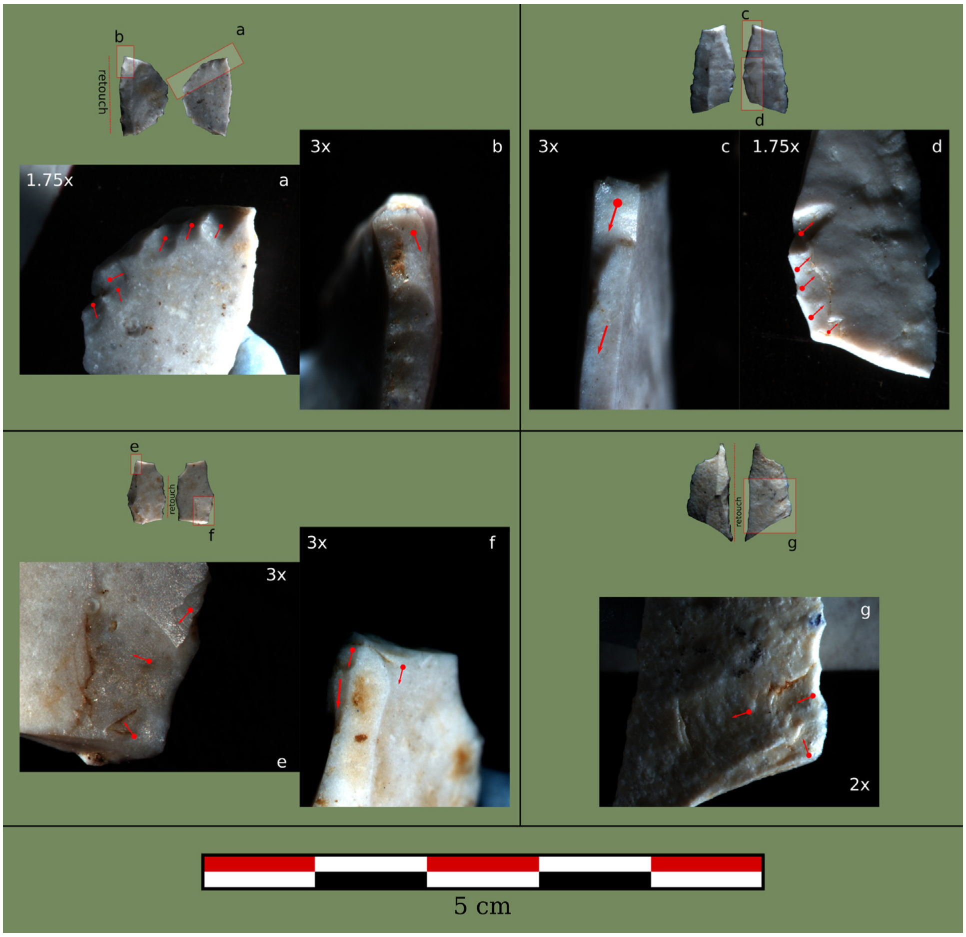


Fig. 5. KSA microliths presenting Diagnostic Impact Fractures (DIF). Top left: complex bending fracture with cone initiated and feather termination spin-offs (a), burin like spin-off cutting the retouched back (b) and lateral scarring. Top right: bending feather fracture with well-developed burin-like spin-off (c) and lateral oblique scarring (d). Bottom left: lateral oblique scarring (e), and distal bending feather fracture with burin like spin-off (f). Bottom right: proximal bending complex fracture including step bending fracture and lateral oblique scarring.

Fig. 5. Microlites de KSA présentant des fractures d'impact diagnostiques (DIF). En haut à gauche : fracture de flexion complexe avec initialisation en cône et finalisation afinée (a), fracture burinant coupant le dos retouché (b) et écaillement latéral. En haut à droite : fracture de flexion avec termination afinée, avec fracture burinant bien développée (c) et écaillement oblique latéral (d). En bas à gauche : écaillement oblique latéral (e), et fracture de flexion distale avec termination afinée et fracture burinante (f). En bas à droite: fracture proximale de flexion complexe comportant une fracture de flexion avec termination en escalier et un écaillement oblique latéral.

several active zones. One of these pieces is a burin on lateral retouch with three active zones used for working a medium-hard organic material, probably antler (Fig. 4, top). The burin plane and the plane created by a proximal fracture were used for medium-hard organic material scraping, while the opposed edge for cutting medium-hard organic material. Interestingly, a bladelet obtained from a burin-like core, made on a similar flint variety, also has traces of medium-hard organic material scraping on the edge corresponding with the burin plane. The other piece is an elongated flake that has a small borer in the distal end (Fig. 4, middle). This was used for boring a hard material, while the two lateral edges were used for cutting a medium organic material, probably antler. The other two pieces used in this kind of materials are a burin on lateral retouch, used for grooving a hard organic material, and a non-retouched bladelet fragment used for cutting a medium organic material, probably antler (Fig. 4, bottom).

The microliths analyzed from KSA were only made on erratic flint and used as projectile weapon armatures. A single unretouched elongated chip also has diagnostic projectile fractures. Most of the pieces ($n = 7$) show a combination of axial fractures (burinations and bending fractures) and lateral oblique scarring (Fig. 5). Three of them present only bending fractures (Table 5). Lateral oblique scarring always appears on the edge opposite to the retouched back suggesting that the back was the inserted edge while the non-retouched edge was the exposed part. All the microliths with DIF are fragmented, with only a few of them presenting partially preserved the distal part, and only one example is clearly pointed. Nevertheless, the abundance of axial fractures (10 pieces) suggests that direct, axial damage was also caused, and that perhaps some of these armatures were also pointed.

KSB: The activities identified in KSB (Tables 6 and 7) are also varied and include cutting, scraping, grooving and chiseling of different materials. As is the case in KSA, there are also microliths used as armatures, but on this occasion also include erratic flint and rock crystal elements.

The worked materials at KSB are different from KSA. The presence of hide working traces is quite noteworthy although these usually appear in heavily-curated and recycled pieces, probably indicating that these activities were not carried out at the site but elsewhere. An example of this are three carinated atypical endscrapers that retain hide scraping related traces on the convex edges, which, in turn, were also used to obtain elongated chips (Fig. 6, top, middle). These traces are discontinuous because they were interrupted by a final resharpening/production phase, which very likely carried out at the site. The morphology of the pieces seems to be heavily transformed by use and resharpening. These pieces are short, the front is not positioned in the very distal edge of the original support, the delineation of the scraper front is irregular, with several retouch steps, and they exhibit traces previous to the last resharpening/production episode. Another clear example of this is a two fragment splintered piece that reuses an endscraper previously used for working dry hide (Fig. 6, bottom). This is also the case of another splintered piece that retains dry hide scraping traces from a previous use. There are other pieces that were used for scraping abrasive materials, probably dry hide, including two carinated atypical endscrapers made on rock crystal (Fig. 7a and b). Other pieces have traces linked to the working of hard minerals, perhaps ochre, but traces are not sufficiently developed to be adequately identified with more precision. Ochre lumps have been recovered from both loci (Škrdla et al., 2016).

Three splintered pieces were used for chiseling medium-hard organic materials, probably bone or antler, while in two additional pieces the worked material could not be precisely identified. As mentioned earlier, two of the splintered pieces, made on flint, had been recycled from tools previously used for hide scraping. The other two splintered pieces made on flint are more elongated and do not show previous use-wear traces. Finally, there is a rock-crystal splintered piece with indeterminate use wear traces (Fig. 7c). This is why it is possible that the latter splintered pieces were in fact bipolar anvil cores.

The microliths analyzed from KSB were mainly used as armatures ($n = 11$), although several pieces were used in other activities such as cutting soft ($n = 1$) and indeterminate materials ($n = 3$) (Fig. 7), hard organic grooving ($n = 1$), whereas for two rock crystal microliths the precise activity could not be determined ($n = 2$). The types of pieces

Table 5
DIF types in KSA microliths.
Tableau 5
Types de DIF dans des microlites de KSA.

KSA	Bending snap	Bending feather	Bending hinge	Bending step	Bending complex	Burination	Lateral oblique scarring	Spin off	Flute like fracture	Total
Flint			1			1				2
Flint			1				1			2
Flint					1					1
Flint		1				1	1			3
Flint					1		1			2
Flint			1				1		1	3
Flint				1			1			2
Flint					1					1
Flint		1				1	1			3
Flint				1						1
Flint					1					1
Total	0	2	3	2	4	3	6	0	1	

Table 6
Activities identified in KSB, according to the lithic raw materials.
Tableau 6
Activités identifiées en KSB, d'après les matières prémieres lithiques.

KSB				
Activities	Flint	Plasm	Rock crystal	Total active zones
Cutting soft	1			**1**
Cutting mineral	1			**1**
Cutting indeterminate	1		5	**6**
Scraping hide	1			**1**
Scraping dry hide	4	1		**5**
Scraping mineral	1			**1**
Scraping abrasive			2	**2**
Scraping indeterminate			2	**2**
Grooving hard organic	1			**1**
Chiseling medium-hard organic	3			**3**
Chiseling indeterminate	1		1	**2**
DIF	6		5	**11**
Used indeterminate	1		3	**4**
Total active zones	**21**	**1**	**18**	**40**

Table 7
Activities identified in KSB, according to the tool types.
Tableau 7
Activités identifiées dans KSB d'après les types d'outils.

KSB							
Activities	Endscraper	Carinated endscraper	Retouched piece	Splintered Piece	Microlith	Elongated chips and bladelets	Total active zones
Cutting soft					1		**1**
Cutting mineral		1					**1**
Cutting indeterminate	1		1		3	1	**6**
Scraping hide		1					**1**
Scraping dry hide		2		3			**5**
Scraping mineral		1					**1**
Scraping abrasive	1					1	**2**
Scraping indeterminate		1	1				**2**
Grooving hard organic					1		**1**
Chiseling medium-hard organic				3			**3**
Chiseling indeterminate				2			**2**
DIF					10	1	**11**
Used indeterminate		1			2	1	**4**
Total active zones	**2**	**7**	**2**	**8**	**17**	**4**	**40**

used in these activities are usually bigger in size than the microliths with diagnostic impact traces. In terms of the microlithic armatures with DIF, six are made on flint and five on rock-crystal. Six of the pieces present a combination of bending fractures or burinations with lateral oblique scarring, while five pieces, including 4 made on rock crystal present only bending fractures or burinations (Table 8). Of the flint armatures, only two are pointed although the rest have distal fractures and probably were also pointed. If we consider the four rock-crystal microliths with DIF, two of them are pointed whereas the other two have distal fractures.

4. Comparison between the two assemblages

The KSA and KSB assemblages, despite their technological and typological similarities, which link both assemblages to the same 'Epi-Aurignacian' technocomplex and its particular industry type with Sagaidak–Muralovka-type microliths, show relevant differences. From a technological point of view, the most significant difference is the greater variety of raw materials used in KSB, especially with the inclusion of rock-crystal tools into the repertory. Considering the preserved use-wear evidence, there are also important differences in the kinds of worked raw materials (Fig. 8). In KSB 'hide + abrasive' is more prevalent, while in KSA medium-hard organic materials are better represented. This does not, however, necessarily represent actual differences in the activities carried out in both places. As we have highlighted previously, most of the traces related with hide work in KSB appear in highly curated and recycled tools, and may represent activities that did not take place at Molheno-Plevoce, but somewhere off-site. This recycling of burins and endscrapers into splintered pieces has been observed elsewhere (i.e. Beyries and Cattin, 2015) and both uses can occur at the same place. In the case of pieces from KSB, the absence of refittings corresponding to the curational phase of the endscrapers, and the fact that these pieces were made on long distance transported flint, impose some cautions about interpreting that hide working was carried out at the site. On the other hand, the working of medium-hard organic materials KSA was probably carried out *in situ*.

5. Discussion

The temporary occupation of northern Europe (above parallel 45°) during the LGM represents one of the best scenarios to test the behavior of pioneer populations in the Upper Paleolithic. The hunter-gatherer groups linked to the 'Epi-Aurignacian with Sagaidak–Muralovka-type microliths' industry type were likely behind these exploration movements, with the site of Mohelno-Plevovce in Moravia being one of the best representatives of this pioneering process. Moreover, the site of Mohelno-Plevovce represents a particular settlement, with two close and coeval occupations that have two industrially very similar, albeit functionally different, lithic assemblages.

Lithic use-wear results suggest that the range of activities in both occupations was closely linked with the rearmament of hunting parties. In KSA the microliths with DIF formed a part of weapons. Given the small size of the lithic implements, the lateral back preparation, and the scarcity of pointed elements, these microliths were probably part of composite projectile weapons. They were made on distant erratic flint, and probably were substituted with other flint microliths produced at the site. This could represent an example of a hunting group arriving to a new and rather unexplored territory. In this case the technological provisioning is assured with the transported materials. The other activities identified at the site are also coherent with this interpretation. The relevance of medium-hard organic material processing could be also linked with the rearmament, but unfortunately no bone/antler points have been recovered at the site and tools other than points could have been made/repaired at the site. In KSB, on the other hand, we mostly observe

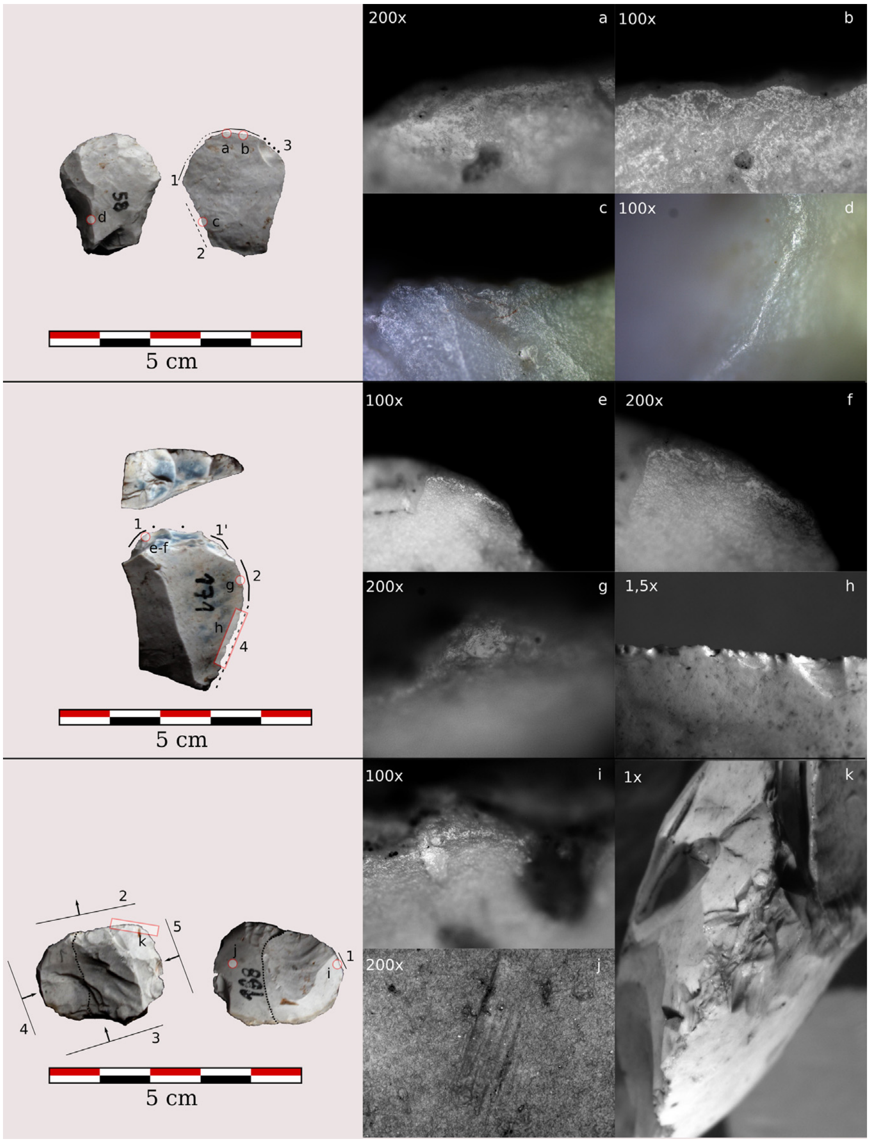


Fig. 6. KSB heavily curated and recycled pieces. Top: carinated atypical endscraper, 1. Hide scraping: a and b: edge rounding with semi-close matte polish and marked transversal linear components suggesting the use of abrasives. 2. Hard mineral cutting: c: semi-close bright polish located on the ridges between scars; d: Ridge abrasion. 3. Elongated chip final extraction. Middle: Carinated atypical endscraper. 1. Hide scraping: e and f: discontinuous matte and semi-close polish, not very invasive that creates edge rounding. 2. Hard mineral scraping: g and h: Bifacial semicircular scars with step and feather terminations associated with patches of bright and flat polish. Bottom: endscraper recycled into splintered piece (two fragments). 1. Hide scraping: i: edge rounding with semi-close matte polish and transverse linear components. 2–5. Chiseling: j: deep striae transverse to edge 5; k: battered edge.

Fig. 6. Pièces avec une longe vie outil et recyclées. Sommet : grattoir caréné atypique. 1. Grattage de peau : a et b : arrondisement du tranchant avec poli mat semi-fermé et composants linéaires transverses marqués suggérant l'utilisation d'abrasifs. 2. Decoupe de minéral dur : c : poli brillant semi-fermé localisé sur les arêtes entre les écaillures ; d : abrasion du tranchant. 3. Extraction finale d'un éclat allongé. Milieu : grattoir caréné atypique. 1. Grattage de peau : e et f : poli discontinu mat et semi-fermé, pas très invasif et créant un arrondisement du tranchant. Grattage de minéral dur : g et h : Écaillures semi-circulaires bifaciales avec termination en escalier et afiné, associés à des taches de poli plat et brillant. Bas : grattoir recyclée en pièce ésquillée (deux fragments). 1. Grattage de peau : i : tranchant arrondie, avec poli mat semi-fermé et composants linéaires transverses. 2–5. Ciselure : j : stries profondes transverses par rapport au tranchant ; k : tranchant écrassé.

a different situation. At this locus the presence of rock-crystal microliths with DIF suggests that flint was scarcer and, consequently, a local raw material was used for the rearmament of composite projectile weapons. The depletion of imported flint, also seen in the intensive use of rock-crystal, reveals that the hunting group stayed longer in the region, using occasionally the refugia of Mohelno. Interestingly, in this assemblage we have identified some pieces made on flint that reveal an extended life use. These pieces have recorded activities that were not necessarily carried out at the site, especially those related with hide work. Some of these pieces, before being discarded, were recycled for other activities, such as bone/antler chiseling. This chiseling activity could represent preliminary work

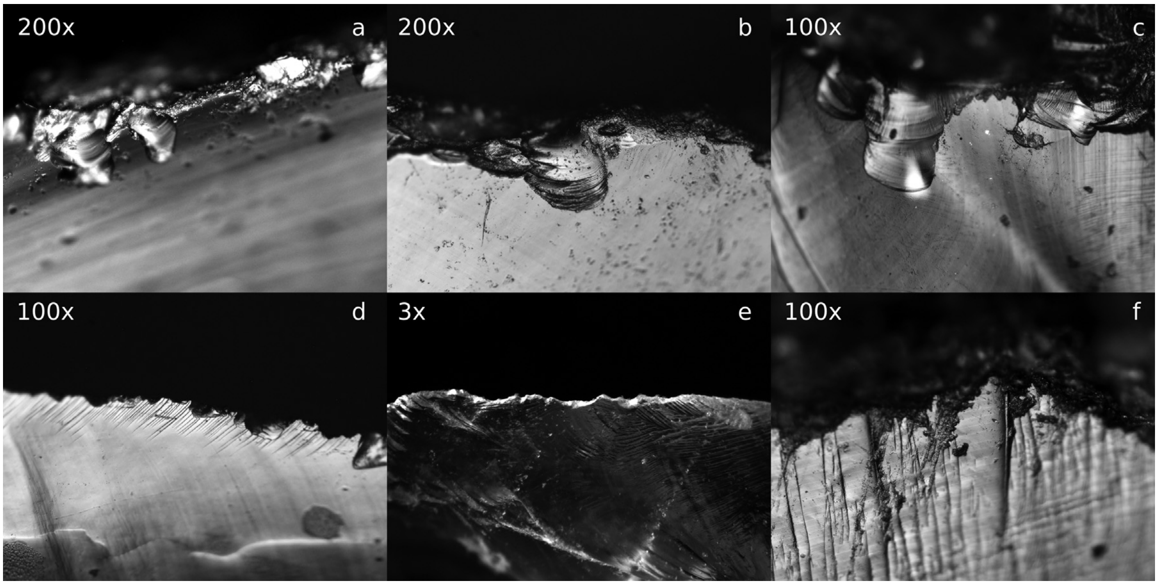


Fig. 7. KSB micro-wear developed in rock crystal artefacts. Scraping abrasion: areas of rough polish and edge rounding associated with mostly unifacial scars (a and b). Splintered piece quadrangular and trapezoidal scars with step terminations (c). Cutting: bifacially distributed semicircular and half-moon scars associated with some longitudinal striae (d and e). Scraping: edge abrasion with transverse striae (f).
Fig. 7. KSB, micro-usure développée sur des outils en cristal de roche. Grattage : zones de poli grossier et d'arrondissement du tranchant, associées à des écaillures le plus souvent unifaciales (a et b). Écaillures quadrangulaires et trapézoïdales à terminaison en escalier sur une pièces esquillée (c). Découpe: écaillures semi-circulaires et en demi-lune distribuées bifacialement, associées à quelques stries longitudinales (d et e). Grattage : abrasion du tranchant avec stries transverses (f).

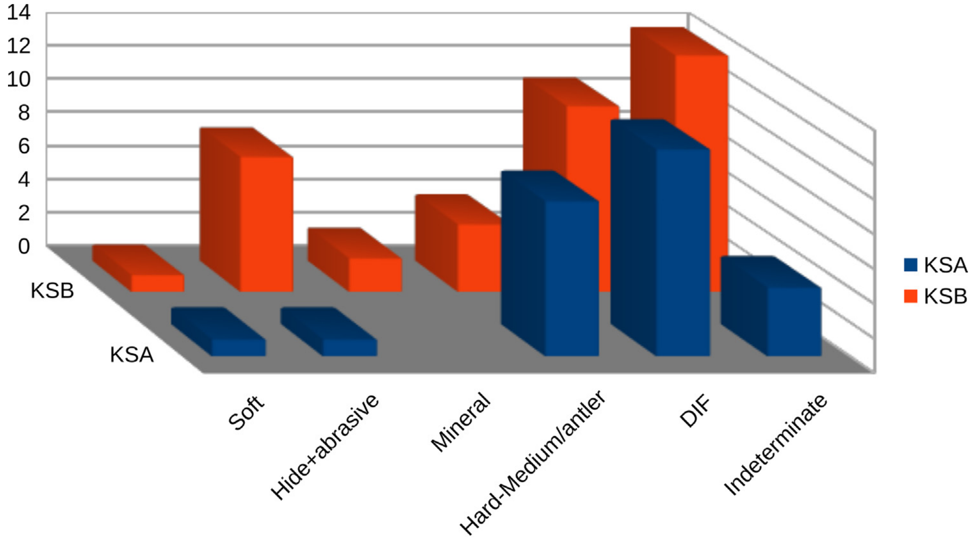
Table 8
DIF types in KSB microliths.
Tableau 8
Types de DIF dans des microlites KSB.

KSB	Bending snap	Bending feather	Bending hinge	Bending step	Bending complex	Burination	Lateral oblique scarring	Spin off	Flute like fracture	Total
Flint			1				1			2
Flint					1					1
Flint				1			1		1	3
Flint						1	1			2
Flint				1		1	1			3
Flint		1					1			2
Rock crystal				1						1
Rock crystal			1							1
Rock crystal					1		1			2
Rock crystal						1				1
Rock crystal (not retouched)			1							1
Total	0	1	3	3	2	3	6	0	1	

on recently obtained bones or antlers, maybe oriented towards the procurement of matrices for future bone tools.

The above described functions fit perfectly with the expected range of activities of a hunting group that exploits logistically a new territory. The repeated use of space, the short term occupations, the use of local raw materials when transported resources are depleted, the long life and even recycling of tools, the relevance of microlithism, and the range of activities are the expected features of an archaeological record corresponding to a hunting camp of pioneer populations (Riede, 2009). Similar re-colonization processes have been described in Siberia, where the archaeological record at the end of LGM has been interpreted as the product of small groups of highly mobile hunter-gatherers (Goebel, 2012).

Our analysis has also offered new insights on the function of microliths in this particular technocomplex. The analysis of the Muralovka assemblage carried out by Filippov (1977) suggested that the Sagaidak–Muralovka-type microliths were used in composite 'domestic knifes'. The results obtained from the Mohelno-Plevovce assemblage clearly show that this type of microliths was mainly used as composite projectile lateral elements and points. Apparently, this would indicate that these microliths have not a fixed function, but instead were used as knifes or hunting weapons in different contexts. Additionally, a test carried out on 10 Sagaidak–Muralovka-type microliths from the site of Rosenburg (Austria), revealed that two of them also had DIF, further strengthening the hypothesis of a projectile use. Nevertheless, these analyses should



	KSA	KSB
Soft	1	1
Hide+abrasive	1	8
Mineral	0	2
Medium-Hard/antler	9	4
DIF	12	11
Indeterminate	4	14
Total Active Zones	**27**	**40**

Fig. 8. Activity comparison between KSA and KSB.
Fig. 8. Comparaison d'activité entre KAS et KSB.

be extended to other assemblages to provide a more clear answer(s) to this question.

6. Conclusion

The use-wear analyses of the lithic assemblages from Mohelno-Plevovce have provided interesting information about the activities carried out within the two stone structures excavated there (KSA and KSB). In both loci the most represented task is rearming with microlithic armatures. However, there are differences between the two loci: in KSA bone and antler work has been identified, while in KSB hide scraping is more represented. Some of these activities probably were not carried out in situ because they represent earlier tasks done using heavily curated and recycled tools. These differences are also visible in other features of the lithic assemblages, for example in the use of imported erratic flint (KSA) versus the use of local rock-crystal (KSB). The characteristics of these two occupations — namely activities mostly related with re-gearing; the use of local lithic raw materials when transported tools and blanks are exhausted after a long use-life; the importance of microlith — composed tools; and the repeated short term occupations at the site — fit perfectly with the expected archaeological signature of pioneer populations, and contribute to further refining a model for the interpretation of the Last Glacial Maximum EASMM in behavioral and adaptive terms.

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