USE OF OBSIDIAN IN THE EPIGRAVETTIAN PERIOD•

OBSZIDIÁN FELHASZNÁLÁS AZ EPIGRAVETTI IDŐSZAKBAN

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Abstract

Obsidian sources in the continental Europe are known exclusively from the Carpathian basin, where the occurrences of this volcanic rock were reported from several outcrops in the north-eastern part of Hungary, Eastern Slovakia and the westernmost part of Ukraine. The three or four distinct variants of the so-called Carpathian obsidian are easy to identify by macroscopic methods: the transparent - translucent type are found in the Slovakian sources, the homogenous black and grey (and exceptionally reddish) variants are known from Hungary. The poor quality pieces from the Transcarpathian Ukraine were rarely used on the territories lying far from the source area, so in the following the occurrences of the Slovakian and Hungarian variants will be discussed.

In this paper we review the available evidences on the use of the obsidian in the Central European assemblages dated to the Epigravettian period, dated to the second half of the LGM and to the Late Glacial. The distance of the raw material transport and the intensity of the obsidian manufacture will be emphasised.

Kivonat

A szárazföldi Európában csak a Kárpát-medencéből, északkelet-Magyarország, kelet-Szlovákia és Ukrajna legnyugatibb, kárpátaljai területéről ismerünk obszidián előfordulásokat. Az úgynevezett kárpáti obszidián három vagy négy változatát szabad szemmel is könnyen el lehet különíteni: az átlátszó-áttetsző típus a szlovákiai forrásokból, az átlátszatlan fekete, szürke, vagy nagyon ritkán mahagóni színű változatok a magyarországi előfordulásokhoz köthetőek. A kárpátaljai, gyenge minőségű kőzetet eddigi adataink szerint csak elvétve használták fel a forrásterülettől távolabbi lelőhelyeken, ezért csak a szlovákiai és magyarországi típusokat tárgyaljuk.

A tanulmányban áttekintjük a közép-európai epigravetti korú régészeti lelőhelyekről ismert, az obszidián felhasználásra vonatkozó adatokat. Különös tekintettel a nyersanyagszállítás távolságára és a helyi megmunkálás intenzitására.

KEYWORDS: EPIGRAVETTIAN PERIOD, OBSIDIAN, REFITTING, RAW MATERIAL TRANSPORT

KULCSSZAVAK: EPIGRAVETTI IDŐSZAK, OBSZIDIÁN, REFITTING, NYERSANYAG SZÁLLÍTÁS

Obsidian sources in the Carpathian basin

In the continental Europe obsidian sources are found exclusively in the Carpathian basin, where occurrences of this volcanic glass were reported from several outcrops in the north-eastern part of Hungary, Eastern Slovakia and the westernmost part of Ukraine.

As very few data are available on the Palaeolithic use of the low quality obsidian from the Transcarpathian Ukraine as extralocal raw material (Dobrescu et al 2018, 124), in the following the artefacts of the Slovakian and Hungarian variants will be discussed.

We agree with the observations by Biró and her colleagues (1986, note 1) and Biró (2006, 268; 2014) the widely used term 'Carpathian obsidian' is inaccurate or even inappropriate from geographical, geological and geochronological point of view.

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In earlier paper (Markó 2014; 2017) we used the terms Slovakian, Tolcsva and Mád type for these variants easy to distinguish even after macroscopic inspections. The first variant (Carpathian I or C1) was originally reported from Viničky, Streda nad Bodrogom, Vel'ka and Malá Bara (all in Slovakia: Kaminská 1991) in pyroclastic or slope deposits. The most probable source of the transparent or translucent archaeological artefacts from the vast region of Central Europe was recently identified at Cejkov and Brehov in the Zemplínske vrchy (Janšák 1935; Přichystal & Škrdla 2015, Bačo et al. 2017), where large pieces of the same macroscopic type are found in alluvial deposit.

In the southern part of the 'obsidian region' two main macroscopic groups are distinguished (Hungarian, Carpathian II or C2 variants). The rock of grey coloured, sometimes with grey and black laminated structure (Mád type, C2E) are collected from Mád and Olaszliszka, from the eastern part of the Szerencs caldera, while the homogenous black coloured or the exceptionally rare 'mahogany', non-transparent variant is from the southern slopes of the nearby Szokolya hill at Tolcsva and Erdőbénye (Tolcsva type, C2T). The pieces, generally not larger than a fist are typically found in slope deposits.

For a more detailed petrographic and geochemical description of the different variants and their outcrops the papers by Szepesi, J. and Bačo, P. and Bačova, Z. are recommended in the same volume.

Epigravettian period

In the following we shortly review the available data (**Table 1., Fig. 1.**) on the occurrence of raw material on archaeological assemblages dated to the second half of the LGM and to the Late Glacial. In the seventies the ‘Epigravettian’ was used e.g. in Slovakia for the localities dated the older Dryas and postdating the W3 Kašov and Cejkov sites (Bárta 1970, 213), however, the according to our present understanding this term was introduced for the Late Upper Palaeolithic industries of Italy (Bartolomei et al 1979). In our view, in Central Europe the 'Epigravettian' is not a cultural entity but a chronological period, following the latest Gravettian industries, represented by the lower layer of Kašov I in Eastern Slovakia (Novák 2002).

In lithostratigraphic point of view the artefacts of this period were excavated in the uppermost loess layer, sometimes in embryonic soils, marked as h2 and h1 levels in Hungary (Pécsi 1975). The formation of these humic horizons was compared to the Laugerie and Lascaux climatic oscillations by Gábori-Csánk (1978); the former one is most probably identical with the Grubgraben oscillation described from Lower Austria and Cossautsi VI-4 and VI-2 in the Dniester valley (Haesaerts et al 2007, 36, 43).

In biostratigraphic point of view, the artefacts were associated with faunal assemblages dated to the Pilisszántó faunal phase following the division used in Hungary (Jánossy 1986) clearly dominated by reindeer and horse remains. Finally, the radiocarbon dates from the discussed sites are listed on **Table 2**. In our view, there are a number of problems with these dates:

1. The site of Moravány – Žakovska, Slovakia (Pazdur 1995) and level II excavated in layer 6a of the site of Kraków - Spadzista C2, Poland (Kozłowski & Sobczyk 1987, 12, 68) yielded single C-14 dates of the Epigravettian period. The recent measurements of the same assemblages, however, yielded much older dates, suggesting the Gravettian classification for these assemblages (Verpoorte 2002, 314; Wilczyński et al. 2015). In fact, the majority of the sites discussed in this paper is dated by a single radiocarbon age too, which can be erroneous by a number of reasons.

2. Not necessarily the rich sites are dated, which are interesting in archaeological point of view. E.g. no radiocarbon ages are published from the localities of Pilismarót - Diós and Bitóc (Dobosi 2006) which yielded more important assemblages than the dated upper yellowish layer of the Bivak cave in the northern Transdanubia, Hungary (Jánossy et al. 1957).

3. In the vicinity of the obsidian sources few palaeontological remains and clear hearths were preserved due to the intense viticulture and the Vertisol ('nyirok'). Moreover, the dated charcoal of the upper artefact bearing layer of the Kašov I site was collected from a fireplace, lying at the depth of 35 cm below the present-day surface in a forested area. At the same time, the Late Gravettian lower layer of the same site, excavated only 10-20 cm beneath the upper one (Bánesz 1969; Bánesz et al. 1991) yielded a 2000 years older age (20.700 ± 350 BP: Bánesz 1993), which may raise certain questions about the authenticity of these absolute dates. These doubts underline the opinion by L. Bánesz (1990, 10), who emphasised, that although the upper layer of this site yielded the richest collection in the Carpathian basin with unique typological composition, the geochronological background is very problematic, and therefore, the use of a 'Kašovian' term as a cultural entity would be less well-based (c.f. Svoboda & Novák 2004).

The variability of the archaeological assemblages of the Epigravettian period is best illustrated by the upper culture bearing layer of the same locality. Here a characteristic industry with numerous backed bladelets were documented during the 1960 and 1967 excavations on the northern part of the site (Bánesz 1961, 778; 1961a, 220; 1969: 287; 1990, 16).

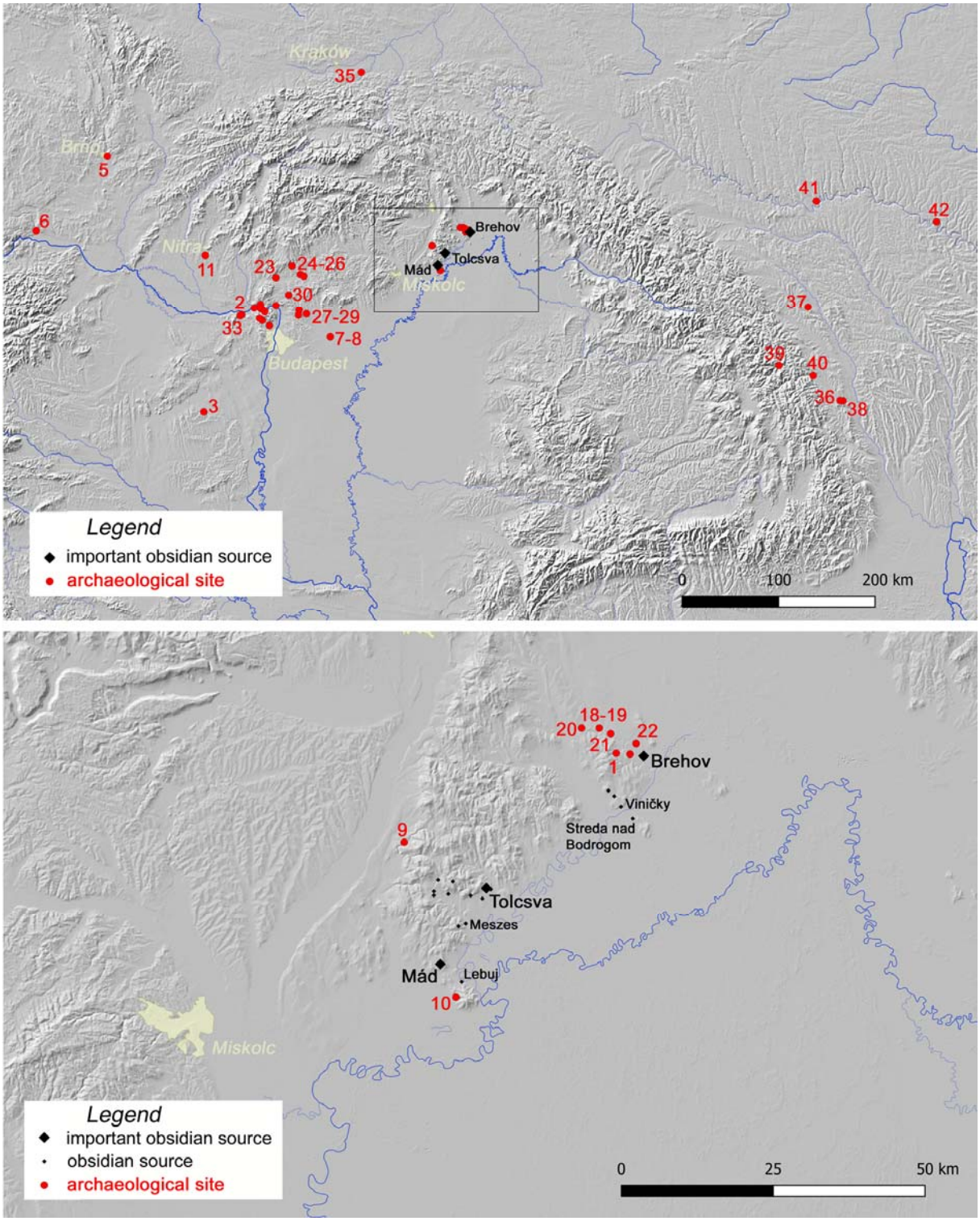

Fig. 1.: The sites mentioned in the text (Map by B. Holl, for the numbering see: **Table 1**.).

1. ábra: A szövegben említett lelőhelyek (Térkép: Holl Balázs, a számozás feloldása az **1. táblázat**ban)

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Table 1.: The distance of the archaeological sites from the obsidian sources

1. táblázat: A lelőhelyek távolsága az obszidián nyersanyag forrásoktól

	Site name	Slovakian type (C1)	Tolcsva type (C2T)	Mád type (C2M)
1	Kašov I	4 km	31 km	45 km
2	Mogyorósbánya	251 km	220 km	210 km
3	Ságvár	335 km		
4	Szob	229 km	198 km	188 km
5	Stránska skála IV	360-385 km		
6	Grubgraben	450 km		
7-8	Jászfelsőszentgyörgy	181 km	148 km	135 km
9	Arka - Herzsa-rét	42 km	15 km	20 km
10	Tarcal	50 km	19 km	6 km
11	Nitra III	240-275 km		
12	Pilismarót - Öregek-dűlő	230 km	200 km	188 km
13	Dömös	228 km	197 km	186 km
14	Verőce	215 km		
15	Esztergom - Gyurgyalag	236 km		
16-17	Pilismarót - Diós, Bitóc	231 km	200 km	189 km
18-19	Hrčeľ – Pivničky, Nad baňou	9 km	32 km	47 km
20	Vel'aty	11 km	31 km	46 km
21	Kysta	7 km	33 km	47 km
22	Zemplínske Jastrabie	3 km	35 km	49 km
23	Vel'ka Ves nad Iplom	205-167 km		
24	Kiarov	181-143 km		
25	Kováčovce	178-139 km		
26	Slovenské Ďarmoty	190-151 km		
27	Acsa - Viszoki hill		163 km	
28	Kálló - Puszta hill	190 km	157 km	145 km
29	Galgagyörk - Kelemen föld	198-153 km		
30	Romhány	199-157 km		

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Table 1. cnt.

1. táblázat folytatás

	Site name	Slovakian type (C1)	Tolcsva type (C2T)	Mád type (C2M)
31	Pilisszántó rockshelter			190 km
32	Bivak cave	235 km		
33	Jankovich cave	253 km		
34	Kiskevély cave	230 km	198 km	186 km
35	Targowisko	200 km		
36	Buda			438 km
37	Udeşti	358 km		
38	Lespezi-Lutărie	422-440 km		
39	Bistricioara-Lutărie III	349-368 km		
40	Piatra Neamț - Pietricica	386-405 km		
41	Voronovitsa I	360-398 km		
42	Cossauti	481-516 km		

At the same time, these elements are practically absent from the central and southern part of the excavated territory (Bánesz 1980, 30); e.g. in the published assemblage, excavated during the 1979 and probably 1972 seasons there is a single backed blade and two bladelets with micro-retouch (Bánesz et al. 1992, 15).

Similarly, the different ratio of backed elements in the assemblages of Pilismarót and Esztergom led Gy. Lengyel (2018, 9) to place the sites into the Early and the Late Epigravettian industries, respectively. However, the artefact-bearing layers of Pilismarót - Pálrét and Esztergom - Gyurgyalag were documented in the same embryonic soil and both the malaco-biostratigraphic evaluation and the radiocarbon dates of these sites perfectly agree (Ringer & Schweitzer 1983; Krolopp, E. 1983; 1991; Hertelendi 1991; Sümegi & Krolopp 2000, Table 1). In fact, the boundary between the Early and Recent Epigravettian in Italy is postdated to 16 ka cal B.P. (based on the data from Riparo Tagliente, NE Italy, Veneto: Tomasso 2017, 17, 18), showing that each dated assemblage discussed in this paper is contemporaneous with the Early Epigravettian of Italy.

In the following we will use the chronological and archaeological framework developed by V. Dobosi (1996; Dobosi & Szántó 2003) based on the lithostratigraphic and radiocarbon dates from Hungary. According to this schema the Pebble Gravettian industry is associated with the h2 embryonic soil 20-19 ky radiocarbon dates. Another, more heterogeneous group of assemblages (younger blade industries) were basically excavated in the younger h1 level and are dated to around16 ka. These periods seemingly fit well to the Stránská skála and Plevovce phases, which, together with the third Vídeňska phase were recently suggested for the chronological division of the sites in Moravia (Škrdla et al. 2014).

Table 2.: Radiocarbon dates from the assemblages discussed in the paper
2. táblázat: A dolgozatban tárgyalt lelőhelyek radiokarbon koradatai

site	lab.code	material	age	ref.
Esztergom - Gyurgyalag	Deb–1160	charcoal	16,160 ± 200 BP	Hertelendi 1991
Kašov I, upper layer	Gd – 6569	charcoal	18.600 ± 390 BP(?)	Bánesz 1992
Stránská skála IV	GrN-13945	bone	18.220 ± 120 BP	Svoboda 1991
Stránská skála IV	GrN-14351	bone	17.740 ± 90 BP	Svoboda 1991
Ságvár, upper layer	GrN-1959	charcoal	17.760±150	Vogel & Waterbolk 1964
Ságvár, lower layer	GrN-1783	charcoal	18.900±100	Vogel & Waterbolk 1964
Ságvár, 'cultural layer'	Deb–8821	charcoal	19.770±150	Krolopp & Sümegi 2002
Ságvár, 'cultural layer'	Deb–8822	mollusc shell	18.510±160	Krolopp & Sümegi 2002
Mogyorósbánya	Deb-1169	charcoal	19.930±300	Dobosi 1992
Mogyorósbánya	Deb-9673	charcoal	19.000±250	Dobosi & Szántó 2003
Bivak cave, upper yellowish layer	Gd-15614	bone	15.970±207 B.P	Pazonyi 2006
Targowisko	Poz-14691	charcoal	14.790±80 BP	Wilczyński 2009
Targowisko	Poz-14693	charcoal	13.720±70 BP	Wilczyński 2009
Targowisko	Poz-14692	charcoal	14.790±70 BP	Wilczyński 2009
Targowisko	Poz-14694	charcoal	14.520±70 BP	Wilczyński 2009
Targowisko	Poz-14695	charcoal	14.820±70 BP	Wilczyński 2009
Jászfelsőszentgyörgy - Szúnyogos, lower layer	DEB-1674	bone	18.500±400 BP	Hertenedi 1993
Arka – Herzsa-rét, lower layer	GrN-4038	charcoal?	17.050±350 BP	Vogel - Waterbolk 1964
Arka – Herzsa-rét, upper layer	GrN-4218	charcoal from a hearth	13.230±85 BP	Vogel - Waterbolk 1967
Arka – Herzsa-rét, lower layer?	A-518	charcoal	18.600±1900 BP	Haynes et al 1966
Grubgraben KS 1	GrN-21902		18.380±130 BP	Zöller 2000
Grubgraben KS 2	GrN-21529		18.890±140 BP	Zöller 2000
Grubgraben KS 3	GrN-21530		18.920±180 BP	Zöller 2000
Grubgraben KS 3+4	LV-1660		18.170±300 BP	Zöller 2000
Grubgraben KS 4	AA-1746		18.960±290 BP	Zöller 2000
Grubgraben KS 4	LV-1680		18.400±330 BP	Zöller 2000
Grubgraben KS 4	GrN-21531		19.380±90 BP	Zöller 2000

Table 2., cont.

2. táblázat folytatás

site	lab.code	material	age	ref.
Buda, lower layer	GrN-23072		23.810±190 BP	Tuffreau et al. 2018
Buda, level C	OxA-29525	bone	23.300±160 BP	Tuffreau et al. 2018
Buda, level C	OxA-29526	bone	23.440±160 BP	Tuffreau et al. 2018
Lespezi - Lutărie layer II	Bln-805	charcoal	17.620±320 BP	Tuffreau et al. 2018
Lespezi - Lutărie layer II	OxA-31557	bone	18.500±110 BP	Tuffreau et al. 2018
Bistricioara - Lutărie	DeA-7465		16.949±57 BP	Anghelinu et al. 2018

The use of obsidian in the archaeological assemblages

The upper artefact-bearing layer of Kašov I yielded more than 43 thousand lithic artefacts, dominantly made of obsidian. Although the site is lying in the immediate vicinity of the Brehov and Cejkov obsidian occurrences, in the time of the publication only the outcrops of Viničky and Streda nad Bodrogom were known, which led the authors to suppose a non-local source (Bánesz et al 1992, 9). For the time being, only 5.2% of the lithics collected from 4.8% of the excavated surface was published in details (Bánesz et al 1992) and the ratio of the different obsidian variants is not known; probably a comprehensive evaluation of this large assemblage in the future will give new data on the raw material, typological and intra-site variation of the locality.

The Pebble Gravettian sites (Ságvár and Mogyorósbánya in the Transdanubia, Szob in the Danube bend and Madaras in the southern part of the Great Hungarian Plain) form a fairly homogenous group of assemblages both in stratigraphic and archaeological point of view. The obsidian artefacts (Markó 2017), dominantly made of the Slovakian (C-I) variant, introduced to the site as tools (end scrapers, retouched blades), cores in the advanced stage of exploitation and possibly, very rarely as nodules. The intense on-site bladelet production from typical cores and burin-cores, moreover, the rejuvenation of transversal burins or burins on end scrapers is evidenced from the assemblage of Mogyorósbánya, lying at a distance of 250 km from the source area. According to our data in the lower layer of Ságvár only single atypical pieces were found of the same variant. Finally, the Hungarian (Tolcsva and Mád type) obsidian are represented by tools in Mogyorósbánya and Szob.

In the Brno basin, Moravia, the site of Stránska skála IV is the single locality dated to this period (Stránska skála IV phase by Škrdla et al. 2014). In the rather uncharacteristic assemblage a single atypical retouched tool of obsidian is also found (Svoboda 1991, 34, Obr. 20, 17).

From the site of Grubgraben, Lower Austria a unique end-scraper of transparent obsidian was reported, probably from the main artefact bearing layer 3 (Brandtner 1996, 129, Taf. VI, 13; Neugebauer-Maresch et al. 2008, 113). Based on the lithostratigraphic observations (Grubgraben oscillation: Haesaerts et al 2007) and the radiocarbon ages (**Table 2.**) the artefact-bearing layer could be contemporaneous with the Mogyorósbánya site.

The lower artefact-bearing layers of the sites at Jászfelsőszentgyörgy in the northern part of the Great Hungarian Plain (Dobosi 1993, 2001) were excavated in a loess layer, associated by a 'cold' malacofauna, underlying the sediment deposited under milder conditions (Sümegi 2005, 225-232.). Contrary to the objection by Lengyel (2008-2009, 253, 258-259) the single radiocarbon date from the Szúnyogos site perfectly agrees with the lithostratigraphic dates of the artefact-bearing layer.

Although the assemblages of the localities are contemporaneous in stratigraphic point of view, certain differences are observed in the use of the obsidian raw material. In the Székes-dűlő assemblage the four artefacts of Mád-type obsidian (**Fig. 2.**) document the local core reduction. In the lower layer of the neighbouring Szúnyogos site fifty pieces (including two burins and an end-scraper) were made of the Slovakian obsidian, which is represented by a single flake fragment at Székes-dűlő. Additionally, four pieces are made of the Tolcsva and two of the Mád-type obsidian.

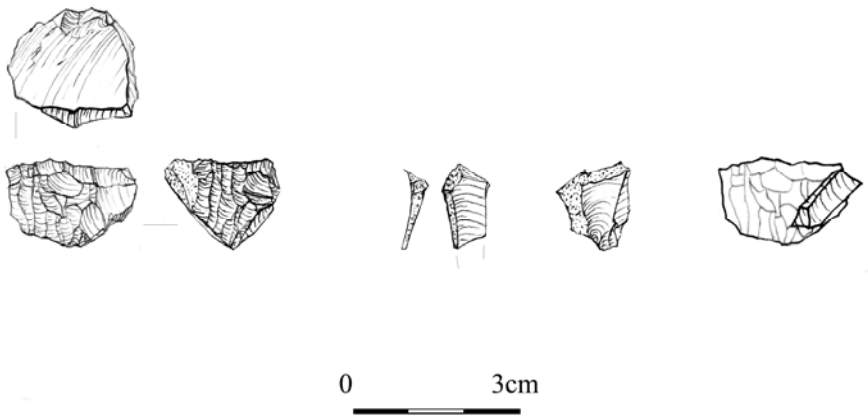

Fig 2.: Jászfelsőszentgyörgy – Székes-dűlő: refitted obsidian artefacts from the lower layer (drawing: Katalin Nagy)

2. ábra: Jászfelsőszentgyörgy – Székes-dűlő: összeilleszthető obszidián eszközök az alsó rétegből (rajz: Nagy Katalin)

The lithic assemblages from the important Upper Palaeolithic site of Arka, lying in the Hernád / Hornád valley, Northern Hungary belong probably to the same period. The artefacts of this locality were collected partly from two artefact bearing layers underlying a fossil soil horizon of unknown age, partly during the surface collections. The list of the characteristic forms (Vértes 1965, 348; 1964-65, 102-103) reflects important differences in the ratio of the backed elements or the carenoid pieces of each assemblage. From the surface collection a 'Willendorf type' shouldered point as well as a leaf shaped scraper, similar to the pieces from the lower layer of the Szeleta cave were reported. No information is published about the place of recovery of the rather atypical *fléchette* and the backed points with flat ventral retouch, published by Gy. Lengyel (2016) as diagnostic pieces for the Late Gravettian. Regrettably, the interpretation of the radiocarbon dates from the site (**Table 2.**) is rather problematic (Lengyel 2008-2009, 251-253), however, it seems to be clear, that if sample A-518 was collected from a charcoal concentration lying 25 cm above the lithics belonging to the lower layer and 75 cm beneath the charcoal layer from where the 13 ka old sample (GrN-4218) was collected (Lengyel 2008-2009, 253), this later one is reasonably linked to the upper archaeological layer. Moreover, although the field observations published by the excavator (Vértes 1962, 143; 1964-1965, 82) raised certain questions on the nature of the site formation processes, the radical conclusions by Lengyel (2018, 15) claiming that the "Pleistocene layers were severely reworked by cryoturbation down to the andesite bedrock" are unrealistic. In fact, the upper level of the slope loess and the upper artefact-bearing layer was most probably disturbed by the frost, however, in the lower part of the same layer instead of polygonal pattern root-channels with carbonate infill were found. Furthermore, the documented pits from both layers (Vértes 1962, Plate IX, 2) and the circular feature of the upper level (Vértes 1962, 145-147, Abb. 2, Plate IX, 4; Bild 1a) does not support the hypothesis of intense and deep cryoturbation.

Unfortunately, the assemblages have not been published yet, and the recent cultural classification, based exclusively on the analysis of the armatures, more precisely on the points (Lengyel 2016) is not convincing. In the future the detailed study of the whole assemblages, including the domestic tools (reaching 78.7% of the typical pieces from Arka: Lengyel 2016, Table 1) and the pieces of 'Aurignacian character', the raw material types used on this locality, as well as the documented features will certainly shed new light on this important locality.

Following the data given by K. Biró (1984, 36, Table 3) 351 specimens from a total of 8543 lithics (i.e. 4.11% of the lithic assemblage) were made of Slovakian and Hungarian obsidian, including the very rare mahogany coloured type (Biró et al. 2005). We have to keep in our mind, however, that only a sample was collected from the workshop material of the local hydrothermal rocks, so this ratio could have been even lower.

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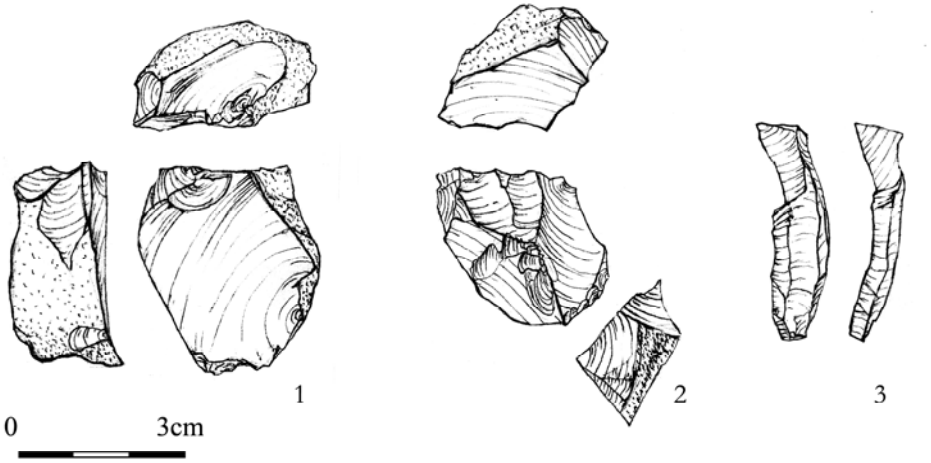

Fig. 3.: Obsidian artefacts from the Danube bend: 1-2: Verőce, former brickyard, 3: Esztergom – Gyurgyalag (drawing: Katalin Nagy)

3. ábra: Obszidián eszközök a Dunakanyarból: 1-2: Verőce, régi téglagyár; 3. Esztergem-Gyurgyalag (rajz: Nagy Katalin)

The little assemblage excavated from Tarcal (Dobosi 1974; Markó 2014), excavated in a humic layer imbedded to the uppermost loess layer. Among the obsidian artefacts of this little collection the Mád-type is the most abundant (8.29%), while the Tolcsva-type (5.80%) and the Slovakian variant (2.20%) are represented by a smaller number of artefacts, suggesting that the ratio of each variant depends on the distance of the raw material source from the locality. Unusually, 22 lithics (5.38% of the assemblage) are made of perlite, with a possible source lying at a distance of 2-3 km from the site (Lebuj kanyar at Bodrogkeresztúr). As a total, the ratio of the volcanic glasses among the chipped stone artefacts is 21,72%, which is clearly higher than it was observed in the Arka assemblage.

Finally, during the excavations of the Nitra III site in western Slovakia four flakes, a blade and a burin made of obsidian were found (Bárta 1971, 213; Kaminská & Nemergut 2014, Table 1, Fig. 8:8). The artefacts were found in the upper loess layer and the general character of the assemblage supports the Epigravettian classification.

The use of obsidian in the Danube bend - transport of raw material pieces

The Danube bend, lying north of Budapest in Hungary belongs to one of the classical regions of the Palaeolithic research in Hungary. In the 1980s and 1990s a number artefact bearing layers were excavated in the vicinity of Pilismarót and Esztergom, partly in the younger embryonic soil h1, partly in a younger sediment, on the top of the loess layer, immediately underlying the Holocene humic soil (Dobosi et al 1991; Dobosi 1996; 2006). The former assemblages, excavated in the h1 embryonic soil are stratigraphically contemporaneous with the layer excavated at Szeged - Öthalom in the 1930s and can be compared to the Plevovce phase described recently from Moravia (Škrdla et al. 2014).

In spite of the topographic proximity and the contemporaneity of the assemblages, they are very different both in the raw material and typological composition. The common points are the intense use of extralocal raw material types imported from eastern direction, including the limnic quartzite variant from Magyarkút or the metarhyolite / felsitic porphyry from the eastern part of the Bükk mountains. In the exceptional assemblage of Esztergom - Gyurgyalag the majority of the artefacts were made of Prut flint, imported to the site from the source region lying more than 600 km (Dobosi et al 1991). Obsidian artefacts were excavated at Esztergom (a single blade: **Fig. 3/3**) as well as at the localities of Diós and Bitóc I and II at Pilismarót (Dobosi 2006).

The first evidences of the transport of obsidian nodules were published by K. Biró (1984, 20) from Pilismarót - Öregek-dűlő and Dömös. However, the field documentations of the excavations carried out after the World War II are not available, and the artefacts of the former locality were collected from secondary position and later mixed during the publication (Gábori & Gábori 1957).

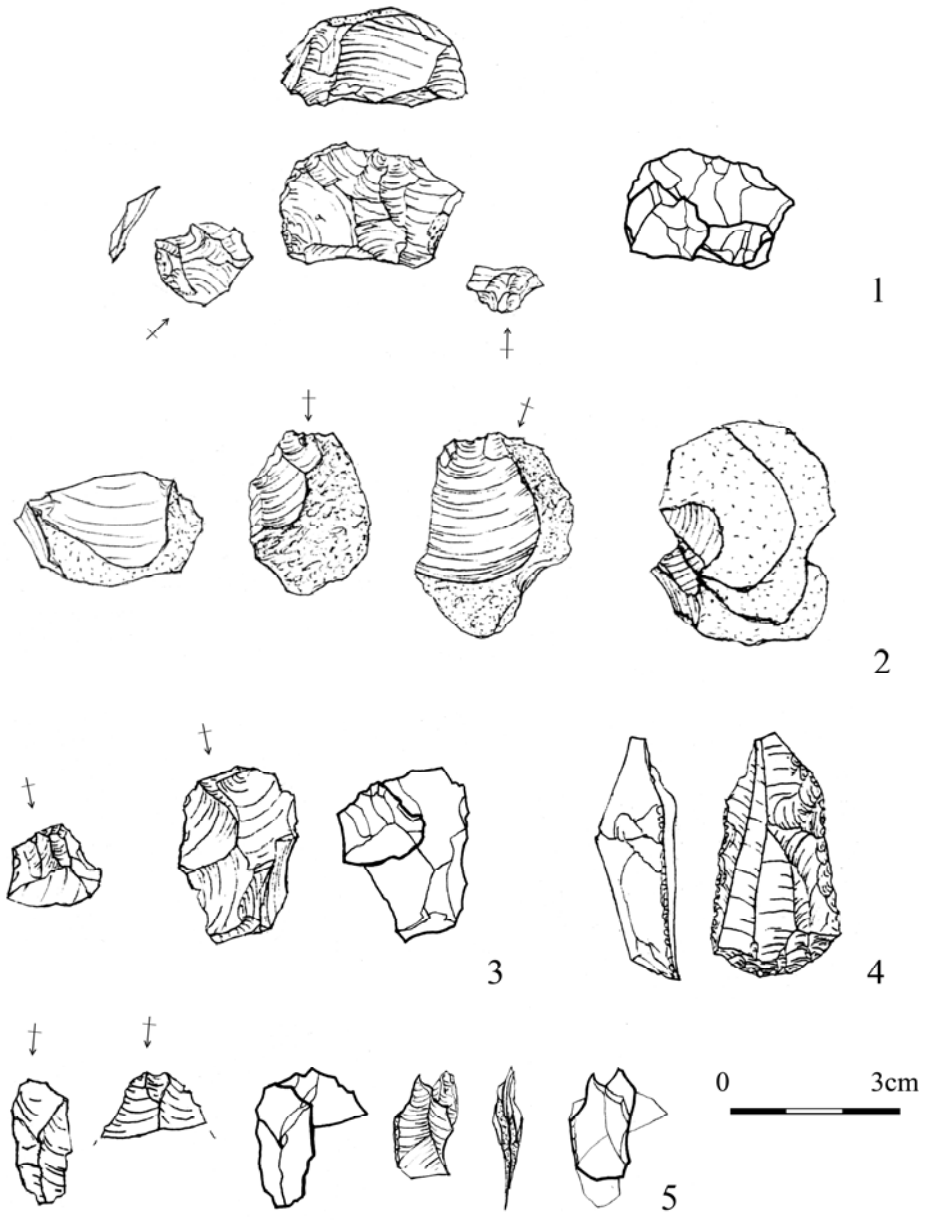

Fig. 4.: Pilismarót – Diós: 1-3, 5: refitted artefacts of Tolcsva-type (C2T) obsidian; 4: end-scraper of Slovakian (C1) type (drawing: Katalin Nagy)

4. ábra: Pilismarót – Diós: 1-3, 5: összeillesztett eszközök, Tolcsva-típusú (C2T) obszidiánból; 4: Szlovákiai (C1) obszidiánból készült vakaró (rajz: Nagy Katalin)

The artefact-bearing layer found in the uppermost loess layer in the former brickyard at Verőce yielded five pieces of obsidian (of the best quality, Slovakian variant), including a nearly half nodule and a totally exhausted core (**Fig. 3/1-2**) suggesting the complete on-site exploitation of a raw material piece, imported from more than 200 km to the site. Even if the stratigraphic data are absent in this case too, the character of the lithic industry places the site to the Epigravettian period (Markó 2002).

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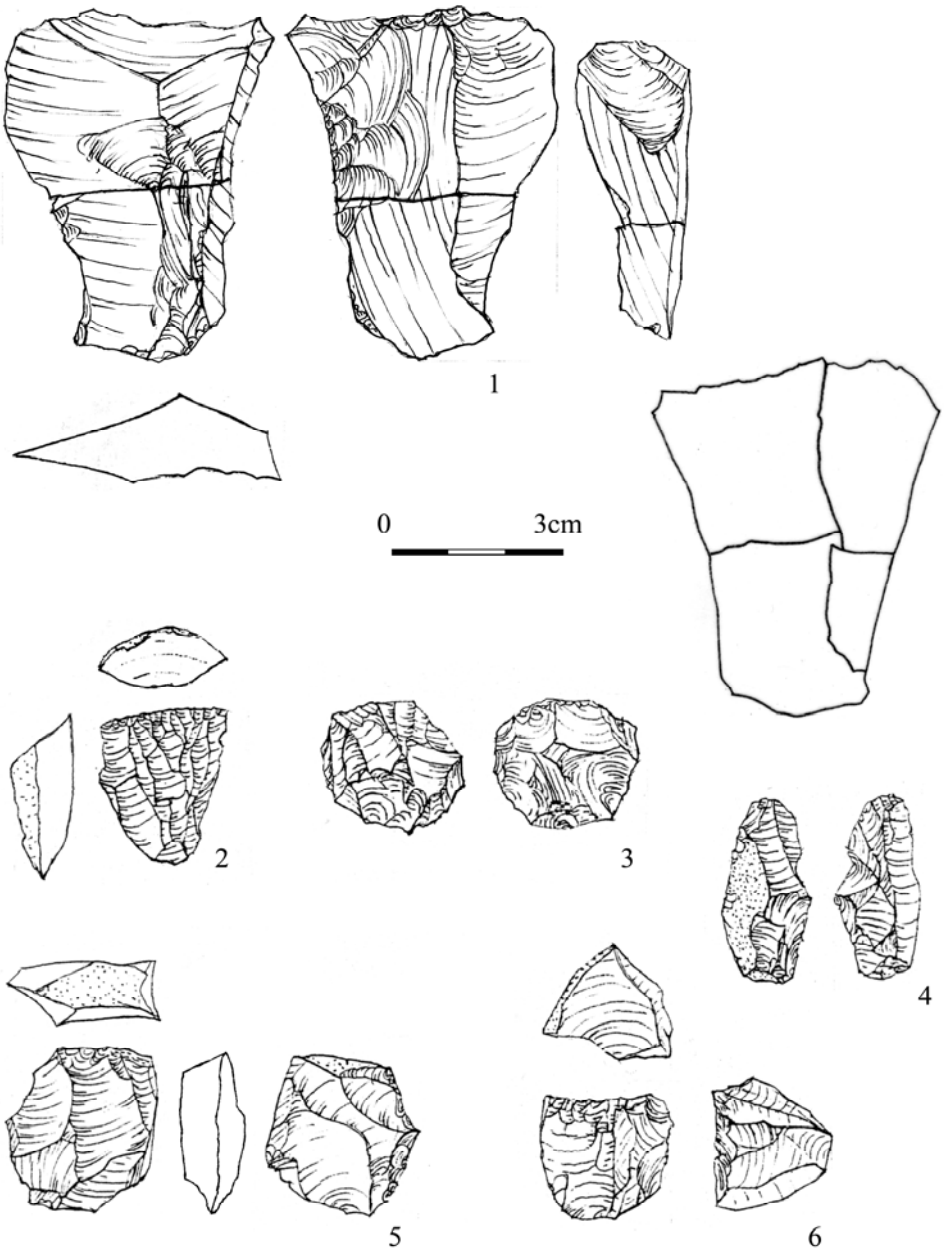

Fig. 5.: Pilismarót – Bitóc: 1: refitted artefacts; 2-6: bladelet cores and residual core of Slovakian and Tolcsva-type obsidian (drawing: Katalin Nagy)

5. ábra: Pilismarót – Bitóc: 1: összeillesztett eszközök; 2-6: mikropenge-magkövek és magkőmaradék szlovákiai és tolcsvai típusú obszidiánból (rajz: Nagy Katalin)

Around 2 per cent of the artefacts from Pilismarót - Diós are made of obsidian, but only five pieces (including an end-scraper: **Fig. 4/4**) belong to the Slovakian variant. The majority of the artefacts (16 pieces) most probably belong to a single nodule of the homogenous black Hungarian (Tolcsva) variant. According to the refit studies, the preparation of the striking platform of a core was carried out on this site (**Fig. 4/2**). Partly cortical and refitted blanks (**Fig. 4/3, 5**) removed from the same core are also present in the assemblage, however, only the last removals: two tiny chips could have been refitted to the exhausted core (**Fig. 4/1**).

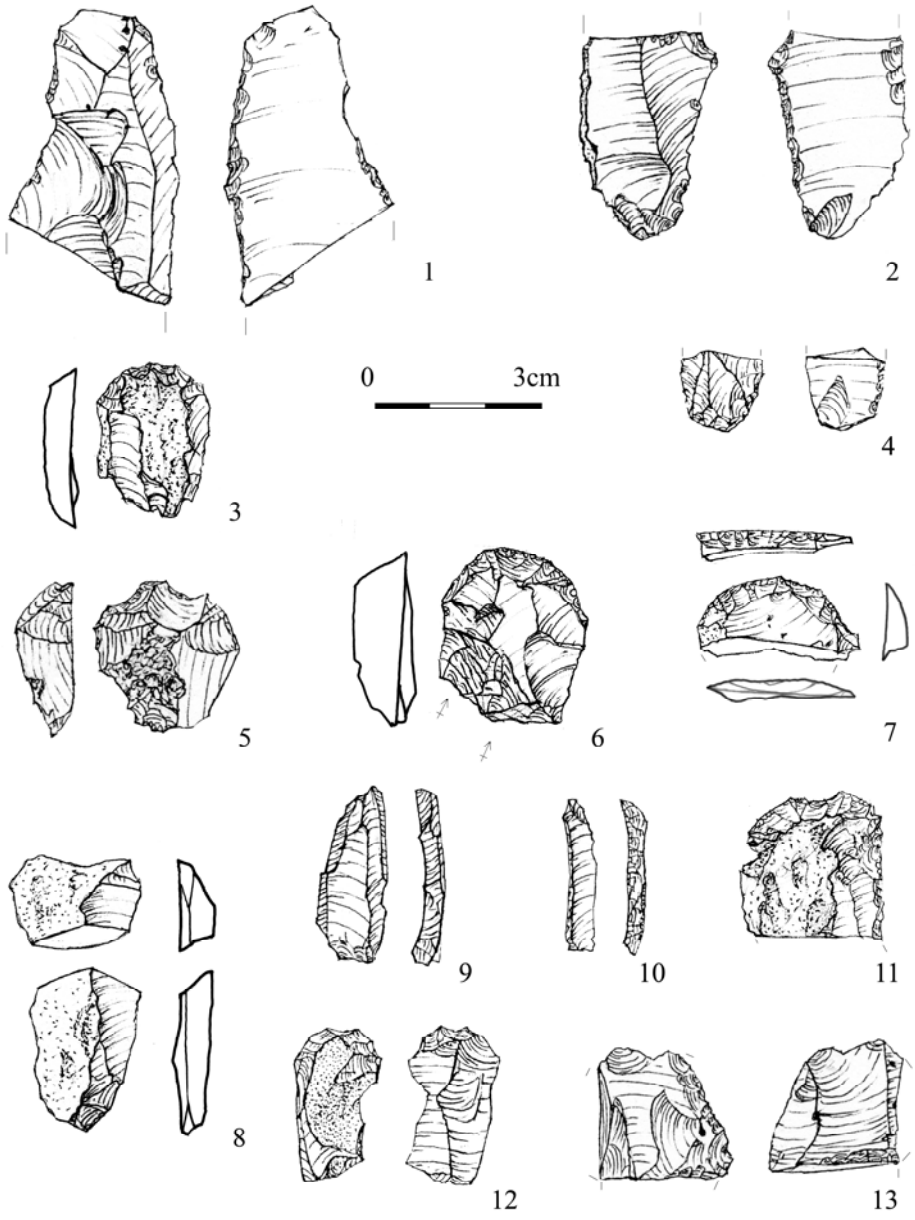

Fig. 6.: Pilismarót – Bitóc: tools and refitted cortical blade of obsidian (drawing: Katalin Nagy)

6. ábra: Pilismarót – Bitóc: eszközök és összeillesztett kortexes szilánk obszidiánból (rajz: Nagy Katalin)

Importantly, the majority of the blanks are not found in the excavated assemblage, suggesting that only the waste material was found on the site.

Finally, 21.02% of the assemblages (230 pieces) from the neighbouring Bitóc site were made of obsidian, dominantly the Slovakian (best quality, transparent) type. Refit studies proved that intact raw material pieces, flakes of natural origin were introduced to the locality. However, in some cases unsuccessful removals led to breaks and the abandonment of the pieces (**Fig. 5/1**). Besides, bladelet cores (**Fig. 5/2-6**) and formal tools like end scrapers and burins (**Fig. 6.**), as well as a large amount of waste material are also found in these assemblages.

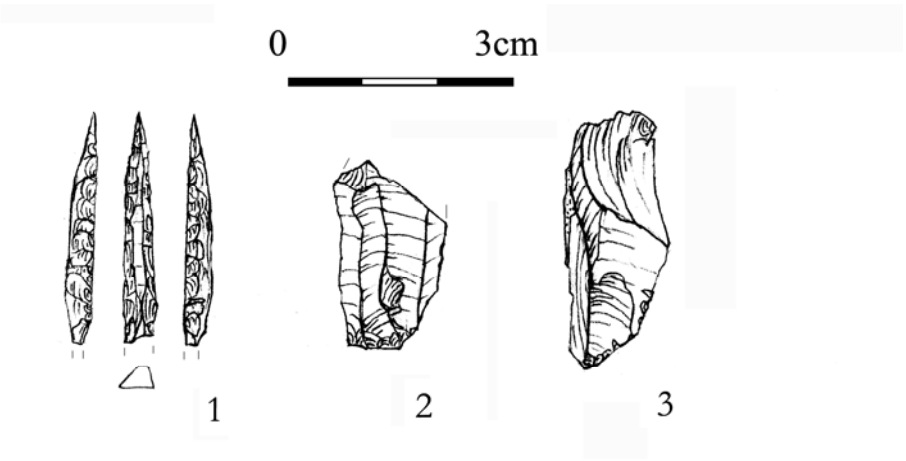

Fig. 7.: Pilisszántó I rockshelter, Bivak cave and Jankovich cave: artefacts of obsidian (drawing: Katalin Nagy)

7. ábra: Obszidián eszközök a Pilisszántó I kőfülkéből, a Bivak és a Jankovich barlangból (rajz: Nagy Katalin)

As a summary, from the assemblages of the Danube bend each obsidian variant is known, however, their importance changed from site to site. Moreover, the pieces were partly imported to the sites as not modified nodules or natural flakes, partly as ready made tools. Finally, the regular bladelet production of this raw material is evidenced in each locality.

Occurrence of obsidian in the assemblages without stratigraphic control

In the surface collected assemblages of Hrčeľ - Nad baňou and Hrčeľ - Pivničky, lying in the vicinity of the obsidian occurrences in Eastern Slovakia the relatively high ratio of obsidian (50-70% of the assemblages), including not modified nodules and pre-cores is evidenced. Regrettably, during the excavations no Palaeolithic artefact-bearing layer was observed, but at the locality Nad baňou Copper Age features were documented. Based on the presence of the 'Aurignacian type' lithics and the moderate ratio of the 'northern flint' types the assemblage from Hrčeľ-Pivničky as well as the little collections from Vel'aty, Kysta and Zemplinske Jastrabie were compared to the published assemblage of upper layer of Kašov I. The site of Hrčeľ - Nad baňou where the 'Aurignacian types' are absent and the flint types are better represented were placed into an earlier period, approximately between the two layers of Kašov (Kaminská 2004, 212; 2014, 283-285).

From the Cserhát region and the Ipoly / Ipel' valley a number of surface collected were dated to the Gravettian or Epigravettian period (Bárta & Petrovský-Šichman 1962; Dobosi 2010, Péntek-Zandler 2016), even if from Kiarov II, Kováčovce I. and Slovenské Ďarmoty in the Ipel' valley only less typical, Gravettian or Epigravettian artefacts are known (Bárta & Petrovský-Šichman 1962, 298-300, 305-306) and the results of the excavations at Vel'ka Ves nad Iplom (Bárta 1970, 213) are not published. From the Cserhát localities in Northern Hungary (Acsa - Viszoki hill, Kálló - Puszta hill and Galgagyörk - Kelemen földek) the presence of mahogany obsidian from Kálló (Biró et al. 2005, 94-95, 94–95, Fig. 3: 4; Péntek-Zandler 2016, 133) is worth to mention. The obsidian artefacts collected also from the surface at Romhány most probably does not belong to the Palaeolithic period (Dobosi 2011-2013, 21).

Occurrence of obsidian in the Upper Palaeolithic assemblages in the cave sites

After the first excavations of the cave localities lying in the north-eastern part of the Transdanubia it became clear that two 'Magdalenian' artefact bearing levels could have been observed: an older layer containing cave bear bones and teeth and a more recent one without the remains of this species. Using the modern terminology, the assemblages are placed to the Gravettian and Epigravettian period, respectively.

During the excavations of the 'Lower diluvium' of the Pilisszántó I rock shelter, the eponymous site of the biostratigraphic stage dated to the late Würm, a single backed bladelet (Fig. 7: 1 – c.f. Kormos & Lambrecht 1915, 10. ábra) of grey Mád-type obsidian was collected. In the upper yellow layer of the nearby Bivak cave a blade fragment of Slovakian obsidian (**Fig. 7/2**) associated by another blade of low quality siliceous rock and a fossil shell fragment (Jánossy et al. 1957, 31, Taf. I, 9, 7, 2) was found. Based on the presence, or, in the case of the Bivak cave, the dominance of the cave bears (Jánossy 1986), these assemblages should be earlier than 24 ka, when this species is estimated to be disappeared from Central Europe (Pacher & Stuart 2008). The single radiocarbon date measured on a bone fragment of unknown species from the Bivak

cave (Pazonyi 2006, see **Table 2.**) contradicts to the Gravettian age; further fieldworks or radiocarbon measurements are necessary to clear the age of the layers.

We have to mention the Jankovich cave, where a single flake of Slovakian obsidian was found in a not specified Upper Palaeolithic layer, and finally, from the Kiskevély cave a number of artefacts made of this rock was reported (Biró 1984, 25, Fig. 13, 7-18), however, the typological and technological observations suggest for a more recent Prehistoric period for these objects.

Obsidian artefacts excavated north and east of the Carpathians

In Poland, during the excavations at Targowisko the local exploitation of a Slovakian obsidian (Hughes et al 2018) nodule was documented in a restricted artefact concentration lying on the western part of the excavated trench; the 43 blades and flakes and the roughly 250 chips and fragments make up 5.3% of the assemblage (Wilczyński 2010, 114-115, 121). The site is well dated into a younger period than the localities discussed earlier (see **Table 2.**), and it is seemingly contemporaneous with the Vídeňska phase in Moravia (Škrdla et al. 2014).

In the Bistrița and Suceava valleys, eastern Romania, two assemblages, dated to the Herculane II period, i.e. to the Laugerie interstadial and the late glacial period by V. Chirica (1989, 146) yielded some obsidian artefacts. In layer I of the site at Buda, excavated in a pseudo-mycelian level, a few pieces of black or greyish, non-transparent obsidian were found (Căpitanu 1967, 270; Bitiri 1981, 339; Bitiri-Ciortescu et al 1989, 21; Chirica 1989, 108-110; Tuffreau et al, 2018, 138), not found in the collections today (Tuffreau et al, 2018, 140). The available excavation reports from the 1958 and 1959 seasons (Nicolăescu-Plopşor et al 1961; Căpitanu et al. 1962) do not mention these pieces, which were most probably collected during the last excavations in 1960.

Based on the presence of the shouldered points this assemblage was placed into the Late Gravettian period (Căpitanu et al 1962), even if the chronological importance of the atypical pieces was questioned (Chirica 1989, 146). The radiocarbon dates (**Table 2.**), however, clearly support the typological evaluation of the site. The presence of shouldered points suggests for the Late Gravettian classification of the assemblage collected at Udeşti too (Bitiri 1981, 333, 337, Fig. 3,3). At this locality a single translucent obsidian was found (Bitiri 1981, 332; Chirica 1989, 76-78), probably from the surface of the site.

Recently from the eastern part of Romania the presence of obsidian was reported from the Epigravettian layer II of Lespezi – Lutărie, from the 2015 excavations of layer II of Bistricioara - Lutărie III and from the Gravettian or Epigravettian site of Piatra Neamț - Pietricica (Anghelinu et al. 2017, 28; 2018, 311; Dobrescu et al 2018, 112). However, the field reports and the review of the museum collections from these sites did not mention obsidian artefacts (Anghelinu et al, 2016, 223; Bitiri-Ciortescu et al 1989, 18-19; Tuffreau et al 2018, 151-156.).

Finally we have to shortly mention two localities from the Dniester valley. From the assemblage excavated in the upper layer of Voronovitsa I two obsidian artefacts were published (Chernysh 1956; Noiret 2009, 244). The well dated layer 5 of Cossautsi, lying between the embryonic soil horizons COS VI and COS V seven pieces were found during the 1995 season (Borziac et al 2006, 326, fig. 226, 3-6, 11-12; Noiret 2009, 256, 257). In the future the publication of these lithic assemblages will certainly provide important data on the use of obsidian in Eastern Romania and Moldavia. Moreover, considering the large distance of the raw material transport in these cases, the archaeometrical analysis of the artefacts would be important to confirm the macroscopic raw material determination.

Discussion and conclusions

From the assemblages discussed above, Buda and Udeşti most probably belong to the Gravettian period. After typological and biostratigraphic considerations the site of Arka, the lower layer of the Pilisszántó rock shelter, the upper yellow layer of the Bivak cave may also be dated to the Middle Upper Palaeolithic period, similarly to the surface collected assemblages in Slovakia and in Hungary. On the other hand, the upper artefact bearing layers documented immediately beneath the present day humic soil at Pilismarót - Bitóc and Bánom, at Jászfelsőszentgyörgy and probably in Arka may belong to the Late Upper Palaeolithic. The radiocarbon dated bone from Jászfelsőszentgyörgy - Székes-dűlő (with an age of 11.600±137 BP: Sümegi 2005, 226, Fig. 138) was possibly collected from the upper layer of this site. In the future, the detailed publication of these archaeological assemblages would be very important.

The use of obsidian in the assemblages dated to the Epigravettian period followed some simple principles. The transport of obsidian nodules and prepared cores and their on-site reduction is evidenced from the northern part of the Great Hungarian Plain (Jászfelsőszentgyörgy), from the Danube bend (Dömös, several sites around Pilismarót, Verőce, probably in Mogyorósbánya, see: Markó 2017) in Hungary and from Little Poland (Targowisko). The maximum of these localities from the source region is not more than 250 km and seemingly the Carpathians did not form an important geographical barrier during the

Epigravettian period (see **Table 1. and Fig.1.**.). The scarcity of the data of the obsidian transport from Poland may be due to the rarity of Epigravettian settlements. In any cases, we have to keep in our mind that the Targowisko site is dated to a more recent period, than that ones, known from Hungary or Slovakia. On the other hand, in the close vicinity of the mentioned localities in the Danube bend, the well preserved site of Esztergom yielded a single blade of obsidian, and from the assemblages of Pilismarót - Pálrét (Dobosi 2006) and Budapest - Csillaghegy (Gáboriné 1984) this raw material is absent, suggesting that the occurrence of this raw material was not regular in each assemblages of the Epigravettian period.

On the sites of the Danube bend and the Jászság area certain differences are observed in the exploitation of the obsidian sources. In Pilismarót - Diós and Jászfelsőszentgyörgy - Székes-dűlő, where only a few obsidian pieces were excavated, mainly a single little nodule of the Tolcsva or Mád variant was found. In the obsidian-rich assemblages from the neighbouring Pilismarót - Bitóc and Jászfelsőszentgyörgy - Szúnyogos site the best quality Slovakian variant was dominating with a large number of waste material and flakes, similarly to the Targowisko assemblage from Poland.

Finally, from the sites lying at a larger distance from the sources like Ságvár, Stránska skála, Grubgraben or the localities in the Bistrița valley only single tools or blanks of obsidian are known. According to the present data the maximum distance of obsidian transport in the Epigravettian period is 450 km (in the case of Grubgraben) or more than 500 km (the sites along the Dniester valley).

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