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NEW DATA ON THE ARCHAEOLOGICAL OBSIDIANS FROM THE BANAT AND TRANSYLVANIA (ROMANIA)

SUMMARY - *New data on the archaeological obsidians from the Banat and Transylvania (Romania).* This paper deals with the study of a limited number of obsidian artefacts from the earliest FTN Criş sites of the Banat and Transylvania. The first impression is that the first FTN farmers, who settled in the region at the turn of the 8th millennium uncal BP, had a limited local supply of bad quality lithic raw materials. The pioneer search for workable stones, north of the maximum spread of the FTN, led to the discovery of the Slovak (Cejkov e Kašov: Carpathian 1) and Hungarian (Mád: Carpathian 2E), Tokaj deposits, which both started to be exploited on a very small scale. The pattern began to vary during the successive stages of the FTN and, more dramatically, since the beginning of the Middle Neolithic Vinča Culture. From this time on, the Slovak sources started to be more intensively exploited, as indicated by the recovery of a greater number of unretouched artefacts and functional tools, and the first of trans-Carpathian Volhynian flints to be imported.

RIASSUNTO - *Nuovi dati sulle ossidiane dei siti archeologici del Banat e della Transilvania (Romania)*. Il presente lavoro riguarda lo studio di un gruppo limitato di manufatti di ossidiana provenienti da siti del Neolitico più antico del Banat e della Transilvania appartenenti al gruppo culturale di Criş. L'impressione generale che deriva dall'analisi dei reperti è che le prime popolazioni di agricoltori-allevatori dell'FTN, che insediarono la regione subito prima dell'inizio del settimo millennio uncal BP, avessero a disposizione localmente pochissimo materiale litico scheggiabile, per di più di qualità scadente. La ricerca pionieristica di fonti di approvvigionamento portò alla scoperta di giacimenti di ossidiana ubicati ben oltre il limite più settentrionale dell'espansione più settentrionale dell'FTN, con un conseguente primo limitato sfruttamento dei depositi dei Monti Tokaj sia della Slovacchia (Cejkov e Kašov: Carpathian 1), sia dell'Ungheria (Mád: Carpathian 2E). Il quadro iniziò a mutare lentamente durante lo sviluppo dell'FTN, e più drasticamente durante la Cultura di Vinča, nel Neolitico Medio, con uno sfruttamento più intensivo principalmente delle fonti Slovacche, che si riflette nella maggiore quantità di prodotti rinvenuti nei siti archeologici e anche dalla confezione di oggetti funzionali, e nell'inizio dell'importazione di selce Volhynian dai giacimenti transcarpatici.

INTRODUCTION

The Carpathian obsidian sources exploited between the Middle Palaeolithic and the Iron Age (Cărciumaru *et al.*, 1985; Biró, 2004) were systematically surveyed for the first time in the 1970s (Nandris, 1975; Williams and Nandris, 1977). A few years later archaeological obsidian artefacts from several central and east European sites were characterised for the first time. The results led to the identification of archaeological obsidians from their original sources according to their different periods of exploitation. The distribution and chrono-cultural maps developed by Williams Thorpe *et al.* (1984: figs. 4 and 8) are very indicative. Among the other things they clearly show that obsidian artefacts from very few Mesolithic and Early Neolithic sites were scientifically analysed in the 1980s.

The scope of this paper is to contribute to the interpretation of the reasons and the ways the Early Neolithic farmers of the FTN Criş group of the Banat and Transylvania exploited obsidian raw material sources. We know that the Neolithisation of these two regions of present-day Romania was a rapid phenomenon that took place along a few main river courses (Kaczanowska and Kozłowski, 2003: 242; Biagi and Spataro, 2005). Although many details of this process are still insufficiently known, the available radiocarbon dates indicate that 1) the spread of the earliest farmers, which the pottery typologists attribute to the PreCriş or Criş I aspects, according to the terminology proposed respectively by Paul (1995) or Lazarovici (1993), began during the last two centuries of the 8th millennium uncal BP, and 2) the number of sites attributable to this early stage is very small

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(Ciută, 2001: fig. 1; 2005: 147-155; Draşovean, 2007; Luca and Suciu, 2007), restricted to specific territories, sometimes close to salt outcrops (Nandris, 1990: 15), often along important waterways, while other fluvial routes across the Carpathians were not followed during this process.

New scientific analyses, among which are radiocarbon dates (Biagi *et al.*, 2005) and pottery manufacture studies (Spataro, 2007), show that Criş was most probably a 'continuous' cultural group that lasted some 800 years (Biagi *et al.*, 2005), and not a recurrent, interrupted series of (three or four main) migration waves as suggested first by Lazarovici (1993), and more recently by Luca and Suciu (2007).

As mentioned above, a first important question concerns when and to what extent the earliest farmers began to exploit the Carpathian obsidian sources. J. Makkay (2007: 232) recently argued that "*the spread of the Méhtelek group ..... was hindered by local Late Mesolithic bands, which occupied the area of the stone resources and were interested in trading stones to the southern groups with the Méhtelek Körös industry*". This argument is hardly tenable for two main reasons: 1) ethnographical, since "*foraging groups are by nature transitory*" (Smith, 1981: 42), and they consider outcrops "*as a focus within the peripheral intersection of several group territories, which would exploit that resource at different seasons of the year*" (Clarke, 1979: 277); and 2) chronological, given that Méhtelek-Nádas is not one of the earliest FTN Neolithic sites of the Carpathian region as a whole. Another different view was expressed by Sherratt (1987: 195), who believes that "*as agricultural communities reached the obsidian sources of the Zemplén Mountains in the north, this material came into widespread use. At Méhtelek ..... formed up to 80% of the chipped stone ..... It was traded both to surrounding Mesolithic groups in Moravia and Little Poland ..... and southwards to the agricultural communities of the Plain*".

Other important questions regard the transport or trade (?) radius of the Carpathian obsidian, its rate of dispersal, and the maximum distance reached by its trade. A territorial gap of at least 400 km is attested during this period between the northernmost distribution of the Melian and the south-easternmost spread of the Carpathian obsidian, which is partly filled by the discovery of two single archaeological specimens in Bulgaria (Nikolov, 2005: 8). This gap was covered by the end of the Neolithic (Biagi *et al.*, 2007: 310), when Carpathian obsidians were traded southwards as far as Western Macedonia (Kilikoglou *et al.*, 1996).

Other problems concern 1) the scarcity of high-quality raw material sources in the two study regions and 2) the absence of both rich chipped stone assemblages and workshops from the earliest FTN sites in the area (Comşa, 1976). The only exception is represented by the site of Iosaş-Anele, in the Arad district, along the course of the White Criş, where a pit structure, excavated by Luca and Barbu (1992-1994: 17), attributed to an early stage in the development of the Criş aspect, has been interpreted as an atelier for the manufacture of Banat flint implements (?).

It is important to point out that the distribution map by Williams Thorpe *et al.* (1984: fig. 8) includes twelve FTN sites, from two only of which obsidian tools were characterised: Méhtelek, in north-eastern Hungary (Kalicz and Makkay, 1976; Chapman, 1987; Starnini, 1994; Kozłowski, 2001; Makkay, 2007), radiocarbon-dated, from charcoal, to 6835±60 (Bln-1331: Pit 1-3/α), 6655±60 (Bln-1332) and 6625±50 uncal BP (GrN-6897: Pit 4-5/α), and Gura Baciului, in central Transylvania (Lazarovici and Maxim, 1995), from which only one radiocarbon date has been obtained from a bone tool collected from a structure of the lowermost occupation layers (GrA-24137: 7140±45uncal BP) (Biagi *et al.*, 2005: 46). Mainly Carpathian 1 (Slovak) obsidians have been identified at Méhtelek (Starnini, 1994: 67) "*although the Carpathian 2 variety (Erdöbénje type) is also present in a small percentage ..... determined only macroscopically*"; whilst both Carpathian 1 (Slovak) and 2b (Hungarian) artefacts are known from Gura Baciului, a Transylvanian multi-stratified site, with structures that yielded material culture remains attributed to all the four Criş phases (Spataro, in press). It is important to point out that, while the radiocarbon dates from Méhtelek show that the site probably flourished during the third Criş phase (Biagi *et al.*, 2005: 44), the chronological attribution of the characterised obsidians from Gura Baciului is uncertain, since they come from the entire settlement sequence (Lazarovici and Maxim, 1995: 156).

THE SITES AND THE CHIPPED STONE ASSEMBLAGES

During the last two years, obsidian samples have been characterised from seven Criş sites attributed to different periods. They are: Miercurea Sibiului-Petriş (Sibiu), Şeuşa-La Cărarea Morii (Alba Iulia), Limba Bordane (Alba Iulia), Dudeştii Vechi (Timişoara), Silagiu-Valea Secerii (Timişoara), Leț (Cluj) and Seimi Cărămidărie (Maramureş) (fig. 1).

a) Miercurea Sibiului-Petriş (Sibiu-Transylvania), a few kilometres west of the homonymous village, is located on the left bank of the Secaş River, a southern tributary of the Mureş (fig. 2). The excavations carried out

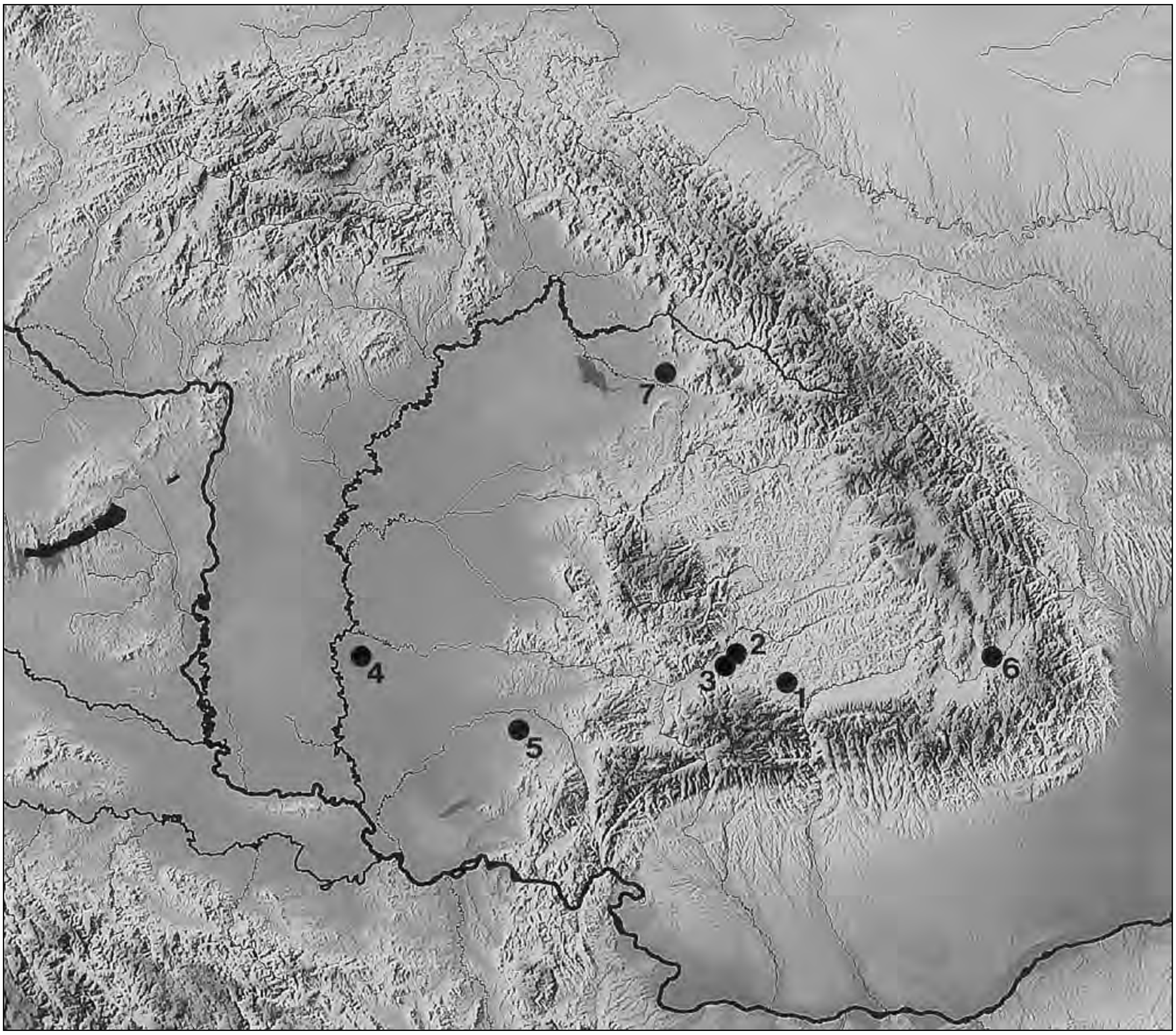

Fig. 1 - Distribution map of the FTN Criş sites mentioned in text: 1) Miercurea Sibiului-Petriş, 2) Şeuşa-La Cărarea Morii, 3) Limba Bordane, 4) Dudeştii Vechi, 5) Silagiu-Valea Secerii, 6) Leţ, 7) Seimi Cărămidărie (*drawing by P. Biagi*).

between 1997 and 2007, and still under way (Luca *et al.*, 2006; Luca and Suciu, 2007), revealed three main phases of occupation attributed to the Criş, Vinča and Petreşti cultural aspects respectively. The Criş layer yielded different types of features consisting of pits of variable size and shape, but no houses of the type so far known from the FTN groups (Trogmayer, 1966; Nandris, 1977: 51; Kalicz and Raczky, 1980-81; Raczky, 2006). Seven radiocarbon dates, obtained from different structures (fig. 2), show that the first Criş occupation took place between the end of the 8th and the beginning of the 7th millennium uncal BP, and that the site was resettled some five centuries later, by the beginning of the Middle Neolithic Vinča period (fig. 3). The chipped stone assemblages from the two main Neolithic complexes (Criş and Vinča) show different characteristics[1]. The Criş assemblage is very poor. It is composed of 31 artefacts, 16 of which come from 8 features and 15 from the archaeological layer.

They include 2 cores, 1 short end scraper, 1 truncation, 5 retouched blades, 1 crested blade and 1 plunging blade all from flint or radiolarites. The preliminary results of the traceological analyses by B.A. Voytek (pers. comm., 2006; Biagi and Voytek, in press) are shown in table 1 and fig. 4. They indicate that 8 tools were utilised for different activities among which is the harvesting of cereals, as suggested by the presence of two oblique sickle blades and caryopses of domestic wheat (Nisbet, in press). The commonest materials employed for chipping artefacts are the so-called Banat flint (Comşa, 1971: 100; 1976: 241) (11 specimens: 35.4%), and a few varieties of radiolarite (11 specimens: 35.4%). They are

[1] The data presented in this paper refer exclusively to the assemblages from the 1997-2005 excavations.

FTN Criş aspect

structure/ layer	raw material	typology (Laplace, 1964)	dimensions (mm)	condition	analytical method-analysis number	weight (gr)	wear traces	figure 4
10	flint	fl	(23)x(10)x4	fragment, burnt		0.25		
10	opaque chert	prismatic (?) flakelet core	30x34x16	complete		20		
10	“Banat” flint	T2 dist [Apd]/Amd.Smm	39x13x4	complete		2	haft (?) sen.cut hard dex	n. 3
14	“Central Banat” Hunedoara?	e	33x27x7	complete		6		
19	“Banat” flint	L1 [Smd dist]	44x15x5	complete		4		n. 11
19	“Banat” flint	eee	11x5x2	complete		0.25		
19	Carpathian 2E obsidian	eee	11x15x3	complete	XRF-103	1		
20	light grey flint	fl	(20)x15x5	fragment, corticated		2	sickle gloss obl dist sen	n. 8
21	red radiolarite	ee	21x26x11	complete, corticated		4		
21	“Banat” flint	L0	(25)x14x5	fragment		3		
21	light grey radiolarite	ee	13x12x3	complete, corticated		0.50		
21	“Banat” flint	G3/Smd sen	15x13x5	complete		0.50	haft prox.scrape hard dist	n. 2
26	“Banat” flint	fl	(20)x10x2	fragment		0.25		
26	“Banat” flint	L0	(24)x12x4	fragment		1	sickle gloss obl prox dex	n. 7
27	brown radiolarite	L1 [Spm sen]	60x28x10	complete, corticated		16	hand held sen dist.cut wood dex	n. 4
28	light grey radiolarite	e	26x38x10	complete, corticated		8		
layer	brown radiolarite	subconical bladelet core	35x42x33	corticated		54		n. 1
layer	brown radiolarite	L1 [Smi sen dist]	40x21x7	complete, corticated		6	cut hard wood sen	n. 5
layer	light grey radiolarite	E	54x35x18	complete, corticated		30		
layer	brown radiolarite	e	42x35x9	complete, corticated		16		
layer	light grey radiolarite	e	36x28x9	complete		8		
layer	brown radiolarite	e	21x33x10	complete		4		
layer	brown radiolarite	crested blade	31x14x5	distal fragment		2		
layer	radiolarite	fe	(31)x18x3	fragment, burnt		2		
layer	“Banat” flint	ee	18x13x5	complete		0.50		
layer	“Banat” flint	L2 [Spi dex]	38x19x7	complete		4	haft dex.cut medium sen	n. 6
layer	“Banat” flint	L0	(22)x18x4	mesial fragment		2	gloss cut vegetation sen	n. 9
layer	Carpathian 1 obsidian	fll	(11)x11x2	mesial fragment	LA-ICP-MS-1	0.25	cut medium dex	n. 12
layer	Carpathian 1 obsidian	L1 Smi dex	(24)x15x2	proximal fragment	XRF-102	1.50	cut medium dex	n. 10
layer	Carpathian 1 obsidian	ee	20x17x2	complete	XRF-101	3		
layer	Carpathian 1 obsidian	plunging blade	(44)x19x7	distal fragment	XRF-100	6		

Table 1 - Main characteristics of the chipped stone artefacts from the Criş occupation at Miercurea Sibiului-Petriş (excavations 1997-2005). In both tables 1 and 2 the dimensions are indicated as follows: ee = microflakelet, e = flakelet, E = flake, ll = microbladelet, l = bladelet, L = blade; ee and ll, 1.25-2.50 cm, e and l, 2.50-5.00 cm; E and L, 5.00-10.00 cm. f = fragment.

Fig. 2 - Miercurea Sibiului-Petriş: Pit 26, belonging to the early FTN Criş aspect, filled with domestic cattle skull remains, radiocarbon-dated to 7010±40 uncal BP (GrN-29954) (*photograph by P. Biagi*).

followed by obsidian (5 specimens: 16.1%), which is represented by 4 artefacts of Carpathian 1 and 1 of Carpathian 2E source. In contrast, the Vinča period assemblage is much richer. It is composed of 185 artefacts, 39 of which are from obsidian (21.08% of the total assemblage), 35 from Carpathian 1 and 3 from Carpathian 2E source, among which are 6 retouched tools and 2 core residuals. This indicates that during this latter period, at least part of the obsidian tools were manufactured within the settlement site (Biagi *et al*., 2007).

b) Şeuşa-La Cărarea Morii (Alba Iulia, Transylvania). The site is located on the left terrace of the Secaş, a small, left affluent of the Mureş River, in an open pasture upland, close to a deposit of bentonite, at 46°02'29"N-23°38'06"E. (Ciută, 1998: plate 1) (fig. 5). The excavations carried out in 1997 brought to light a complex stratigraphic sequence (Ciută, 2005), the bottom of which yielded a rectangular 'surface house' (Ciută, 2000: fig. 4) containing a material culture assemblage attributed to the earliest FTN Criş group, radiocarbon-dated to 7070±60 uncal BP (GrN-28114) (Biagi *et al*., 2005: 46-47). The chipped stone industry is represented mainly by unretouched flakelets and very rare bladelets obtained from quartzite and flint as well as 7 obsidian microflakelets (Ciută, 2000: figs. 5 and 6).

c) Limba Bordane is located on the left terrace of the Mureş, in front of a large island, in the middle of the river itself (Ciută, 2002: fig. 1), a few km from Alba Iulia (Transylvania). Its exact location is 46°02'11"N-23°35'07"E. The excavations carried out in 1998 yielded an Early Neolithic 'surface house' with materials attributable to the beginning of the Criş period and later Criş IIIB and IV occupations (Ciută, 2005: 150). Both these later periods have been radiocarbon-dated (Biagi *et al*., 2005: 46-47) (fig. 6 bottom).

d) Dudeştii Vechi. The FTN Criş site Movila lui Deciov, is located in the Timiş district, north-west of the village of Dudeştii Vechi, 8 km west of Sânnicolau Mare, close to the Hungarian and Serbian borderlines at 46°03'49"N-20°28'38"E. The site, that lies in an area of Holocene river sediments, some 400 m east of the Gornja Aranca canal (El Susi, 2002; Maillol *et al*., 2004; Spataro, unpubl.) is known since the beginning

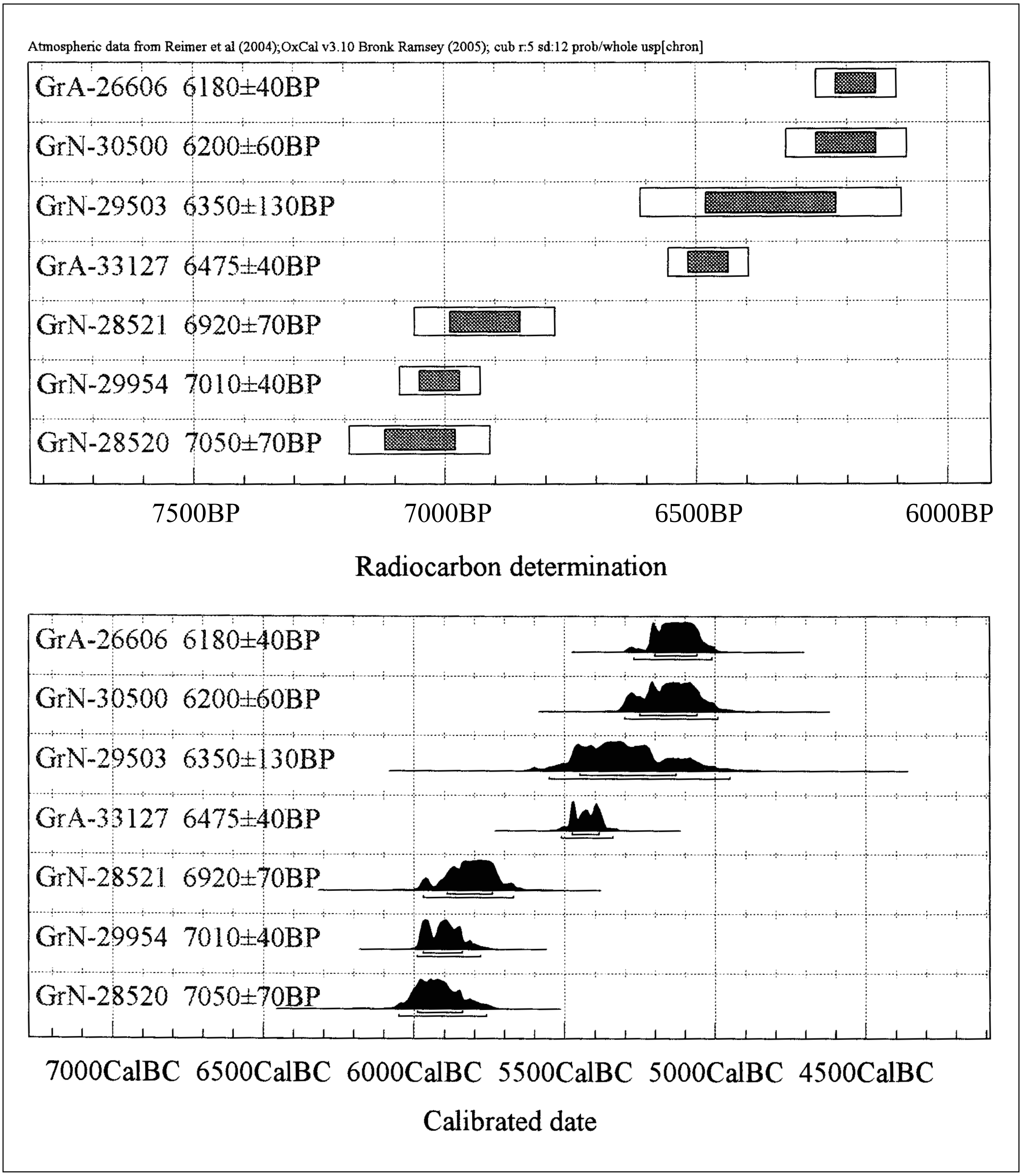

Fig. 3 - Radiocarbon (top) and calibrated dates (bottom) from the Criş and Vinča occupations at Miercurea Sibiului-Petriş, irrespective of stratigraphy.

of the last century (Kisleghi, 1909; 1911). It is an oval-shaped mound, about 75 m in maximum diameter (Maillol *et al.*, 2004: fig. 3) with a Neolithic sequence some 1.50 m deep, attributed to the Starčevo-Criş phases IIB and IIIA (Spataro, 2006; unpubl.), according to the characteristics of the pottery assemblages, radiocarbon-dated between 6990±50 (GrN-28111) and 6815±70 uncal BP (GrN-28876) (Biagi *et al.*, 2005: 46-47) (fig. 6 top).

e) Silagiu-Valea Secerii, in the Buziaş district (Banat), is located in a terraced vineyard, just to the east of the stream that bears the same name, close to a lower-lying cultivated plain at an altitude of some 170 m (Lazarovici and Sfectu, 1990). A concentration of potsherds and stone artefacts was noticed on the site surface during a summer 2006 visit at 45°37’44”N-21°36’57”E. Silagiu is the only Criş site so far known

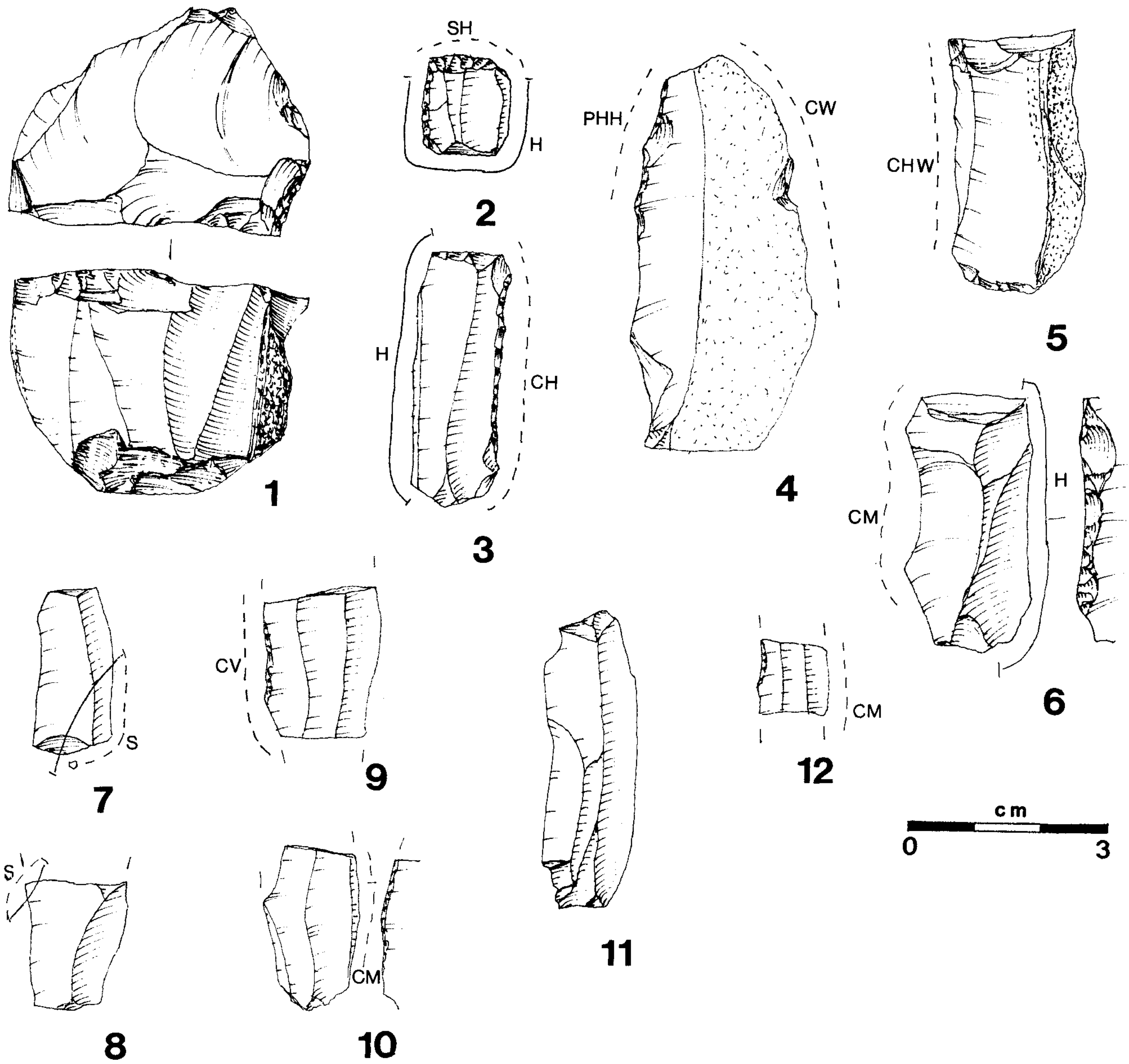

Fig. 4 - Chipped stone implements from the Criş occupation at Miercurea Sibiului-Petriş (excavations 1997-2005): 1) bladelet core; 2) short end scraper; 3) truncation; 4, 6, 9, 10 and 12) retouched bladelets; 5, 7, 8 and 11) unretouched bladelets. Symbols: H) hafting; SH) scrape hard; PHH) pressure hand held; CW) cut wood; CHW) cut hard wood; CM) cut medium; S) sickle gloss; CV) cut vegetation (*drawings by P. Biagi and G. Almerigogna; traces of wear by B.A. Voytek*).

south of the Timiş River, east of Timişoara, along the piedmont course of this important river. The pottery assemblage from this site has been attributed to the IIB-IIIA phase of the Criş aspect, while three obsidian samples analysed by PIXE and XRF are supposed to derive from undefined Tokaj sources (Constantinescu *et al.*, 2002). The characterised obsidian artefacts include 4 specimens among which are 1 flakelet and 1 microflakelet, both of Carpathian 1 material; 1 microbladelet subconical cores and 1 straight perforator of Carpathian 2E source (fig. 7, nn. 1-3).

f) Leţ. The multi-stratified site of Leţ-Várhegy in the Covasna district (Transylvania) is located on a terrace of the River Neagru (Zaharia, 1964). Amongst the other more recent occupations (Păunescu, 2001: 376), the site yielded three levels attributed to the Criş aspect attributed to the IIIB-IVB phases (Maxim, 1999: 166). The chipped stone artefacts are mainly obtained from greyish flint, while obsidians represent 3% of the total assemblage (Păunescu, 1970: 153).

g) Seimi Cărămidărie. This site in the Maramureş district is reported by Z. Maxim (1999: 183) as belonging to the Tiszapolgár Culture, even though from its surface comes a chipped stone assemblage that includes obsidian artefacts attributed to a late Criş period (fig. 7, nn. 4-9) (Maxim, pers. comm. 2004; Biagi *et al.*, 2007).

Fig. 5 - Şeuşa-La Cărarea Morii: site location in the foreground, and white, bentonite deposits in the background (*photograph by P. Biagi*).

OBSIDIAN IDENTIFICATION METHODS

The obsidian presented in this paper were characterised with two different methods: those from Şeuşa-La Cărarea Morii, Limba Bordane, Dudeştii Vechi, Silagiu-Valea Secerii, Leţ, Seimi Cărămidărie and one single specimen from Miercurea Sibiului-Petriş, were analysed by LA-ICP-MS in January 2005, while the remaining 34 specimens from the latter site, including also two broken bladelets from the Chalcolithic Petreşti occupation, were characterised by XRF in December of the same year (fig. 8).

The first method (LA-ICP-MS) allows a quantitative analysis. It is almost undestructive: the diameter of the ablation crater ranges from 60 to 100 µm, and its depth is some 250 µm. The instruments are a VG Plasma Quad PQXS Inductively Coupled Plasma Mass Spectrometer and a VG UV Laser probe laser ablation, sampling device. The specimen is sampled by the laser beam generated by a Nd YAG pulsed laser. Its frequency is quadruplicated in order to operate in the ultraviolet region at 266 nm. An argon gas flow carries the ablated aerosol to the injector inlet of the plasma torch, where the matter is dissociated, atomised and ionised. The ions are then injected into the vacuum chamber of a quadruple system, which filters the ions depending on their mass-to-charge ratio. They are then collected by a channel electron multiplier. Calibration is carried out using a NIST glass standard SRM610. The concentration of 19 elements is determined for each sample. Among them Zr, Y, Nb, Ba, Sr, Ce, La and Ti are used to discriminate amongst the obsidian outcrops (Gratuze, 1999).

The second procedure (XRF) permits to compare directly the net-normalised X-rays fluorescence signals of the archaeological artefacts with those of the obsidian geological samples without determining their composition. It is possible to obtain absolute concentrations by using classical linear regressions, because the coefficient of each element is calculated by comparing the net-measured signal from each single obsidian reference sample with its concentration value. This method allows a good discrimination of all the Mediterranean (Lipari, Sardinia, Parmarola, Pantelleria, Melos and Giali) and Carpathian (1, 2E and 2T) sources. To classify the archaeological samples, we use the net signal measured for 11 minor and trace elements present in obsidian: K, Ca, Ti, Mn, Fe, Zn, As, Rb, Sr, Y and Zr. Geological and archaeological samples are conjointly analysed and the data are compared using simple binary diagrams.

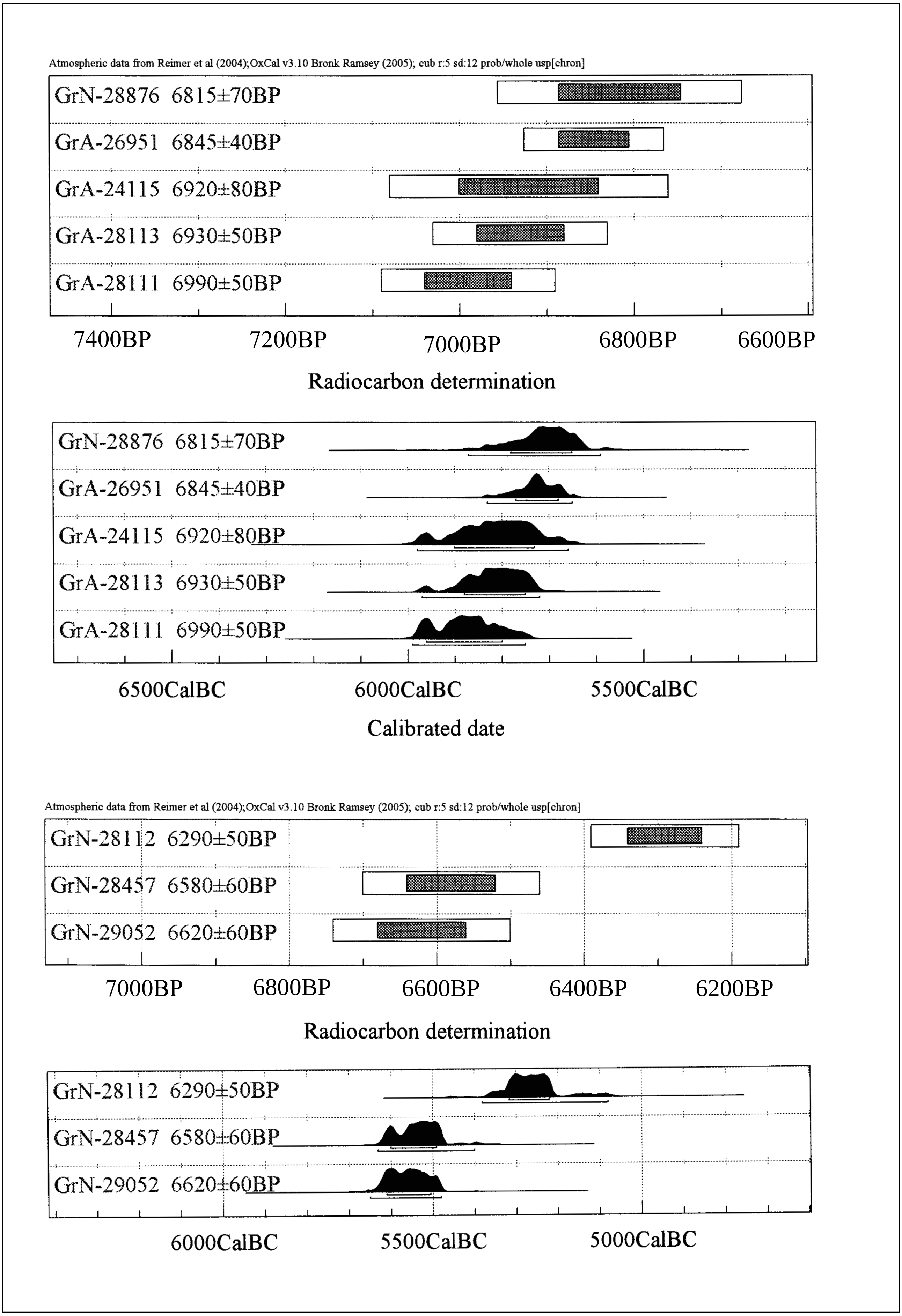

Fig. 6 - Radiocarbon and calibrated dates from Dudeştii Vechi (top), and Limba Bordane (bottom).

The x-rays portable spectrometer can be employed also for on-site analysis. It is equipped with two different x-ray tubes, one with a molybdenum, and one with a tungsten cathode. The analysis is conducted thanks to the tungsten tube. The measurement parameters are: tube voltage 50kV, current intensity 0.8 mA, measurement duration 20 minutes, no filter, X-rays collimator 1.5mm (ASTRUC *et al.*, in press).

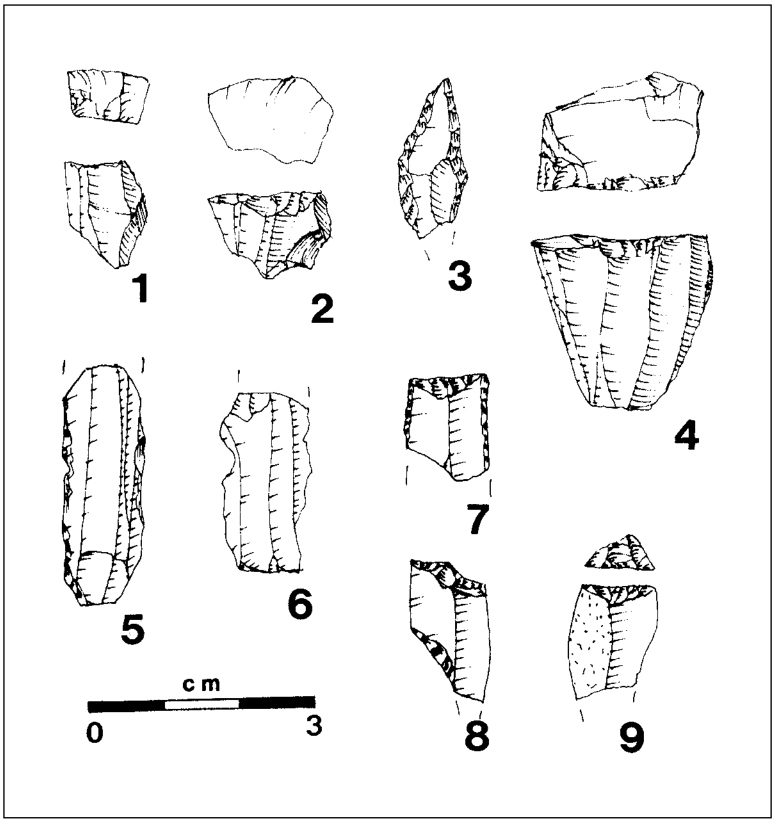

Fig. 7 - Obsidian artefacts from other FTN Criş sites mentioned in the text: 1-3) Silagiu-Valea Secerii, 4-9) Seimi-Cărămidărie. For the description see table 2 (*drawings by P. Biagi and G. Almerigogna*).

DISCUSSION

There are a few important points to discuss on the exploitation of the Carpathian obsidian sources in a period of major transformations, between the end of the 8th and the beginning of the 7th millennium uncal BP. They regard 1) the early demography of the study region, 2) the way the obsidian sources were exploited and transported, and 3) the raw material utilised by the first FTN farmers who settled in the Banat and Transylvania.

THE EARLY DEMOGRAPHY

As mentioned above, the new radiocarbon assays show that farming spread rapidly across the central Balkans as far north as the Hungarian Plain (STARNINI, 2002: fig. 7; WHITTLE *et al.*, 2002; 2005; BIAGI *et al.*, 2005: fig. 5). This phenomenon took place following well-defined and selected watercourses, along a few river routes crossing the Carpathians that can be most probably compared with those followed by transhumant shepherds until the beginning of the 20th century (JARMAN *et al.*, fig. 107). In this territory, apart from the Iron Gates (RADOVANOVIĆ, 1996), no evidence of Mesolithic occupation is so far known.

The only exception, in the whole Banat and the province of Arad (Crisana), a region very poor in high-quality raw material stone resources (PĂUNESCU, 2001: 135-222), is Alibeg, along the northern bank of the Danube, where a sequence with over-imposed Mesolithic and Starčevo-Criş assemblages, was excavated within the same archaeological layer. A radiocarbon date of 7195±100 uncal BP (Bln-1193), from charcoal, is referred to the Mesolithic occupation. It yielded an assemblage obtained from flint, black schist and quartzite, represented by cores, end scrapers, denticulated tools, but no geometric microliths (PĂUNESCU, 2001: 156-159).

The low population density of this Early Neolithic horizon (SHERRATT, 1972: 517) can be assumed also for the Banat, where only three early FTN Criş sites are so far known along the terraces of the Timiş, some 40-50 km west of Timişoara: Foeni-Sălaş (GREENFIELD and DRAȘOVEAN, 1994; DRAȘOVEAN, 2007) and Foeni-Gaz (SPATARO, 2003), respectively radiocarbon-dated to 7080±50 uncal BP (GrN-28454) and 6925±45 uncal BP (GrA-25621), and Fratelia (DRAȘOVEAN, 2001). A 'continuous' series of five dates, spanning from 6990±50 (GrA-28111) to 6815±70 uncal BP (GrN-28876) (fig. 6), has been recently obtained from Dudeştii Vechi, along the course of the Aranca River, a right tributary of the Tisza (BIAGI *et al.*, 2005: 46), close to an area rich in FTN Körös, riverine settlements of various periods, which shows a noticeable concentration in the Tiszazug region, further to the north (NANDRIS, 1970: maps 1-3; KOSSE, 1979: 119; JARMAN *et al.*, 1982: fig. 74). All the above Banat sites yielded very few unretouched obsidian artefacts (see also KUIJT, 1994: table 2 and appendix 1).

The situation in Transylvania is rather similar. A few obsidian artefacts come from the oldest occupation layers at Gura Baciului (LAZAROVICI and MAXIM, 1995: fig. 15), Ocna Sibiului (PAUL, 1995: 36), Şeuşa-La Cărarea Morii (CIUTĂ, 2005: plate IV) and Miercurea Sibiului (LUCA *et al.*, 2006). The finds from these sites indicate

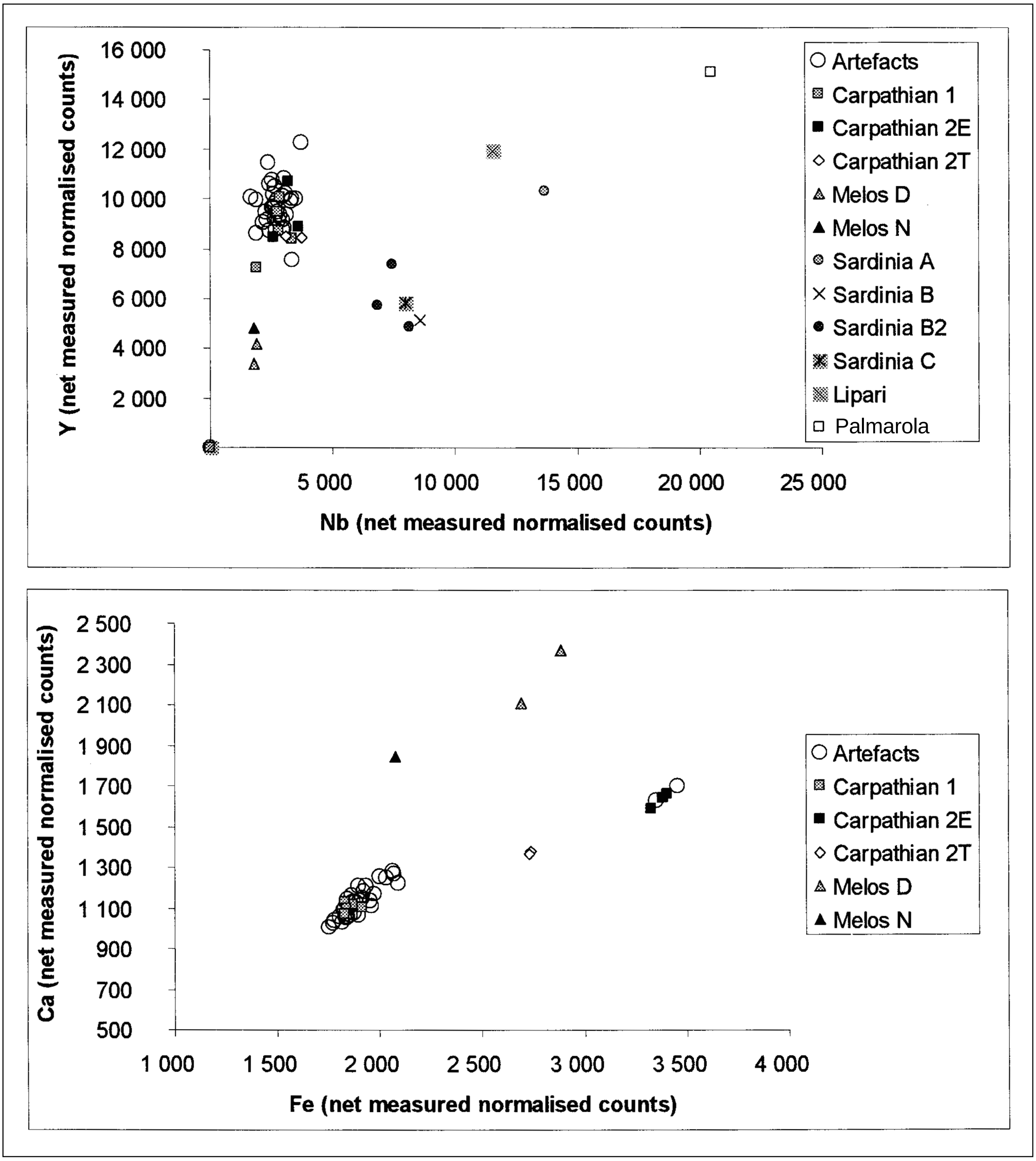

Fig. 8 - Diagrams of Miercurea Sibiului-Petriş obsidian artefacts characterised in December 2005 at Centre Ernest Babelon by XRF: Nb versus Y, showing that they all refer to the Carpathian sources (top); Fe versus Ca with their repartition between the two Carpathian sources 1 and 2E (bottom).

that, already between the last two centuries of the 8th and the very beginning of the following millennium uncal BP, both Carpathian 1 and 2E obsidians had been transported (traded?), although in very small quantities, as far as some 300 km south-east, as the crow flies, of their original sources.

The exploitation of the obsidian sources

A problem of fundamental importance regards the peopling of the Tokaj mountains of Hungary and Slovakia, where the obsidian sources are located, and their rate and mode(s) of exploitation by both Mesolithic hunter-gatherers, if any, and FTN Neolithic farmers around the turn of the 8th millennium uncal BP. Given that these mountains lie well beyond the northernmost limit reached by the spread of the Early Neolithic FTN (Kalicz *et al*., 1998: fig. 1), this evidence poses one more question to the chronology and dynamic of the exploitation of these very important resources.

As already suggested for hunter-forager groups, whose annual complex moves (Brantingham, 2006) are supposed to cover a radius of some (al least?) 150 km (Grimaldi, 2005: 84), "*raw materials and commodities would have been gathered from one spot and circulated with and amongst the family bands* from *one resource or quarry outcrop* that *may often simultaneously ..... serve as a focus within the peripheral intersection of several group territories, which would exploit that resource at different season of the year*" (Clarke, 1979: 277). Furthermore it has been pointed out that no extractive or other implement are normally left at their quarrying place "*if obsidian was collected without modification at the sources, even less well-used areas would exhibit little evidence of having served as quarries*" (Sappington, 1984: 25). According to the ethnographic sources, there is no prove that hunter-gatherers ever 'controlled' (Bánffy, 2004: 393) or 'supervised' (Kalicz *et al*., 1998: 168) any raw material sources, which are periodically, or seasonally, peacefully exploited by different groups, coming from several base-camps (Bettinger, 1982: 113). In effect, as pointed out by Lee and DeVore (1968: 12; see also Rowley-Conwy, 2001: 40) "*frequent visiting between resource areas prevents any one group from becoming too strongly attached to any single area*". It is also important to remark that, 1) given the same energy expenditure, a forager never matters what is the provenance source of the tools he carries (Wilson, 2007: 406), 2) the material he employs does not necessarily derive from the best or the closest source (Jeske, 1989: 44), and, 3) what is most important, "*raw materials used in the manufacture of implements are normally obtained incidentally to the execution of basic subsistence tasks*" (Binford, 1979: 259)

Although, in general, the raw material exploitable zones show different characteristics, represented by sites without any visible remains - like the Tokaj obsidian sources (Nandris, pers. comm. 2007) - or with evident traces of quarrying by pits - Szentgál radiolarites for instance (Biró, 1995) -, this pattern can be extended to other lithic raw material sources, whose exploitation by Mesolithic bands most probably took place following either a procedure very similar to that described in the preceding paragraphs, or unearthing blocks of raw material "*from just below the surface of the ground*" (Gould, 1980: 125), from which to remove a few flakes on the spot and eventually retouch just a small number of them (Binford and O'Connell, 1984), undoubtedly not by 'quarrying' in the way suggested by Bánffy (2004: 346).

The raw material availability

The evidence available to-date, shows that the inhabitants of the earliest FTN Criş sites mentioned in the text exploited mainly local raw material sources. Their chipped stone assemblages are very poor, as it is often the case for the industries of this period, apart perhaps from those of the Iron Gates (Bălteanu, 2005); furthermore the raw materials employed are very variable and of a low technological quality. The typical tools are few: they are represented by obliquely-inserted sickle blades, regular isosceles trapezes, straight truncations, short end scrapers and retouched blades. As far as we know, they were utilised for harvesting, cutting grass, cutting and scraping (Voytek, pers. comm. 2007 and table 1).

A low number of obsidian artefacts is known from both the Banat and Transylvanian sites in the form of unretouched flake(let)s and bladelets, rarely used for cutting, indicating that both Carpathian 1 (Cejkov and Kašov in Slovakia) and 2E (Mád in Hungary) sources were exploited on a very small scale, while the formerly supposed occurrence of obsidians from other 'local' (Oaş Mountains) and southern sources (Melos Island) (Boroneanţ, 2005) does not find any confirmation from the characterisations so far obtained. The 'local' raw materials available within a 40 km radius, according to the terminology proposed by Gould (1980: 145), might include also Banat flint, whose sources are known both in the Hunedoara region (Luca *et al*., 2004: 66) and, in the form of small, isolated boulders, in the hills south of Faget, south of the course of the Bega (Spataro, pers. comm. 2007).

If we take into consideration all the factors that influence the raw material choices, among which is also quality (Wilson, 2007: 396-400), we have to point out the scarcity of 'excellent' material exploited by the earliest FTN populations of the study region that can be restricted only to the Carpathian 1 obsidian. It is important to remark that it forms 80.0% (4 specimens) of the obsidians and 12.9% of the total amount of chipped stones at Miercurea Sibiului-Petriş, Criş occupation (table 1).

CONCLUSIONS

To conclude: the study of the archaeological obsidians from the FTN Criş sites of the above-mentioned two regions of the Carpathian Basin leads to a number of observations that only more numerous analyses might confirm or reject.

At the present state of research the general impression is that

1) the Tokaj mountains were not settled during the early Holocene, prior to the advent of the Neolithic, and that the Early FTN communities did not inhabit the area of the obsidian sources (Kaczanowska and Kozłowski, 1994: 51; Gillings, 1997: 164), which is located north of the northernmost limit reached by the Körös communities (see Kalicz *et al.*, 1998: fig. 1). The supposed presence of Late Mesolithic sites in the area (Chapman, 1994; Kertész, 1996) is still disputed. It does not find confirmation both in the techno-typological characteristics of the chipped stone assemblages yielded by the excavations, which are mostly manufactured from Matra radiolarites and limnoquartzites, opposite to what happens, for instance in Slovakia, at the Early Mesolithic site of Barca (Bárta, 1966), and in the radiocarbon dates so far obtained (Starnini, 2000; 2002; Kozłowski, 2007: fig. 2). Broadly speaking, this picture can be compared with that of eastern Slovakia, although, in this latter case, the previously uninhabited region was firstly settled by specific groups of Linear Pottery (LBK) farmers (Kaczanowska and Kozłowski, 1997);
2) the beginning of the limited exploitation of both Carpathian 1 and 2E sources, at the turn of the 8th millennium uncal BP, might derive from the first exploration of the Tokaj territories by early FTN scouts, in search for good workable stones, given the low quality raw materials locally available to the farmers settled in the plains of the Banat and in the uplands of Transylvania, as indicated by the characteristics of the chipped stone assemblages so far analysed (Comşa, 1976; Kuijt, 1994; Băltean, 2005; Boroneanţ, 2005; Biagi *et al.*, 2007; Draşovean, 2007);
3) this pattern seems to start changing during following stages of the FTN, when the number of obsidian artefacts increases slowly, and retouched obsidian tools make their appearance at some later Criş sites (see table 2) and, more dramatically, during the Middle Neolithic Vinča Culture, when the Carpathian 1 deposits were more intensively exploited, and the first trans-Carpathian, Volhynian flint started to be traded, as the discoveries made at Miercurea Sibiului-Petriş indicate (Biagi and Voytek, in press). These data show subsequent stages of an increasing more intensive exploitation of lithic resources external to the study area, most probably mainly for functional purposes (Biagi *et al.*, 2007) more than for their intrinsic attractiveness (Chapman, 2007), although these latter characteristics might have played a significant role as already observed for the obsidians of Mediterranean region (Tykot, 1996: 56): they contribute to reinforce "*the impression of a set of characteristic land utilization patterns for successive archaeological periods*" (Sherratt, 1972: 514), throughout the entire 7th millennium uncal BP;
4) the distance of the earliest FTN settlement sites under discussion from the Tokaj obsidian sources, located some 300 km northwest of Miecurea Sibiului-Petriş, as the crow flies, although it might have been quite greater if we take into consideration the terrain difficulties (Renfrew, 1977), does not seem to have played a significant role. The available evidence, at least from Transylvania, shows that, throughout a period comprised between the very beginning of the Neolithic and the Chalcolithic, roughly between the last two centuries of the 8th and the end of the 6th millennium uncal BP, the exploitation of the raw material sources varied noticeably. The studies so far conducted on a very limited number of assemblages, shows a slow, although continuous and systematic replacement in the raw material procurement through the time, towards excellent quality sources, independently from their distance and their easy access by watercourses (Reid, 1986), as might have been the case for the Tokaj obsidian outcrops;
5) at the light of the new discoveries, the above pattern can be schematically synthesized in the following successive stages a) earliest FTN: exploitation of local, bad quality sources and search for better exotic raw materials amongst which are both Carpathian 1 and 2E Tokaj obsidians; b) successive FTN periods: increasing utilisation of better quality, local raw materials and beginning of the systematic exploitation of the Slovak Tokaj obsidian source; c) Vinča Culture: more extensive exploitation of both local, higher quality (Banat flint), and exogenous, excellent quality (Carpathian 1), raw material outcrops and beginning of small-scale imports of trans-Carpathian Volhynian flints; d) Chalcolithic: (almost exclusive?) utilisation of excellent exotic raw materials, from great distances, among which are Carpathian 1 obsidians, Volhynian flints and small quantities of Transdanubian radiolarites (Biagi and Voytek, 2006). This oversimplified pattern, which is mainly based on the evidence from two very different key sites in Transylvania, Miercurea Sibiului-Petriş (with non-continuous occupations from the earliest FTN to the Petreşti Culture) and Peştera

FTN Criş aspect

archaeological site	obsidian source	typology (Laplace, 1964)	dimensions (mm)	condition	analytical method-analysis number	weight (gr)	figure 7
Şeuşa	Carpathian 1	fee	(22)x(17)x4	proximal fragment	LA-ICP-MS-S1	2	
Şeuşa	Carpathian 2E	ee	21x27x4	complete	LA-ICP-MS-S2	2	
Dudeştii Vechi	Carpathian 1	ee	13x25x?	complete	LA-ICP-MS-DV1	1.50	
Dudeştii Vechi	Carpathian 1	ee	10x13x?	fragment	LA-ICP-MS-DV3	0.50	
Dudeştii Vechi	Carpathian 1	ee	10x7x?	fragment	LA-ICP-MS-DV4	0.25	
Dudeştii Vechi	Carpathian 1	ll	9x10x?	fragment	LA-ICP-MS-DV2	0.50	
Silagiu-Valea Secerii	Carpathian 1	e	20x37x6	complete	LA-ICP-MS-SVL2	2	
Silagiu-Valea Secerii	Carpathian 1	subconical microbladelet core	15x10x7	complete	LA-ICP-MS-SVL1	1	n. 1
Silagiu-Valea Secerii	Carpathian 2E	subconical microbladelet core	12x17x13	complete	LA-ICP-MS-SVL3	1.50	n. 2
Silagiu-Valea Secerii	Carpathian 2E	Bc2 [Apd+Apd]	(21)x10x5	distal fragment	LA-ICP-MS-SVL4	2	n. 3
Limba Bordane	Carpathian 1	D2 lat-tra [Spd]	19x26x5	complete	LA-ICP-MS-LB1	2	
Leț	Carpathian 1	fll	(11)x9x3	proximal fragment	LA-ICP-MS-LET1	0.50	
Seimi Cărămidărie	Carpathian 1	ee	21x16x6	complete	XRF-SC3	0.50	
Seimi Cărămidărie	Carpathian 1	core trimming flakelet	20x17x8	complete, corticated	XRF-SC4	2	
Seimi Cărămidărie	Carpathian 1	fll	(20)x8x3	proximal fragment	XRF-SC5	1	
Seimi Cărămidărie	Carpathian 1	ll	24x14x3	complete	XRF-SC8	1	
Seimi Cărămidărie	Carpathian 1	ee	18x15x5	complete	XRF-SC2	1	
Seimi Cărămidărie	Carpathian 1	ee	16x18x4	complete, corticated	XRF-SC10	1	
Seimi Cărămidărie	Carpathian 1	fll	(21)x10x4	proximal fragment	XRF-SC11	1	
Seimi Cărămidărie	Carpathian 1	fll	(18)x10x3	medium fragment	XRF-SC1	1	
Seimi Cărămidărie	Carpathian 1	LD2[Apd sen]/.Smd	(31)x11x5	proximal fragment	XRF-SC6	2	n. 5
Seimi Cărămidărie	Carpathian 1	fll	(19)x13x3	proximal fragment	XRF-SC7	1	
Seimi Cărămidărie	Carpathian 1	fl	(24)x13x4	proximal fragment	XRF-SC9	1	n. 6
Seimi Cărămidărie	Carpathian 1	subconical microbladelet core	23x22x15	complete	by visual	8	n. 4
Seimi Cărămidărie	Carpathian 1	T2 rect dir/-Amd bil	(13)x10x3	distal fragment	by visual	1	n. 7
Seimi Cărămidărie	Carpathian 1	T2 obl dir.T3 obl dir	(19)x10x4	fragment	by visual	1	n. 8
Seimi Cărămidărie	Carpathian 1	T2 conc	(15)x11x6	distal fragment, corticatated	by visual	1	n. 9
Seimi Cărămidărie	Carpathian 1	ll	(14)x8x2	mesial fragment	by visual	0.25	
Seimi Cărămidărie	Carpathian 1	ee	19x20x5	complete, corticated	by visual	2	
Seimi Cărămidărie	Carpathian 1	ee	17x13x4	complete	by visual	1	

Table 2 - Main characteristics of the obsidian artefacts from the other sites mentioned in the text.

Ungurească in the Cheile Turzii gorge (from the Petreşti Culture to the beginning of the Bronze Age) (BIAGI *et al*., 2007), will necessitate corrections according to the results obtained from new, under-way systematic analyses. Nevertheless, the above data may contribute to a better understanding of the raw material fall-off curves (RENFREW, 1975), and the use of the territory by the inhabitants of each site and, more broadly, the strategy of landscape exploitation by each cultural unit during the entire Atlantic climatic period (WILSON, 2007: 406).

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