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Lithic raw material exploitation and circulation in Préhistory. A comparative perspective in diverse palaeoenvironments
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1.4. Carpathian Obsidians: State of Art

Résumé

Ce document donne un résumé actualisé des études sur l'obsidienne en Europe centrale, en rapport avec les sources dites des Carpates. L'histoire de la recherche pour les sources géologiques et les données de distribution archéologiques sont présentées accompagnées des informations sommaires sur l'analyse instrumentale. L'enquête est nécessairement biaisée et incomplète, mais le stockage d'informations dans une base de données interactive largement accessible, prévu dans le cadre du Fonds national de recherche scientifique (OTKA-100385) peut aider à promouvoir la recherche. La collecte de données de distribution fondée sur une recherche archéologique lithique et une caractérisation instrumentale du matériau comparatif et des artefacts d'obsidienne archéologiques nous permet de délimiter les principales caractéristiques de distribution et les zones d'approvisionnement en interactions possibles. L'importance historique des obsidiennes des Carpates est particulièrement remarquable au cours de la période paléolithique, où les sources d'obsidienne C1-C2-C3 ont été les sources d'obsidienne uniquement disponibles, connues et utilisées par les hommes préhistoriques sur le continent européen (sans compter les sources en Géorgie et en Arménie). Il est nécessaire de rappeler que la collecte des données est loin d'être achevée, notamment en région orientale des sources d'obsidiennes. La caractérisation des sources d'obsidiennes des Carpates est faisable en utilisant plusieurs méthodes. Récemment, un progrès essentiel a été apporté par l'utilisation de méthodes non destructives, ce qui est impératif dans l'étude des relations commerciales de longue distance.

Abstract

This paper gives an actual summary of obsidian studies in Central Europe, related to the so-called Carpathian sources. History of research for the geological sources and the archaeological distribution data are presented together with summary information on instrumental analysis. The survey is necessarily biased and incomplete but storing information in a widely accessible interactive database, planned in the framework of the National Scientific Fund (OTKA-100385) may help to promote research. Collecting distribution data based on archaeological lithic research and instrumental characterisation of comparative material and archaeological obsidian artefacts allow us to delineate main distribution features and possible interacting supply zones. The historical importance of Carpathian obsidians is especially evident in the Palaeolithic period, when C1-C2-C3 obsidian sources were the only available mainland obsidian sources known and utilised by prehistoric people in Europe (apart from sources in Georgia and Armenia). It is to be remembered that data collection is far from completed, especially to the East of the obsidian sources. Source characterisation of Carpathian obsidians is feasible using several methods. Recently an essential advance was brought about using non-destructive methods that is imperative in the study of long distance trade connections.

Keywords: obsidian, Central Europe, Carpathian obsidian sources, distribution

1 – Introduction

Obsidian is a success story in Central European lithic provenance studies. The beauty, rarity and adaptability of the material for the purpose of making stone tools made it popular and widely know both in prehistory, folklore and archaeological / anthropological special studies.

The well-known expression of Hungarian tales "*az üveghegyen túl*" (=over the glass mountains) and the many popular names it was given by peasants, mainly shepherds and other herdsmen (varjúkova (=crow-flint), csalakova (=pseudo-flint) show that obsidian was noticed and known by people of the not-so-remote past of the region as well.

2 – Obsidian, the raw material of legends and that of prehistoric stone tools

Obsidian is a special kind of rock and gemstone in many ways. Though it looks like a mineral on the strength of its homogeneity, it is a volcanic rock with generally very high silica (SiO_2) content. Obsidian is formed from rhyolitic lava by quenching, i.e., the very fast, practically instantaneous cooling and solidification of the magma (Taylor 1976). These circumstances can be most easily met at volcanic islands surrounded by large water bodies like sea or ocean, occasionally lakes and ice sheet. The result is a solidified rock with no apparent mineral phases. The glass, by the advance of geological times, will crystallize starting from the surface and turn into felsitic volcanic rock with growing number of crystallites and, later, crystals of zeolite and feldspar. The initial part of this process, the formation of the hydration rind, is the basis of obsidian hydration dating (OHD) widely used for, mainly relative dating of obsidian artefacts, especially in stable stratigraphical conditions (Friedman & Smith 1960).

Depending on the composition of the magma, however, the glass can be fairly stable over millions of years.

It may strike you first how we can speak of obsidian volcanism in the centre of Europe, the most continental part of the continent. Looking at the palaeogeographical maps of the Neogene period, however, (Hámor 2001) we can see that during large part of the Neogene when the actual image of the current Carpathian Basin was formed, the territory was covered with large water bodies, remains of the Tethys Ocean of the Mesozoic, turning gradually into a huge with brackish water called Paratethys (Fig. 1).

Apparently, the formation of obsidian requires special conditions; however, these conditions are typically met in young volcanic regions of the tectonically active zones like the Circum-Pacific region or the Mediterranean islands. Collecting information on obsidian worldwide, H. Pollmann (1999) compiled distribution maps for geological obsidian sources all over the World. As his work was mainly directed at collecting bibliographical information, he did not, and could not make a critical assessment of

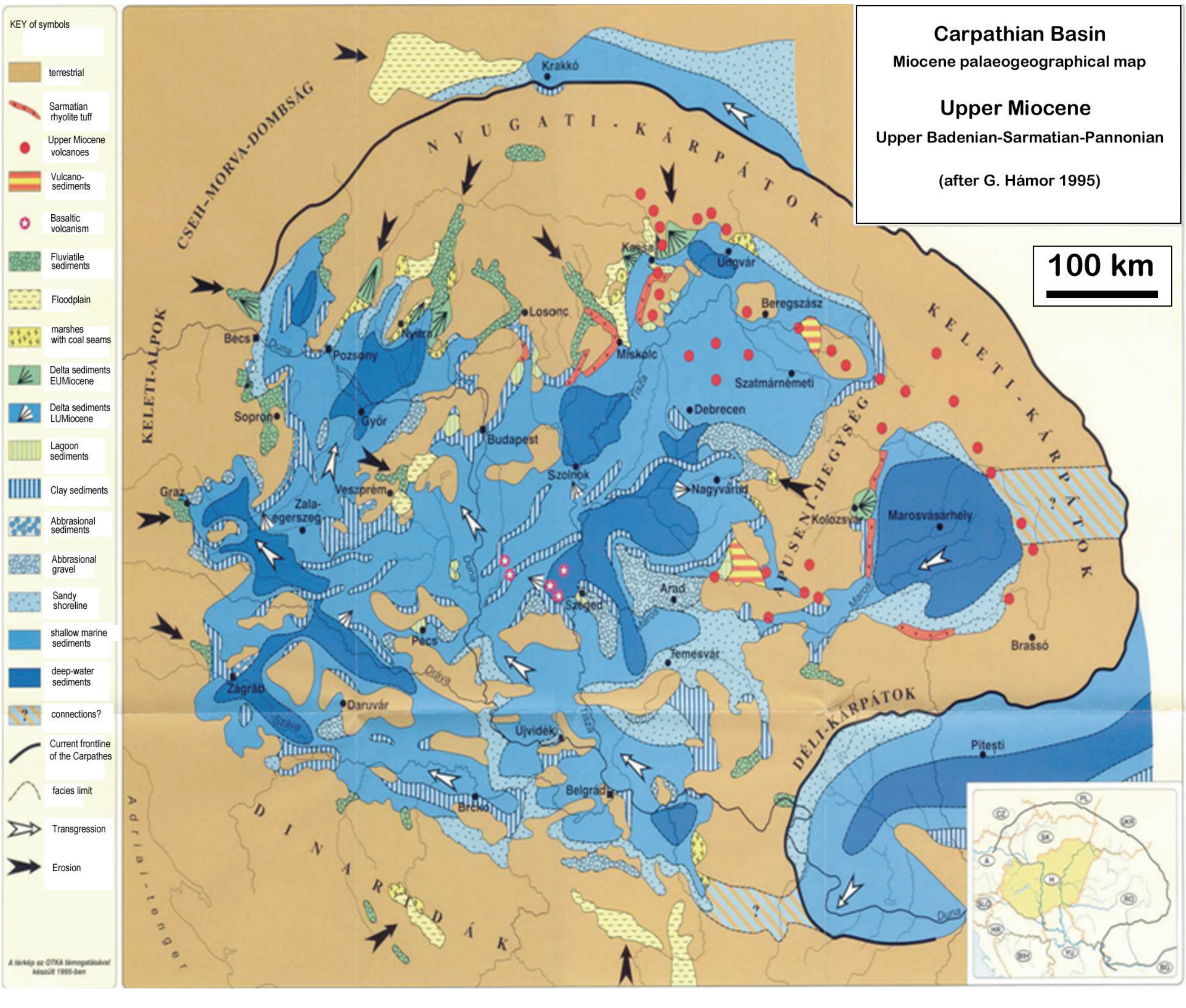


Figure 1 – Palaeogeographical situation in Central Europe, during the Late Miocene period, after Hámor 1995).

his sources – this task should be handled by the experts of the individual regions themselves.

Such a critical review was accomplished by the author in 2004 on the occasion of the 34th International Symposium on Archaeometry, Zaragoza, Spain (Biró 2004, 2006) for the territory of Hungary and the Carpathian Basin.

Summing up fast, in the so-called Carpathian Region we have to consider 3 main obsidian sources, termed in archaeometrical practice Carpathian 1 (Slovakian obsidian), Carpathian 2 (Hungarian obsidian) and Carpathian 3 (obsidian in the NW ('Transcarpathian') parts of the present Ukraine) (Fig. 2).

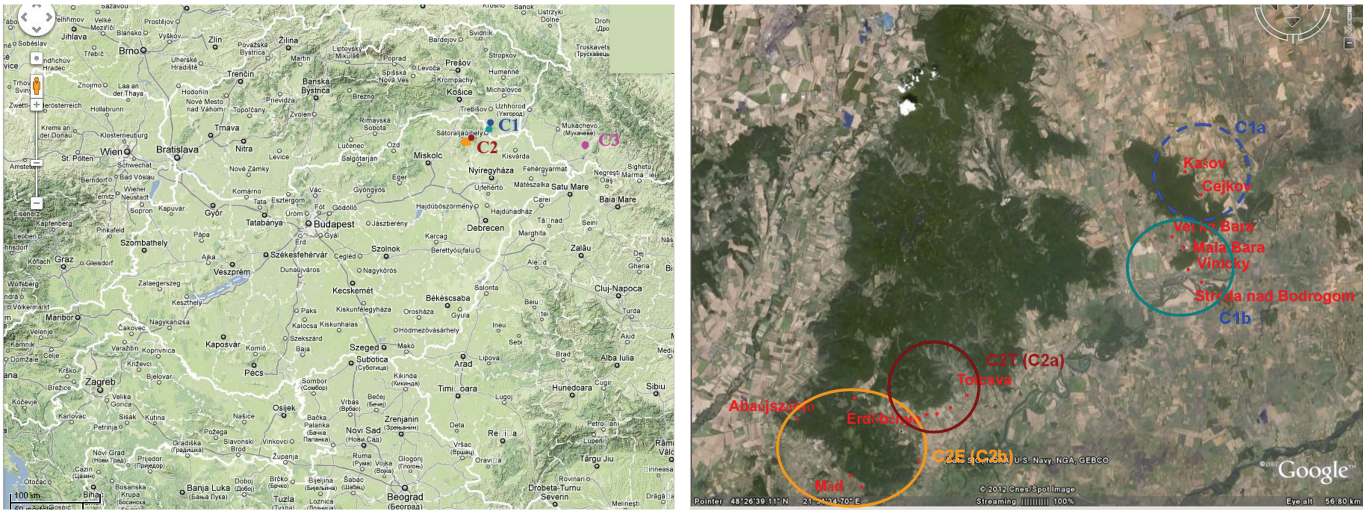
In the following, we shall present here the scientific – geological, archaeological and archaeometrical – analysis of these entities.

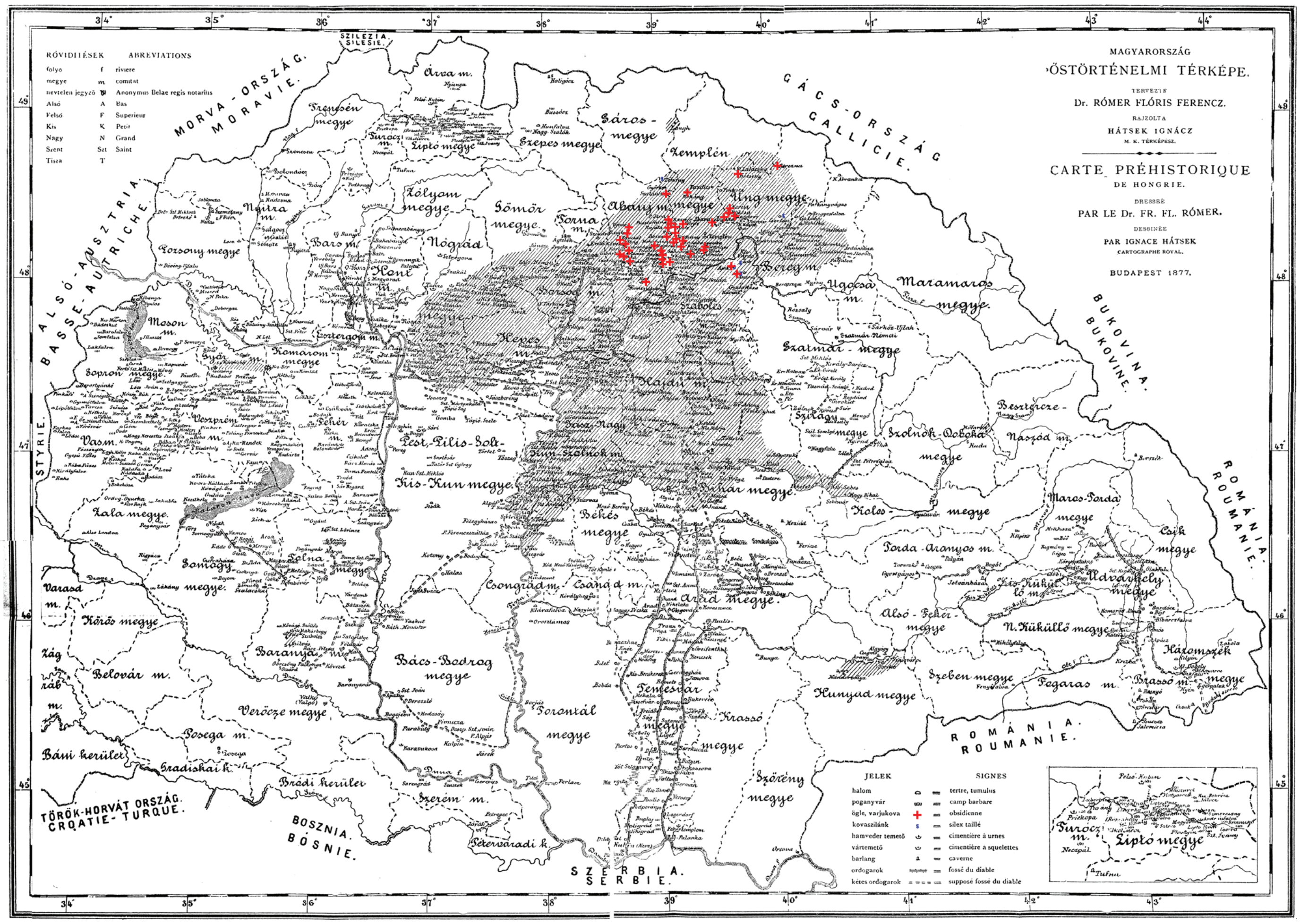
3 – Early localisation and distribution studies

The attention and interest of geologists and prehistorians was attracted to the subject already in the 19th century; partly by early mineralogical and geological descriptions (Fichtel 1791, Beudant 1822) and partly by archaeological and petroarchaeological pioneering studies (Rómer 1867, Szabó 1867, 1878). Flóris Rómer produced the first distribution map of archaeological obsidian on the occasion of the World Archaeological Congress held in Hungary in 1876 (Rómer 1878; Fig.3). On the same conference, J. Szabó compared, from a geological point of view, the obsidians known from that-time Hungary to those from Greece (Szabó 1878). The next great achievement was that of Gy. Szádeczky, (Szádeczky 1886) who gave a detailed geological and geographical description of the obsidian sources, a situation resembling more to possible prehistoric conditions than the modern situation. The next great wave of interest in obsidian and prehistoric trade was encountered in the 1930-ies. Summary maps from the heart of the obsidian region (Janšák 1935) and possible "import" regions Poland (Kostrzewski 1930), Transylvania in Romania (Roska 1934, Fig. 4) were compiled. Roska specifically mentioned possible connections to salt-trade and pottery imports, the latter in the second part of his communication (Roska 1936).

A renewed interest was met in the 1950-ies in Hungary (Gábori 1950, Vértes 1953) for obsidian use in the Palaeolithic period. Both authors emphasised the importance of long distance trade in the Palaeolithic period and its social connotations.

Figure 2 – Carpathian obsidian sources.
Fig. 2a: Carpathian 1, 2, and 3 obsidians; Fig. 2b: location of known Carpathian 1 and 2 sources





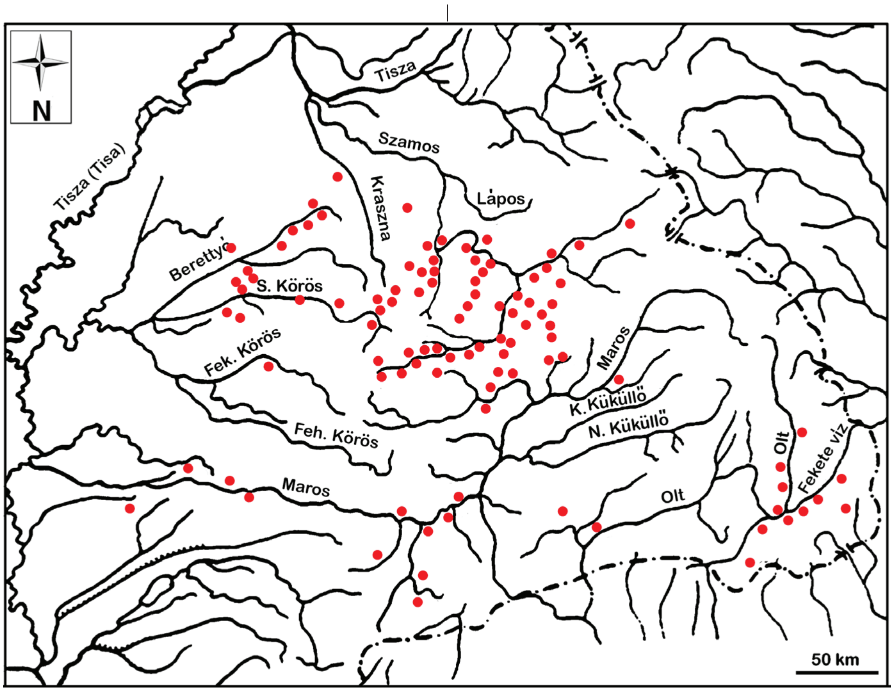


Figure 3 – Distribution map of obsidian from the Carpathian Basin compiled by F. Rómer in 1876

Figure 4 – Archaeological distribution of obsidian in Transylvania, compiled by M. Roska (1934)

4 – Petroarchaeology and archaeometry of obsidian

As a part of the spread of analytical methods in archaeology in the sixties and seventies of the last century, obsidian became a favourite subject for provenance studies on international scale. Following the first communications on the so-called "Mediterranean" obsidian regions (term applied in rather wide sense in various works of C. Renfrew and his collaborators), more and more techniques were successfully applied on sourcing obsidian starting with OES (Cann & Renfrew 1964), later on using NAA (Gordus *et al.,* 1968) and FTD (Bigazzi & Bonadonna 1973). The first successful geochemical characterisation of the Central European (Hungarian and Slovakian) obsidians was realised by NAA (O. Williams and colleagues, Warren & al. 1977, Williams & al. 1984.). Anglo-Saxon archaeometrical research introduced the name "Carpathian obsidian" for these sources with the ease of visitors from far away and grouped known sources accordingly (C1, C2). The name is misleading in many ways; none of the sources are actually in the Carpathian Mountains, though all of them are in the region of the Carpathian Basin, embraced by the above mentioned mountainous range, the (Eastern) Alps and the Dinarides. Further source of misunderstanding, Carpathian is a valid geochronological stage in regional geological system within the Miocene (Haas ed. 2001); the obsidians, however, were formed in a more recent stage, the so-called Sarmatian period (also in the Miocene). We keep the term 'Carpathian' for obsidians here on the strength of priority and to avoid further misunderstanding, noting the problems presented above.

Soon after the successful characterisation by Neutron Activation, the source-characteristic geochemical differences were also detected by EDS and XRF techniques (Biró *et al.,* 1986, 1988) and further sub-groups could be ascertained. Among the C2 (Hungarian) obsidians two variants could be differentiated clearly; C2T type (Tolcsva environs) and C2E (Mád-Erdőbénye environs). The three types can be separated with a trained eye macroscopically as well. C1 is clear / transparent, with shiny glassy surface, black in blocks; C2T (Tolcsva type) is opaque, even in relatively thin slice, black or sometimes reddish (mahogany obsidian); C2E is also opaque but dark graphite grey, often striped. All of them are known from archaeological context, on regional and even long distance range, too, but C1 is far the most popular version.

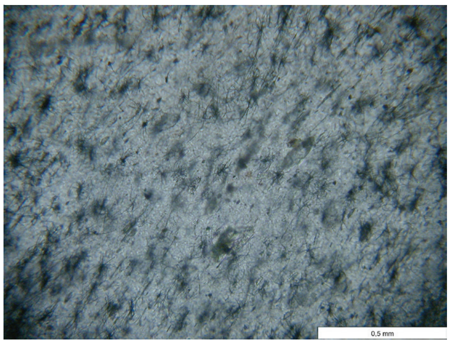


Figure 5
Thin section of C1 obsidian from the Lithotheca collection (L 88/11, Bodrogzsadány 5.)

The observed differences persist in other physical and chemical features as well. The thin section of C1 is clear, with isotropic matrix and few crystallites (Fig. 5) . C2 from Tolcsva and Mád both have more crystallites in the matrix, and there is a felsitic / striped texture observable in the glass. Moreover, the formation of hydration layer is seemingly much faster in the C2 types, very striking in the pieces of Palaeolithic context (Biró & Pozsgai 1982).

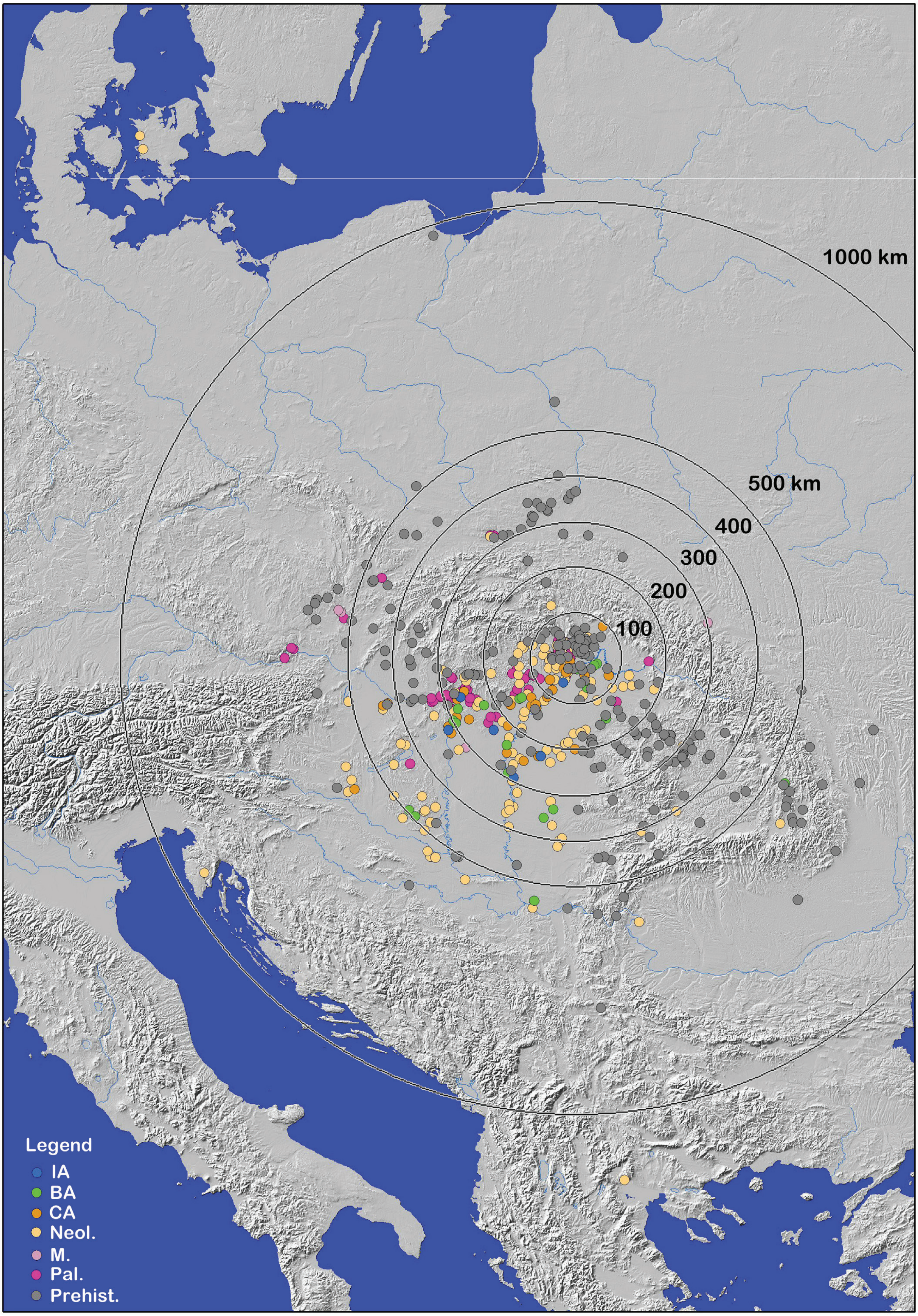
This feature in itself suggests - and we know from various geochemical studies - that the C1 obsidian is closer to the "glass optimum", has more silica and basically less other main components, esp. iron.

Geochemical characterisation of Carpathian obsidians, differentiating the main groups and all of them from other potential concurrent European sources was successful using a number of techniques. Apart from neutron activation analysis, which is still the most accepted routine method, measuring the main components and some trace elements by electron energy dispersive spectrometry (EDS, Biró *et al.,* 1986) and X-ray fluorescence (XRF, Biró *et al.,* 1988), as well as ion beam analytical techniques (PIXE-PIGE, Elekes *et al.,* 2000, Biró *et al.,* 2000c) proved equally successful and are more available for us and less destructive.

Very important contribution to the characterisation of Carpathian obsidians is the determination of the age of formation, i.e., geological age, by fission track dating (FTD, G. Bigazzi in Biró *et al.,* 2000b). It can help in cases when the geochemical composition is undistinguishable like certain C2 types interacting, on the basis of main composition, with one of the Sardinian sources and C1 type, interacting with the highest quality Central Anatolian obsidians. The relatively old age of Carpathian obsidians would clearly identify them in problematic cases; however, no suspect interacting piece was located so far, though we cannot exclude the possibility.

5 – Recent Hungarian contribution to obsidian studies

Following the afore mentioned distribution studies the author started to collect data relevant to obsidian distribution from literature as well as personal survey of the archaeological collections (Biró 1981, 1984). Effort was made to implement objective and instrumental methods for analysis. Unfortunately, most of the methods were destructive at least to some degree and while the historical information obviously justified the damage in debitage relatively close to the source areas, for more distant and unique pieces it was necessary to adopt an effective but non-destructive methodology. Our efforts fortunately met with technical possibilities using PIXE-PIGE techniques (Elekes *et al.,* 2000, Biró *et al.,* 2000c, Rózsa *et al.,* 2000) and PGAA, a non-destructive multi-element technique for geochemical characterisation (Kasztovszky & Biró 2004, 2006, Kasztovszky *et al.,* 2008). Initial application of this technique showed it to be adequate and sensitive enough for obsidian characterisation in view of comparative material from all known sources of Europe. Reference samples were obtained by personal trips to sources as well as kind donations and exchange of samples by means


1000 km
500 km
400
300
200
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Legend
IA
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of the comparative raw material collection of the Hungarian National Museum (Lithotheca, Biró & Dobosi 1990, Biró *et al.,* 2000a). Regular field surveys supported our source database, including special new reference material as the extremely rare red obsidian in our region (Biró *et al.,* 2005) and confirmation and characterisation of the long-debated obsidian sources in Ukraine (C3 type, Rosania *et al.,* 2008). Archaeological interpretation of obsidian distribution data was evaluated from chronological and quantitative aspects (Dobosi 2011 for Palaeolithic distribution and routing; Biró 1998, 1998a for Neolithic stages and Biró 2009 for an essay on overall assessment of Prehistoric obsidian use in Central Europe, by chronological periods and directions).

In this work we can rely on obsidian reported from archaeological sites without instrumental analyses as well as pieces actually analysed by various analytical techniques. The results are stored in a database. The localities are georeferenced, at least on the level of the village (not necessarily on the level of the site proper). The distances from the sources are calculated in direct linear distances – "as the crow flies" (ACF) and represented on topographical maps with concentrical circles set at 100 kms from the source (Fig. 6). I was trying to estimate the importance of directions in the spreading of obsidian artefacts, but there are some objective difficulties in realising this plan as yet.

We must be aware, that the database is far from being complete as yet and the level of information on sites, percentages and analyses is very different regionally. Therefore, the current view of distribution in different time periods is strongly biased by the standpoint of the analyst, the SW direction (from the aspect of the obsidian sources, present-day Hungary) is over-represented in many ways. Also, quite a lot of obsidian artefacts reported in archaeological technical literature lack detailed context or modern interpretation.

It is planned, in the framework of a current National Scientific Grant program, to make data interactively available but we still have to solve many problems for that. For the time being, the author has a relatively representative (though, also not complete)

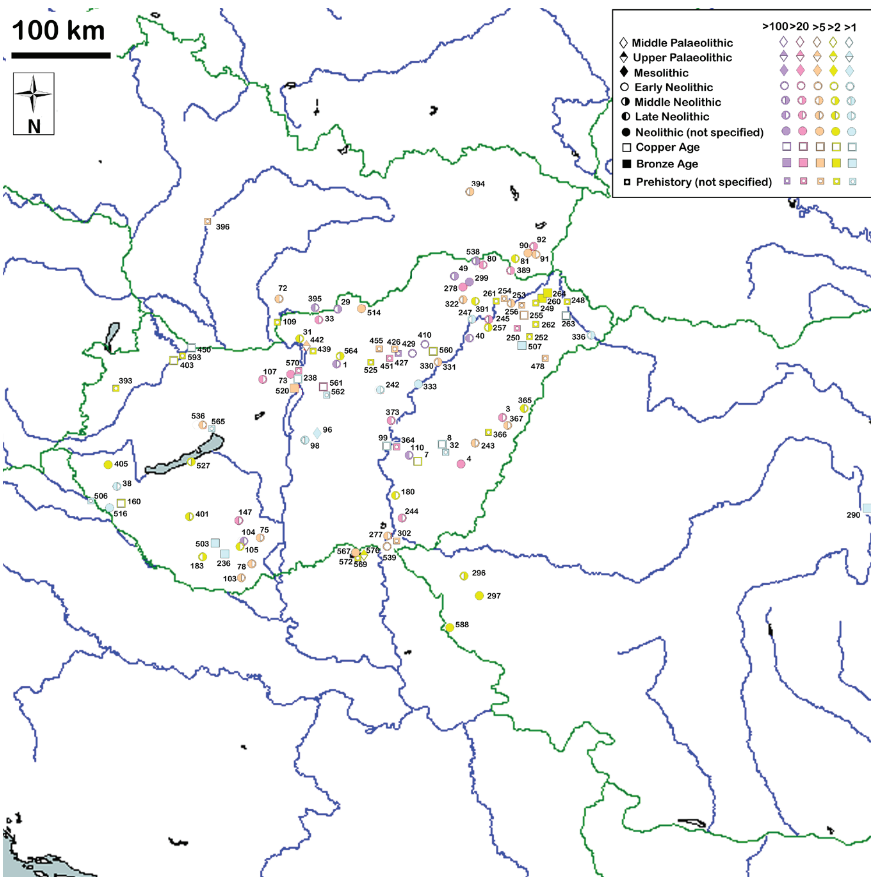


Figure 6 – Left page
Carpathian obsidian distribution by chronological periods and ACF distances from the sources

Figure 7
Quantitative and chronological aspects of obsidian distribution. Sites analysed personally by the author, Lithotheca database

set of information on the distribution of archaeological obsidian from the territory of Hungary mainly. It is presented in the framework of the recently accepted and established chronological scheme for the Carpathian Basin (Visy *et al.,* eds. 2003)(Table 1a & b) (Fig. 7).

The main features of obsidian distribution are summarised below. For the synthesis, I have used former collection of data (mainly Biró 1981, 1984), inventory data of HNM collections (e.g., Table 2), personal petroarchaeological macroscopic studies and analytical data published so far.

6 – Palaeolithic and Mesolithic obsidian distribution

Flakes from terraces of the Hornad river, allegedly Lower Palaeolithic were mentioned by L. Bánesz (1967). As there is no stratigraphical control to this claim, only terrace morphology, we have to treat this datum with caution.

It seems that the first authentic and well-dated instances of obsidian use in the Carpathian Basin date back to Middle Palaeolithic. In Hungary, finds from the Subalyuk Cave are especially important from this respect, with good stratigraphy and sound petroarchaeological characterisation of the lithic industry (Vendl 1939). The Middle Palaeolithic finds from Legénd in the Cserhát Mts. are especially noteworthy in respect of early obsidian use, as the site contains all known Carpathian 1-2 obsidian types including red obsidian (Markó & Péntek 2004).

We can suppose that obsidian reached and surpassed the Danube, a major geographical barrier, in the same period (Pilisszántó II rock shelter, Vértes 1965).

Middle Palaeolithic obsidian use was reported from the territory of Transcarpathian Ukraine around the sources of C3 obsidian (Maly Rakovets (Rokosovo), Ryzhov *et al.,* 2005).

Obsidian is known to be present on all the Early Upper Palaeolithic, mainly to the East of the Danube, as we have no authentic Aurignacian or Szeletian sites to the West of the Danube. The former "Transdanubian Szeletian industries" were more recently classified Middle Palaeolithic (Gábori-Csánk 1993) and contain no obsidian with the exception of the atypical raclette from the Pilisszántó II. rock shelter.

The spreading of the Gravettian culture is more evenly distributed within Hungary and most of the important sites have at least a handful of obsidians. Along the Danube, we have evidence of obsidian distribution till the Vienna Basin. It is also known that obsidian was equally popular on the territory of Slovakia (with the most important obsidian sources) and the territory of Poland, till at least Cracow environs. We have less authentic data on the situation to the East of the sources as yet (Fig. 8.).

The quantitative analysis / frequency data we have from Hungary indicate that obsidian was not a dominant raw material even on the territories close to the sources like Bodrogkeresztúr and Arka (Biró 1984). From Eastern Slovakia, however, we know obsidian dominated large sites with considerable workshop activity like Cejkov and Kašov (Bánesz 1967) where obsidian dominated the lithic assemblage.

We have only sporadic information on the Mesolithic spread of obsidian in the Carpathian Basin, as the number of known authentic sites is very little. Obsidian was described from the Mesolithic site Koroncó along the Danube (Gallus & Mithay 1942). Recently, several sites were discovered and published from the Jászság region. The raw material basis of these communities was mainly local, with sporadic occurrence of obsidian and Transdanubian radiolarite (Kertész 2003 p. 94). In Slovakia, around the sources, however, we have data on sites basically supplied with obsidian (Barca, Prošek (1959). (Fig. 8).

Table 1 (a) – ratio of obsidian and other raw material type groups on the investigated sites

		I.	II.	III.	IV.	V.	VI.	VII.	total	obs %
SITE 299	Encs Kelecsény	775	105	0	0	0	0	24	904	85,73
SITE 429	Füzesabony Gubakút	660	241	5	0	1	0	36	943	69,99
SITE 410	Mezőkövesd Mocsolyás	623	226	2	0	4	0	521	1398	44,56
SITE 1	Aszód Papi földek	615	1234	200	2	402	3	1532	3988	15,42
SITE 538	Hidasnémeti Kis köteles	585	1177	0	0	3	0	19	1784	32,79
SITE 395	Kolary Kolary	369	50	0	0	21	0	22	462	79,87
SITE 29	Szécsény Ültetés	251	112	23	0	22	0	30	438	57,31
SITE 49	Felsővadász Várdomb	172	400	0	0	7	0	56	636	27,04
SITE 104	Zengővárkony	155	0	20	2290	8	0	119	2596	5,97
SITE 427	Kompolt Kistéri tanya 14	144	172	3	0	6	1	129	455	31,65
SITE 110	Öcsöd Kováshalom	109	2566	997	3	8	13	649	4345	2,51
SITE 244	Hódmezővásárhely Gorzsa	99	24	14	94	10	31	49	321	30,84
SITE 33	Csesztve Stalák	98	214	4	0	100	0	34	453	21,63
SITE 389	Sátoraljaújhely Ronyvapart	97	27	0	0	0	0	1	125	77,60
SITE 107	Csabdi Télizöldes	88	52	156	0	11	1	105	413	21,31
SITE 147	Lengyel	57	3	53	460	3	0	24	600	9,50
SITE 92	Slavkovce	56	3	0	0	0	0	7	66	84,85
SITE 364	Tiszaföldvár Téglagyár	56	25	6	0	22	0	31	140	40,00
SITE 278	Ináncs Dombrét	55	57	0	0	1	0	5	118	46,61
SITE 561	Pécel Majorhegy	50	14	22	3	9	0	429	527	9,49
SITE 3	Berettyóújfalu Herpály	41	12	0	0	79	0	26	159	25,79
SITE 250	Nyíregyháza Ságvári TSz	40	6	0	0	0	0	0	46	86,96
SITE 451	Nagyút 4, Göbölyjárás II. M-3 /12	31	18	0	0	1	0	18	68	45,59
SITE 80	Gönc Gát	30	94	0	0	16	0	11	151	19,87
SITE 4	Mezőberény Bódishát	29	17	0	2	18	1	14	81	35,80
SITE 245	Tiszalök Hajnalos	28	8	0	0	0	0	4	40	70,00
SITE 73	Budapest Aranyhegyi út	22	8	159	0	16	0	29	235	9,36
SITE 570	Budapest Nánási út 69	22	157	112	0	23	0	677	994	2,21
SITE 373	Szolnok Tűzköves	21	580	41	0	0	2	41	685	3,07
SITE 254	Balsa Fecskepart	19	1	0	0	4	0	0	24	79,17
SITE 539	Tiszasziget	18	21	49	1	4	4	36	133	13,53
SITE 442	Vác Csipkés	18	201	18	0	22	0	109	368	4,89
SITE 569	Szabadka-Ludasi tó H1-A (Hulló-tanya)	17	4	14	1	1	1	37	75	22,67
SITE 367	Berettyóújfalu Szilhalom	17	9	0	0	50	0	4	80	21,25
SITE 394	Sarisske Michalany	17	20	0	0	2	0	99	138	12,32
SITE 455	Visonta K-II 1A	16	19	1	0	1	0	7	44	36,36
SITE 520	Budapest Albertfalva	15	12	31	0	7	0	522	588	2,55
SITE 255	Kemecse Sarvaj birtok	14	8	0	0	0	0	0	22	63,64
SITE 72	Santovka	14	149	9	0	33	0	19	224	6,25
SITE 478	Nyírlugos Erzsébet-hegy	11	0	0	0	0	0	0	11	100,00
SITE 103	Villánykövesd	11	0	3	30	4	0	2	50	22,00
SITE 75	Kismórágy Tűzkődomb	11	0	4	37	0	0	7	59	18,64
SITE 302	Deszk Vénó	11	2	9	3	19	0	39	83	13,25
SITE 243	Szeghalom Várhely	10	2	0	0	1	1	0	14	71,43
SITE 514	Salgótarján Ipari Park II.	10	5	0	0	2	0	5	22	45,45
SITE 426	Kompolt Kistéri tanya I (15)	10	69	3	0	1	0	138	221	4,52
SITE 396	Trencianske Bohuslavicze	9	0	1	0	0	0	0	10	90,00
SITE 90	Malé Raskovce	9	13	0	0	1	0	8	31	29,03
SITE 277	Tápé Lebő	9	4	10	5	1	1	22	52	17,31
SITE 253	Tiszavasvári Köztemető	8	2	0	0	0	0	0	10	80,00
SITE 330	Tiszavalk Négyes	8	6	0	0	0	0	0	14	57,14
SITE 91	Izkovce	8	5	0	0	63	0	8	84	9,52
SITE 322	Megyaszó Nagyrépás hill	7	28	0	0	1	0	5	41	17,07
SITE 536	Veszprém Jutasi út (ld. Felszabadítók)	7	0	63	0	0	0	85	156	4,49
SITE 256	Nagyhalász Pusztatemplom	6	0	0	0	1	0	0	7	85,71
SITE 78	Babarc	6	0	0	2	0	0	4	12	50,00
SITE 567	Szabadka-Ludasi tó H2-A (Hulló-tanya)	6	4	53	9	0	2	106	181	3,31
SITE 260	Rétközberencs Paradomb	5	0	0	0	0	0	0	5	100,00
SITE 297	Freidorf (Timisoara)	5	1	0	0	0	0	2	8	62,50
SITE 257	Tiszavasvári Keresztfal x	5	5	0	0	0	0	0	10	50,00
SITE 296	Satchinez	5	1	0	0	1	2	3	12	41,67
SITE 7	Békésszentandrás	5	1	0	0	5	0	2	13	38,46
SITE 366	Darvas Kisbogárzó	5	4	0	0	5	0	0	14	35,71
SITE 248	Kisvarsány	4	2	0	0	1	0	2	9	44,44
SITE 576	Nosza Gyöngypart	4	1	1	4	0	30	12	53	7,55
SITE 393	Gór Kápolnadomb	4	0	190	3	0	0	276	482	0,83
SITE 249	Gégény	3	0	0	0	0	0	0	3	100,00
SITE 252	Nyírszőlős Izabella u. 121	3	0	0	0	0	0	0	3	100,00
SITE 264	Kisvárda	3	0	0	0	0	0	0	3	100,00
SITE 572	Szabadka-Ludasi tó H1-C (Hulló-tanya)	3	1	1	0	0	1	9	15	20,00
SITE 439	Vác Szék-hegy	3	12	23	0	4	0	5	47	6,38
SITE 568	Szabadka-Ludasi tó H2-B (Hulló-tanya)	3	1	17	0	0	2	26	49	6,12
SITE 588	Foieni Cimitir	3	9	3	6	1	35	51	109	2,75
SITE 403	Ikrény M-1 546 tripód	3	0	108	0	13	0	31	161	1,86

SITE 401	Kaposvár Gyertyános	3	1	48	67	0	0	60	179	1,68
SITE 593	Ménfőcsanak Széles földek	3	3	82	0	2	0	111	202	1,49
SITE 180	Szegvár Tűzköves	3	90	60	0	0	1	49	203	1,48
SITE 527	Balatonszemes Bagódomb	3	2	210	0	0	0	40	255	1,18
SITE 261	Timár Béke TSz	2	1	0	0	0	0	0	3	66,67
SITE 262	Apagy Nagyharaszti tanya	2	0	0	0	0	0	1	3	66,67
SITE 109	Vámosmikola Harmospuszta	2	0	2	0	0	0	0	4	50,00
SITE 287	Cozmeni	2	0	0	0	2	1	1	6	33,33
SITE 81	Hrcel Nad banou	2	0	0	0	4	0	0	6	33,33
SITE 564	Verseg Zsolnai oldal	2	5	0	0	0	0	0	7	28,57
SITE 560	Szentistván Mádi rét, MOL-24	2	7	0	0	0	0	0	9	22,22
SITE 525	Vámosgyörk MHAT telep	2	6	1	0	0	0	3	12	16,67
SITE 183	Szentlőrinc Szentlörinc	2	0	7	5	0	0	1	15	13,33
SITE 391	Szerencs Taktaföldvár	2	12	0	0	0	0	4	18	11,11
SITE 160	Nagykanizsa Sánc	2	0	46	19	1	0	68	136	1,47
SITE 105	Pécsvárad Aranyhegy	2	0	6	222	0	0	2	232	0,86
SITE 31	Verőcemaros Magyarkút	2	168	89	0	8	0	16	283	0,71
SITE 405	Gellénháza Városrét	2	6	1043	5	3	0	352	1414	0,14
SITE 247	Tiszadob Sziget	1	0	0	0	0	0	0	1	100,00
SITE 251	Oros Fölvár	1	0	0	0	0	0	0	1	100,00
SITE 258	Tiszabercel Ráctemető	1	0	0	0	0	0	0	1	100,00
SITE 259	Nagyhalász TSz Gépáll.	1	0	0	0	0	0	0	1	100,00
SITE 265	Tiszalök Kisfás, Bereczki d.	1	0	0	0	0	0	0	1	100,00
SITE 32	Gyomaendrőd Gyoma 117	1	0	0	0	0	0	0	1	100,00
SITE 331	Tiszavalk Tetes	1	0	0	0	0	0	0	1	100,00
SITE 333	Kisköre Gát	1	1	0	0	0	0	0	2	50,00
SITE 336	Szamossályi Szamossályi	1	1	0	0	0	0	0	2	50,00
SITE 8	Gyomaendrőd Endrőd 108	1	0	0	0	1	0	0	2	50,00
SITE 99	Tiszabög Kincsem	1	0	0	0	1	0	0	2	50,00
SITE 263	Nagydobos Petőfi TSz	1	1	0	0	0	0	2	4	25,00
SITE 290	Leliceni Leliceni (Csikszentlélek)	1	0	0	0	2	0	1	4	25,00
SITE 592	Karmacs ??	1	0	1	1	0	0	2	5	20,00
SITE 365	Esztár Fenyvespart	1	0	0	0	8	0	1	10	10,00
SITE 507	Nagykálló Telekoldal	1	8	0	0	0	0	2	11	9,09
SITE 98	Kunszentmiklós Középszenttamás	1	2	12	0	0	0	3	18	5,56
SITE 503	Kovácsszénája Füstöslik	1	0	0	10	0	0	9	20	5,00
SITE 238	Budapest Medve u.	1	3	3	0	0	0	15	22	4,55
SITE 236	Pécs Nagyárpád	1	0	0	28	0	0	1	30	3,33
SITE 242	Alattyán Vizköz 3	1	34	0	0	1	0	4	40	2,50
SITE 450	Ménfőcsanak Bevásárlóközpont	1	0	9	0	0	0	31	41	2,44
SITE 562	Pécel M0 Kelet, 02	1	7	8	0	3	0	86	106	0,94
SITE 96	Kunpeszér Felsőpeszéri út	1	78	12	2	0	0	22	115	0,87
SITE 565	Litér Papvásárhegy	1	0	185	0	0	0	2	188	0,53
SITE 38	Zalaszentbalázs Szőlőhegyi mező	1	5	202	7	3	3	193	414	0,24
SITE 506	Muraszemenye Aligvári mező	1	0	511	7	0	0	483	1004	0,10
SITE 516	Petrivente Újkúti dűlő	1	0	1200	28	1	7	2649	3913	0,03

Key:

I.	obsidian
II.	hydrothermal and limnic silicites
III.	Transdanubian radiolarite
IV.	Mecsek radiolarite
V.	"Northern" flint
VI.	"Southern" flint
VII.	other raw materials

Table 1a – Archaeological sites with obsidian from the Lithotheca database. Table 1a: main raw material groups;

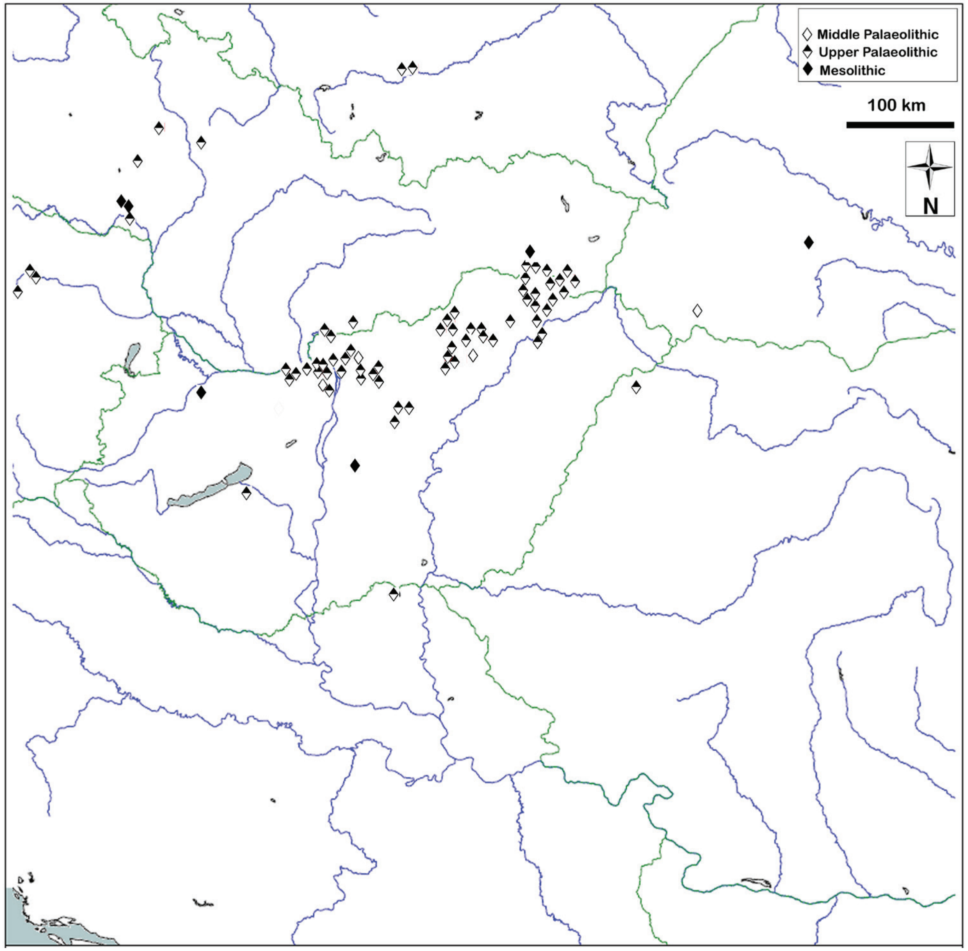
Table 1 (b) – ratio of obsidian and obsidian types on the investigated sites

		Obs. Total	C1	C2E	C2T	total	Obs. %
SITE 299	Encs Kelecsény	775	751	0	24	904	85,73
SITE 429	Füzesabony Gubakút	660	640	1	19	943	69,99
SITE 410	Mezőkövesd Mocsolyás	623	609	1	13	1398	44,56
SITE 1	Aszód Papi földek	615	580	11	24	3988	15,42
SITE 538	Hidasnémeti Kis köteles	585	565	1	19	1784	32,79
SITE 395	Kolary Kolary	369	357	1	11	462	79,87
SITE 29	Szécsény Ültetés	251	244	1	6	438	57,31
SITE 49	Felsővadász Várdomb	172	160	1	11	636	27,04
SITE 104	Zengővárkony Zengővárkony	155	153	0	2	2596	5,97
SITE 427	Kompolt Kistéri tanya 14	144	143	0	1	455	31,65
SITE 110	Öcsöd Kováshalom	109	104	1	4	4345	2,51
SITE 244	Hódmezővásárhely Gorzsa	99	99	0	0	321	30,84
SITE 33	Csesztve Stalák	98	97	0	1	453	21,63
SITE 389	Sátoraljaújhely Ronyvapart	97	94	0	3	125	77,60
SITE 107	Csabdi Télizöldes	88	86	0	2	413	21,31
SITE 147	Lengyel Lengyel	57	56	0	1	600	9,50
SITE 92	Slavkovce Slavkovce	56	56	0	0	66	84,85
SITE 364	Tiszaföldvár Téglagyár	56	55	0	1	140	40,00
SITE 278	Ináncs Dombrét	55	51	1	3	118	46,61
SITE 561	Pécel Majorhegy	50	48	0	2	527	9,49
SITE 3	Berettyóújfalu Herpály	41	38	0	3	159	25,79
SITE 250	Nyíregyháza Ságvári TSz	40	40	0	0	46	86,96
SITE 451	Nagyút 4, Göbölyjárás II. M-3 /12	31	30	0	1	68	45,59
SITE 80	Gönc Gát	30	25	0	5	151	19,87
SITE 4	Mezőberény Bódishát	29	27	1	1	81	35,80
SITE 245	Tiszalök Hajnalos	28	22	2	4	40	70,00
SITE 73	Budapest Aranyhegyi út	22	21	0	1	235	9,36
SITE 570	Budapest Nánási út 69	22	21	1	0	994	2,21
SITE 373	Szolnok Tűzköves	21	21	0	0	685	3,07
SITE 254	Balsa Fecskepart	19	17	1	1	24	79,17
SITE 539	Tiszasziget Tiszasziget	18	18	0	0	133	13,53
SITE 442	Vác Csipkés	18	14	2	2	368	4,89
SITE 569	Szabadka-Ludasi tó H1-A (Hulló-tanya)	17	16	0	1	75	22,67
SITE 367	Berettyóújfalu Szilhalom	17	17	0	0	80	21,25
SITE 394	Sarisske Michalany Sarisske Michalany	17	17	0	0	138	12,32
SITE 455	Visonta K-II 1A	16	16	0	0	44	36,36
SITE 520	Budapest Albertfalva	15	15	0	0	588	2,55
SITE 255	Kemecse Sarvaj birtok	14	14	0	0	22	63,64
SITE 72	Santovka Santovka	14	14	0	0	224	6,25
SITE 478	Nyírlugos Erzsébet-hegy	11	11	0	0	11	100,00
SITE 103	Villánykövesd Villánykövesd	11	11	0	0	50	22,00
SITE 75	Kismórágy Tűzkődomb	11	10	0	1	59	18,64
SITE 302	Deszk Vénó	11	11	0	0	83	13,25
SITE 243	Szeghalom Várhely	10	10	0	0	14	71,43
SITE 514	Salgótarján Ipari Park II.	10	10	0	0	22	45,45
SITE 426	Kompolt Kistéri tanya I (15)	10	9	0	1	221	4,52
SITE 396	Trencianske Bohuslavicze Trencianske Bohuslavicze	9	0	9	0	10	90,00
SITE 90	Malé Raskovce Malé Raskovce	9	9	0	0	31	29,03
SITE 277	Tápé Lebő	9	9	0	0	52	17,31
SITE 253	Tiszavasvári Köztemető	8	8	0	0	10	80,00
SITE 330	Tiszavalk Négyes	8	8	0	0	14	57,14
SITE 91	Izkovce Izkovce	8	8	0	0	84	9,52
SITE 322	Megyaszó Nagyrépás hill	7	7	0	0	41	17,07
SITE 536	Veszprém Jutasi út (ld. Felszabadítók)	7	7	0	0	156	4,49
SITE 256	Nagyhalász Pusztatemplom	6	6	0	0	7	85,71
SITE 78	Babarc Babarc	6	6	0	0	12	50,00
SITE 567	Szabadka-Ludasi tó H2-A (Hulló-tanya)	6	6	0	0	181	3,31
SITE 260	Rétközberencs Paradomb	5	5	0	0	5	100,00
SITE 297	Freidorf (Timisoara)	5	5	0	0	8	62,50
SITE 257	Tiszavasvári Keresztfal x	5	2	3	0	10	50,00
SITE 296	Satchinez Satchinez	5	5	0	0	12	41,67
SITE 7	Békésszentandrás Békésszentandrás	5	5	0	0	13	38,46
SITE 366	Darvas Kisbogárzó	5	5	0	0	14	35,71
SITE 248	Kisvarsány Kisvarsány	4	4	0	0	9	44,44
SITE 576	Nosza Gyöngypart	4	0	3	1	53	7,55
SITE 393	Gór Kápolnadomb	4	4	0	0	482	0,83
SITE 249	Gégény Gégény	3	3	0	0	3	100,00
SITE 252	Nyírszőlős Izabella u. 121	3	3	0	0	3	100,00
SITE 264	Kisvárda Kisvárda	3	3	0	0	3	100,00
SITE 572	Szabadka-Ludasi tó H1-C (Hulló-tanya)	3	3	0	0	15	20,00
SITE 439	Vác Szék-hegy	3	3	0	0	47	6,38
SITE 568	Szabadka-Ludasi tó H2-B (Hulló-tanya)	3	3	0	0	49	6,12
SITE 588	Foieni Cimitir	3	3	0	0	109	2,75
SITE 403	Ikrény M-1 546 tripód	3	3	0	0	161	1,86

SITE 401	Kaposvár Gyertyános	3	3	0	0	179	1,68
SITE 593	Ménfőcsanak Széles földek	3	3	0	0	202	1,49
SITE 180	Szegvár Tűzköves	3	3	0	0	203	1,48
SITE 527	Balatonszemes Bagódomb	3	3	0	0	255	1,18
SITE 261	Timár Béke TSz	2	2	0	0	3	66,67
SITE 262	Apagy Nagyharaszti tanya	2	2	0	0	3	66,67
SITE 109	Vámosmikola Harmospuszta	2	2	0	0	4	50,00
SITE 287	Cozmeni Cozmeni	2	2	0	0	6	33,33
SITE 81	Hrcel Nad banou	2	2	0	0	6	33,33
SITE 564	Verseg Zsolnai oldal	2	2	0	0	7	28,57
SITE 560	Szentistván Mádi rét, MOL-24	2	2	0	0	9	22,22
SITE 525	Vámosgyörk MHAT telep	2	2	0	0	12	16,67
SITE 183	Szentlőrinc Szentlörinc	2	2	0	0	15	13,33
SITE 391	Szerencs Taktaföldvár	2	1	0	1	18	11,11
SITE 160	Nagykanizsa Sánc	2	2	0	0	136	1,47
SITE 105	Pécsvárad Aranyhegy	2	2	0	0	232	0,86
SITE 31	Verőcemaros Magyarkút	2	2	0	0	283	0,71
SITE 405	Gellénháza Városrét	2	2	0	0	1414	0,14
SITE 247	Tiszadob Sziget	1	0	0	1	1	100,00
SITE 251	Oros Fölvár	1	1	0	0	1	100,00
SITE 258	Tiszabercel Ráctemető	1	1	0	0	1	100,00
SITE 259	Nagyhalász TSz Gépáll.	1	1	0	0	1	100,00
SITE 265	Tiszalök Kisfás, Bereczki d.	1	1	0	0	1	100,00
SITE 32	Gyomaendrőd Gyoma 117	1	0	0	1	1	100,00
SITE 331	Tiszavalk Tetes	1	1	0	0	1	100,00
SITE 333	Kisköre Gát	1	1	0	0	2	50,00
SITE 336	Szamossályi Szamossályi	1	1	0	0	2	50,00
SITE 8	Gyomaendrőd Endrőd 108	1	1	0	0	2	50,00
SITE 99	Tiszabög Kincsem	1	1	0	0	2	50,00
SITE 263	Nagydobos Petőfi TSz	1	1	0	0	4	25,00
SITE 290	Leliceni Leliceni (Csikszentlélek)	1	1	0	0	4	25,00
SITE 592	Karmacs ??	1	1	0	0	5	20,00
SITE 365	Esztár Fenyvespart	1	1	0	0	10	10,00
SITE 507	Nagykálló Telekoldal	1	1	0	0	11	9,09
SITE 98	Kunszentmiklós Középszenttamás	1	1	0	0	18	5,56
SITE 503	Kovácsszénája Füstöslik	1	1	0	0	20	5,00
SITE 238	Budapest Medve u.	1	1	0	0	22	4,55
SITE 236	Pécs Nagyárpád	1	1	0	0	30	3,33
SITE 242	Alattyán Vizköz 3	1	1	0	0	40	2,50
SITE 450	Ménfőcsanak Bevásárlóközpont	1	1	0	0	41	2,44
SITE 562	Pécel M0 Kelet, 02	1	1	0	0	106	0,94
SITE 96	Kunpeszér Felsőpeszéri út	1	1	0	0	115	0,87
SITE 565	Litér Papvásárhegy	1	1	0	0	188	0,53
SITE 38	Zalaszentbalázs Szőlőhegyi mező	1	1	0	0	414	0,24
SITE 506	Muraszemenye Aligvári mező	1	0	1	0	1004	0,10
SITE 516	Petrivente Újkúti dűlő	1	1	0	0	3913	0,03

Table 1b – ratio of obsidian and obsidian types on the investigated sites. The quantitative data on the relevant sites are mapped on Fig

Figure 8 – Palaeolithic and Mesolithic obsidian distribution map



7 – Neolithic obsidian use and distribution

The Early Neolithic brought about essential changes. Obsidian-dominated lithic industries appeared on the Great Hungarian Plain and the marginal zones of the Körös-Cris complex (Bácskay & Biró 1983, Bácskay & Simán 1987, Starnini 1994, 2001). This abundance of obsidian is still observable in the roughly contemporary earliest LBC industries (Biró 1987, 2002, Biró in press for Mezőkövesd-Mocsolyás and Füzesabony-Gubakút site monographs). Though most of these assemblages have been studied only by macroscopic inspection and relatively few of them were actually tested by instrumental analytical methods we can say that they were based on Carpathian sources as no outliers were found so far in the territory of Hungary. As the Neolithisation process had undoubtedly very strong connections to the Balkans and we can suppose not only "trade" contacts but direct migrations as well, it is historically not unlikely that Eastern Mediterranean obsidian had an essential advance towards the North: obsidian analysis data however do not support this as yet.

Other raw materials, notably Balkan/Banat flint has already been observed in Körös context (Kaczanowska *et al.,* 1981). We still lack authentic information on the Northern limits of the spreading of Melian obsidian and the southern (South-Western) advance of Carpathian obsidians (Fig. 9).

By the Middle Neolithic, the situation seems to, sort of, stabilised in the Carpathian Basin. The good quality local resources were known and in use by the established Neolithic population inside the Carpathian Basin, especially Hungary (Biró 1998). Obsidian supplied the lowland area, so to say, its natural supply zones, together with hydrothermal and limnic siliceous rocks travelling most likely on the same routes with minor amounts of long distance imports. (Biró 1998a Figs. 3-4). The areas to the West of the Danube and along the floodplain were supplied basically with Transdanubian siliceous rocks, in the first place, radiolarite and the occurrence of obsidian on the western parts of the country was rather an exception than a tendency (e.g., Balatonszemes, Biró 2007). By the end of the Middle Neolithic period, it seems that the best quality obsidian sources

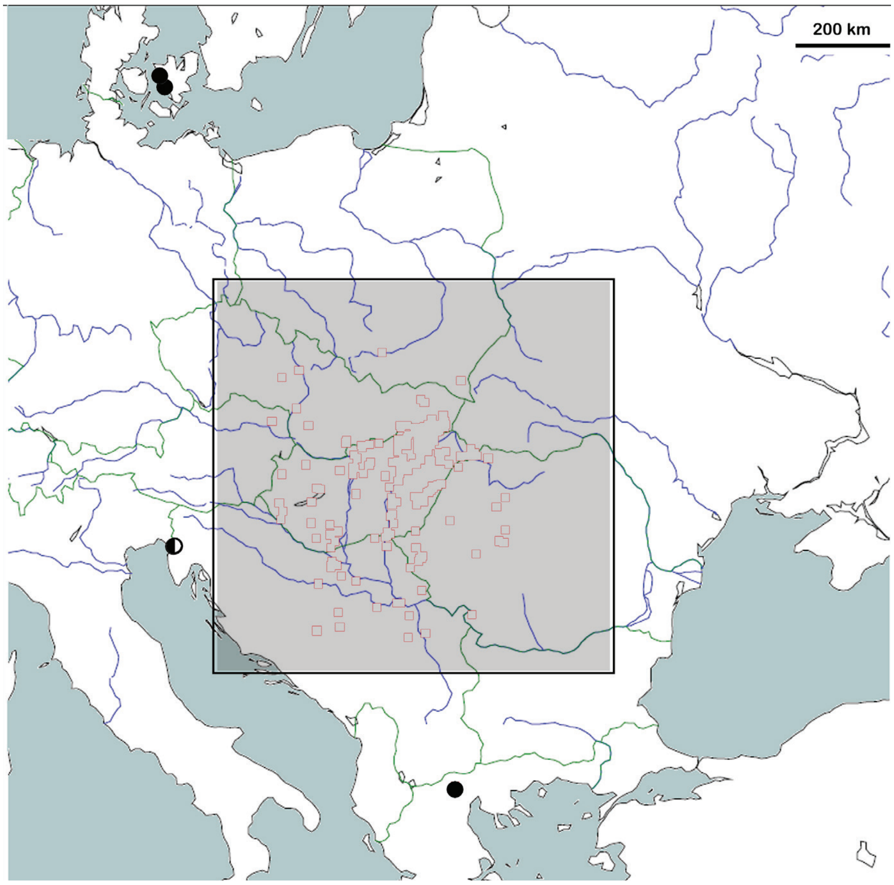


Figure 9a
Neolithic obsidian distribution map

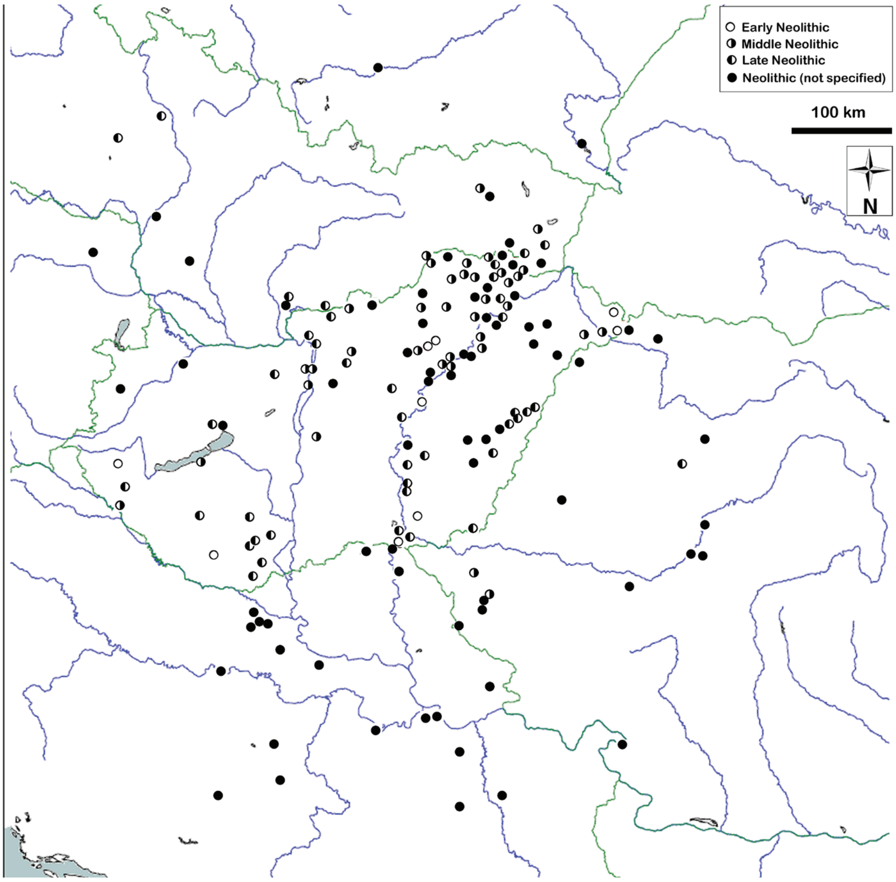


Figure 9b
Neolithic obsidian distribution map

were practically exploited. This is mainly apparent in the size of the pieces used. The depot find of giant obsidian cores from Nyírlugos can be tentatively dated to Middle Néolithic period (Fig.10) though in the very first publication, on the strength of the large (flint) blades found in Early/Middle Copper Age graves, J. Hillebrand associated them with the Copper Age. (Hillebrand 1928). Analogous finds from Bükk Culture settlement context (Kašov-Čepegov, Bánesz 1991; Szécsény-Ültetés, Biró 1987) and the lack of large obsidian tools after the Neolithic seem to speak for a MN context (Fig 9).

The Late Neolithic period brought about essential changes in obsidian raw material management. The most striking features are:

- a seemingly "low obsidian" area on the place of the former evenly distributed Alföld region, roughly corresponding to the Tisza culture area
- a marked advance on behalf of the Lengyel (and Csőszhalom) cultures towards the obsidian sources
- the appearance of distribution centres along the fringes of the Lengyel Culture distribution area as well as some Vinča culture centres (Aszód, Csabdi, Zlkovce; on the south, Vinča, Zengővárkony, Samatovci etc.). In these localities, obsidian microblade production was intensive and by individual number of chipped stone finds, the ratio of obsidian could surpass 10 %.

Most of the obsidian implements of this period are of extremely small size and the production of microblades typically start on the settlements from the stage of micro-cores with essential amount of cortex. All these phenomena indicate that the

Figure 10
Nyírlugos, obsidian core depot find

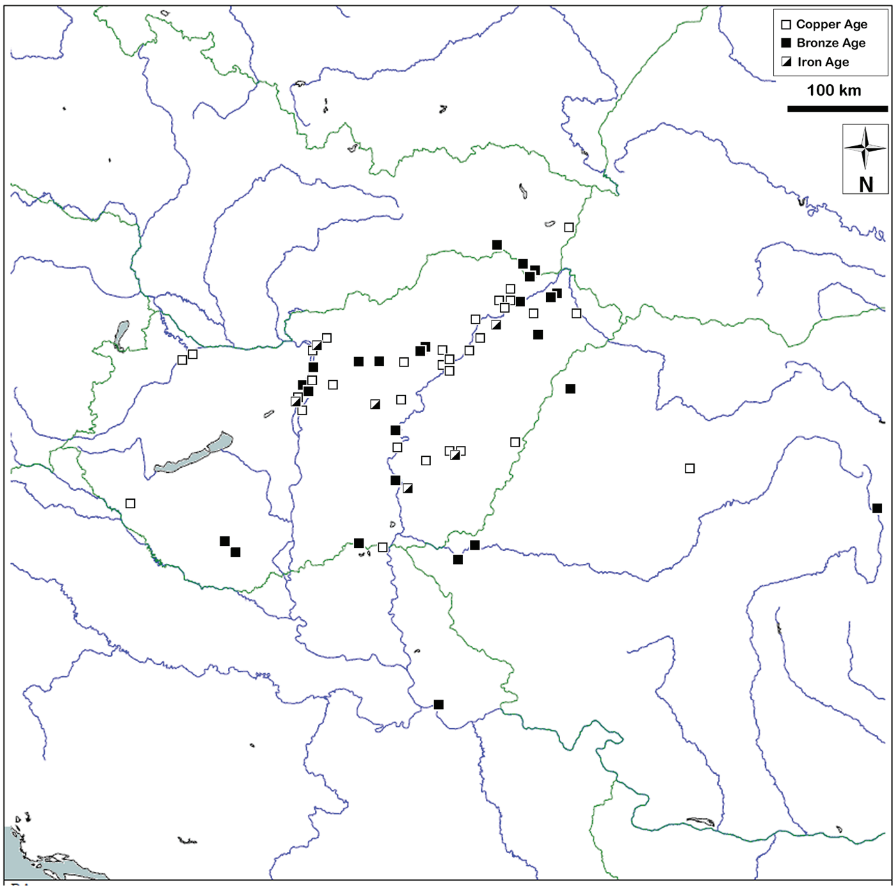
obsidian sources were considerably depleted (probably, still during the late phase of the Middle Neolithic). Some of the most distant instances of obsidian distribution can be connected most probably to the Late Neolithic (Denmark, p.c. by D. Liversage, Mandalo, Greece (Kilikoglou *et al.*, 1996), Grotta Tartaruga, Istria, Williams *et al.*, 1984), though not all of the finds are from absolutely stable stratigraphical context.

By the end of the Late Neolithic period we can observe the inflow of good quality flint raw material in large quantities, partly from Poland (Jurassic Cracow flint, Chocolate flint) but mainly from the north-east; Volhynian flint and Prut flint. The large flint blades from Copper Age graves originate from these sources. Obsidian is still present, but the main form of utilisation seems to change. (Fig. 11). We can come across, very frequently, projectile points of bifacial triangular type as well as trapezoid bladelets, also known in the function of projectiles. It is rather difficult to estimate the role of obsidian in the very young chipped industries. Its importance and high prestige is documented in the Csongrád-Felgyő grave retouched blade (Fig. 12), probably the last really important long obsidian blade known so far from Hungary.

Recently there is more attention drawn to Bronze Age and younger lithic industries. We can say that as long as the authentic primary utilisation of chipped stones can be observed (currently the limit is somewhere in the LBA/EIA finds), obsidian is present though quite often in secondary use. The details of Late Prehistoric obsidian use in the Carpathian Basin will need much more studies in the future (*Table 2: obsidian artefacts in the prehistoric collection of the Hungarian National Museum. Data from the HNM inventory register*).

Figure 11 – Copper Age and more recent obsidian distribution map

Figure 12 – Large obsidian blade from the early bronze age pit-grave culture Csongrád-Felgyő grave Ecsedy 1979



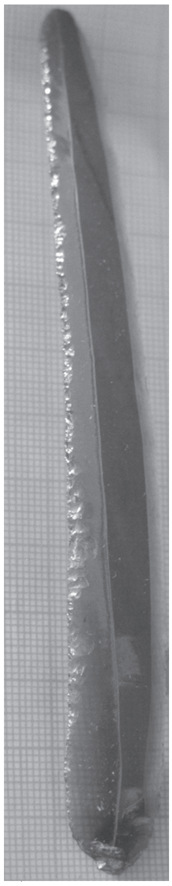


Table 2 – Obsidian artefacts in the prehistoric collection of the Hungarian National Museum. Data from the HNM inventory register

Site name	Körös Culture	Szatmár group	AVK (Alföld LBC)	Bükki Culture	Tisza Culture	Neolithic	Neolithic total
Abaújszántó						10	10
Aggtelek				1		3	4
Aggtelek, Baradla-barlang				4			4
Ároktő						1	1
Baskó						5	5
Berettyóújfalu						1	1
Bodrogkeresztúr					9	21	30
Bódvaszilas						1	1
Budapest						3	3
Büdöspest-barlang				1			1
Bükk-hegység						1	1
Dévaványa					1		1
Edelény				22			22
Érpatak						1	1
Hencida						1	1
Hódmezővásárhely	1						1
Hollóháza						3	3
Kenézlő						1	1
Kisbárapáti						1	1
Kisköre					1		1
Kisköre, Gát			1		2		3
Korlát				11		50	61
Koroncó						1	1
Krasznokvajda			6				6
Megyaszó						8	8
Mikóháza						1	1
Miskolc, Herman Ottó-barlang				19			19
Mórágy						13	13
Nagyecsed			1				1
Nagyszalánc						4	4
Örvényes						1	1
Pazdics						5	5
Poroszló						1	1
Rakamaz						1	1
Regéc						9	9
Sárazsadány				8		2	10
Sátoraljaújhely				1		3	4
Sonkád		11					11
Szamossályi			1				1
Szeged					16		16
Szeleta-barlang						7	7
Szihalom						4	4
Szilvásvárad				1			1
Szinyér						6	6
Tállya				2			2
Tiszafüred			3				3
Tiszalúc, Sarkad-puszta						1	1
Tiszanána			1				1
Tiszavalk			7				7
Tiszavalk, Tetes			1				1

Uppony			1				1
Velejte						9	9
Zajta		1					1
Zalkod						1	1
Zsáka					2		2

Site name	Tisza-polgár Culture	Bodrog-keresztúr Culture	Hunyadi-halom Culture	Boleráz Culture	Baden Culture	Copper Age	Copper Age total
Alsópetény						1	1
Érd						1	1
Jászladány		4					4
Magyarhomorog		9					9
Polgár, Basa-tanya						6	6
Poroszló					1		1
Sárazsadány	7						7
Szabolcs						2	2
Szigetcsép					3		3
Tahitótfalu				1			1
Tarnabod						2	2
Tiszafüred, Majoroshalom			2				2
Tiszakeszi						1	1
Tiszalúc, Sarkad-puszta			33				33
Tiszavalk, Tetes		6					6
Tokaj						1	1

Site name	Early Bronze Age	Bell-beaker Culture	Hatvan Culture	Füzes-abony Culture	Late Bronze Age	Bronze Age	Bronze Age Total
Bodrogszerdahely						3	3
Dunakeszi		1					1
Edelény					1		1
Füzesabony				1			1
Nagykálló						3	3
Pancsova						1	1
Szihalom			16				16
Tószeg, Laposhalom	2					2	4
Vámosgyörk						1	1

Site name	La Tene Culture	Scythian	Late Iron Age	prehistory	no data	Sum Iron Age + uncertain
Aggtelek				4		4
Baskó				11		11
Berettyóújfalu				15		15
Bodrogkeresztúr-Kutyasor					3	3
Bojt					1	1
Dunaújváros				1		1
Felsőtárkány				1		1
Fony					1	1
Gyomaendrőd				1		1
Győr				1		1
Hatvan				1		1
Kisürögd				4		4
Komárom				1		1
Kosd	1					1
Magyarhomorog					1	1

Megyaszó					30	30
Mélosz				4		4
Mikóháza				1		1
Mohács				1		1
Nagykörű				3		3
Nagykövesd				2		2
Nyíri				10		10
Peskő-barlang					2	2
Polgár					4	4
Polgár, Basa-tanya					15	15
Polgár, Csőszhalom					6	6
Sátoraljaújhely					4	4
Százhalombatta			1			1
Szelevény				41		41
Szentes		1				1
Szihalom					1	1
Szilvásvárad, Istállóskő-barlang					1	1
Szolnok				1		1
Tápiószele		1			1	2
Tarnabod					7	7
Tiszaigar				11		11
Tiszakeszi					1	1
Tiszatarján				1		1
Tiszavasvári		4				4
Tószeg					2	2
Varsó				1		1
Zsujta				1		1

8 – Extending the scope: the prehistoric border-lines

Distribution data were collected and surveyed several times. (Biró 2004, 2006). Seemingly, we have to count on three basic sources lying in the adjacent regions of South-East Slovakia, North-East Hungary and Western Ukraine (Fig. 2). From the Hungarian provenance data we could see a basic dominance and popularity of Slovakian (C1) obsidian, a regional role of Hungarian (C2T, C2E) obsidians. According to what we know so far, the Ukrainian (C3) obsidian was used only locally.

The three main type groups can be differentiated macroscopically as well, controlled and verified several times by various analytical methods, e.g., EDS, PIXE-PIGE or PGAA. On *Fig. 13*, (Fig. 13) the known distribution of C1-C2E-C2T types is presented, as we know today, on the basis of macroscopic inspection (see also Table 1b) and instrumental analysis.

Interaction of Carpathian obsidian types is a common feature, both for all C1-C2E-C2T types together and C1-C2T and C1-C2E interactions. It is less frequent that the Hungarian (C2) obsidians occur on their own or coupled with each other (C2E-C2T interactions).

Knowing the archaeological distribution data it became more and more pressing to focus on the limits of Carpathian obsidian distribution and possible interaction zones with obsidian coming from other parts of the Mediterranean region, i.e. the Western Mediterranean (Italy) and the Eastern Mediterranean (Greece and Anatolia).

Instrumental obsidian characterisation data already justified the presence of Carpathian obsidian in the sphere of both: i.e., Grotta Tartaruga (Williams *et al.,* 1984) and Mandalo (Kilikoglou *et al.,* 1996). To know the limits more exactly, we could organise with the help of international collaboration projects the investigation of essential

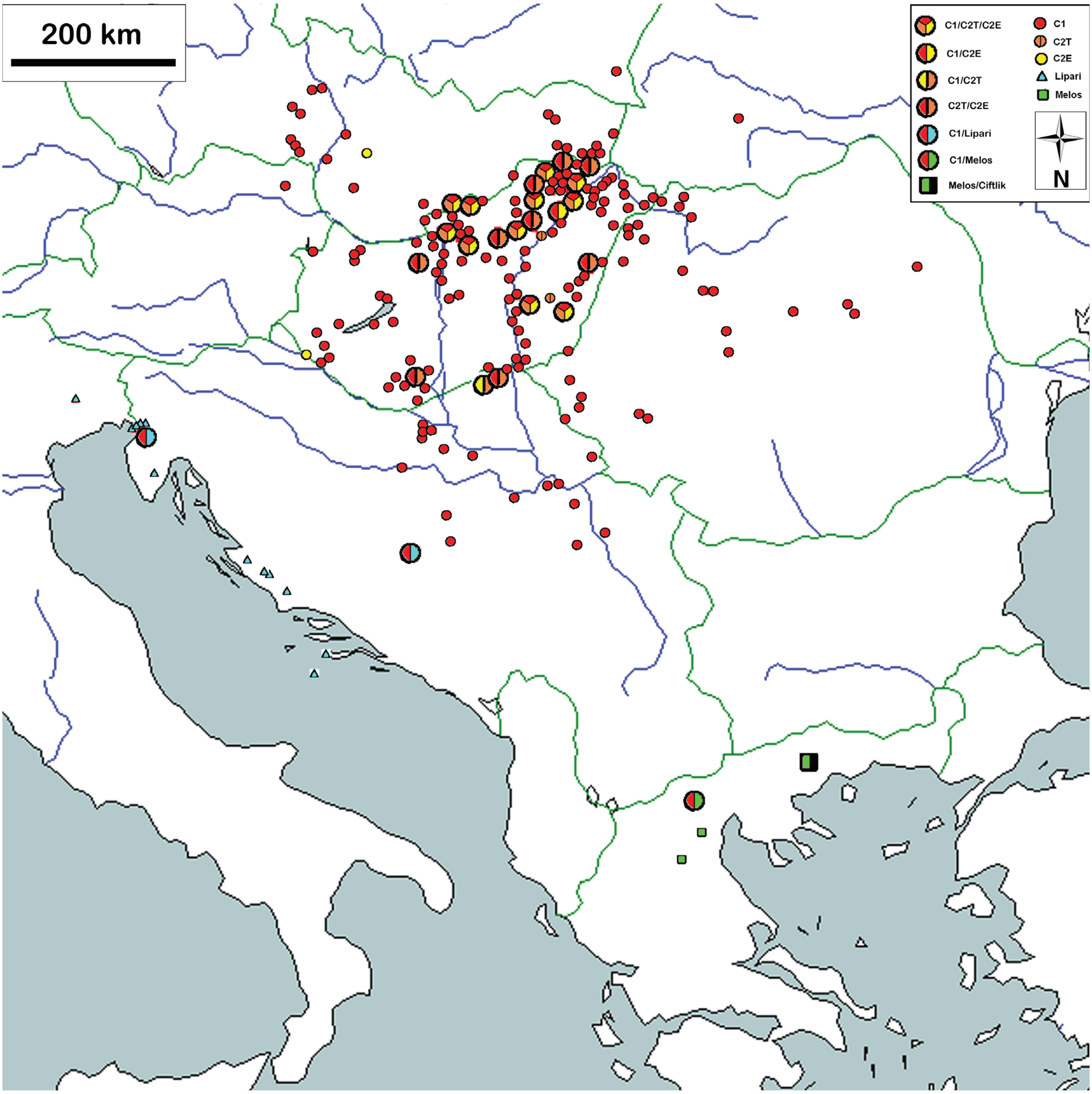


Figure 13 – Interaction of various obsidian types with C1-C2 obsidians on archaeological sites

number of archaeological obsidian finds from most of the neighbouring countries (Croatia, Serbia, Romania, Ukraine and Poland) and we are trying to cover more. The most recent summary was presented on the 39th International Symposium on Archaeometry, Leuven (May 2012, Kasztovszky *et al.,* 2012). Accordingly, we can see interaction zones of the Carpathian (mainly C1) obsidian towards the SW and SE borders of the distribution zone; interaction with Lipari obsidians was observed on the territory of former Yugoslavia (currently: Croatia and Bosnia) at the Neolithic site Obre (Kasztovszky *et al.,* 2009, Kasztovszky & Tezak-Gregl 2009). Towards the SE, the only Thessalian piece (Mandalo) raises the possibility of an interaction zone between Carpathian and Melian obsidians. Towards the North (NW, NE) we can expect no interactions; here, the question is the extent of obsidian transport and the authenticity of the pieces. The furthermost pieces reported in this direction are from Zealand, Denmark (approx. 1400 km ACF from the sources); we had no possibility to study these pieces as yet.

9 – Conclusion

Obsidian was an attractive and much desired commodity in prehistoric times and it is a popular and successful subject for the research of prehistoric societies. Non-destructive methods and representative comparative sample collection help to make our work more efficient.

There are, though, some important things to keep in mind:

1. we still do not know the exact location of the most important C1 sources (=material of Cejkov and Kašov workshops (Bánesz 1967), probably that of the Kašov and Nyírlugos giant cores, Bánesz 1991, Kaminska & Duda 1985).
2. obsidian distribution and obsidian trade is only one element of a most versatile and colourful prehistoric network of connections and should be interpreted accordingly among 'sourceable' and 'non-sourceable' goods.

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Abbreviations used in the text

ACF	'As the crow flies' - Linear distance from site to source
C1	Carpathian 1 (Slovakian) obsidian
C2	Carpathian 2 (Hungarian) obsidian
C2E	Carpathian 2 (Hungarian) obsidian, Mád-Erdőbénye sub-group
C2T	Carpathian 2 (Hungarian) obsidian, Tolcsva sub-group
C3	Carpathian 3 obsidian from Transcarpathian Ukraine
EDS	Energy Dispersive Spectrometry
FTD	Fission track Dating
HNM	Hungarian National Museum
NAA	Neutron Activation Analysis
OES	Optical emission spectroscopy
OHD	Obsidian Hydration Dating
PGAA	Prompt Gamma Activation Analysis
PIGE	Proton Induced Gamma Spectrometry
PIXE	Proton Induced X-Ray Spectrometry
XRF	X-Ray Fluorescence Spectrometry

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