ANNOTATED BIBLIOGRAPHY OF STUDIES ON CARPATHIAN OBSIDIAN•

A kárpáti obszidiánok vizsgálatának annotált bibliográfiája

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Abstract

This paper gives a short annotated bibliography of studies on Carpathian obsidians, created, when accessible, on the basis of authors' abstracts. If possible, the original papers in pdf will be available on the conference website for IOC-2019 (http://ioc-2019.ace.hu/).

Kivonat

Ez a cikk a kárpáti obszidiánokkal foglalkozó tanulmányok annotált bibliográfiája. Amennyiben lehetséges, az eredeti közleményt letölthető pdf formájában közzé tesszük az IOC-2019 konferencia weblapján (http://ioc-2019.ace.hu/).

KEYWORDS: CARPATHIAN OBSIDIAN, RAW MATERIAL ANALYSES, ARCHAEOMETRY, BIBLIOGRAPHY

KULCSSZAVAK: KÁRPÁTI OBSZIDIÁN, ANYAGVIZSGÁLAT, ARCHEOMETRIA, BIBLIOGRÁFIA

Allard, P., Klaric, L., Hromadová, B.: Obsidian blade debitage at Kašov-Čepegov I (Bükk culture), Slovakia. *Bulgarian e-Journal of Archaeology* 7/1 (2017), 17–35.

This paper presents the first results of a new lithic study of the site of Kašov-Čepegov I (KČ-I) in eastern Slovakia. Excavations at Kašov were conducted by Ladislav Bánesz during the mid-1980's after finds were made during the digging of a drainage ditch. Archaeological excavation exposed a pit that contained several concentrations of hundreds of obsidian artefacts associated with decorated pottery sherds belonging to the Bükk culture. Previous analyses of the chipped stone industries from various sites have shown that obsidian played a major role in distribution networks, especially given the existence of so-called 'specialized on-site workshops' where blocks of raw material were preliminarily worked and partially exploited to obtain blades. Technological study of two concentrations at KČ-I shows that the chaîne opératoire of debitage of obsidian blades is quite distinctive and made by 'punch technique' (indirect percussion).

Astalos, C., Kasztovszky, Zs.: Prompt gamma activation analysis of some prehistoric stone tools from North-Western Romania. In: Moreau, J. F., Auger, R., Chabot, J., Herzog, A. (eds.): *Proceedings of the 36th International Symposium on Archaeometry.* [Proceedings Actes ISA 2006] Quebec, 2006, 135–140.

In this paper we present the first application of Prompt Gamma Activation Analysis (PGAA) on chipped stone tools from Romania. PGAA experiments were previously made on different chipped stone raw materials from Hungary, such as obsidian, grey flint and Szeletian felsitic porphyry. The main objective of the project was to determine the chemical composition of the rocks (major and trace elements) as a significant step in the studies of the provenance of the raw materials. For this, 24 samples from Satu Mare and Baia Mare museum collections have been investigated by PGAA. The samples originate from prehistoric sites from North-Western Romania, a region that is part of the Upper Tisza Basin, in the North of the Carpathian Basin. The pieces were selected from representative sites that belong to the Middle and Upper Palaeolithic, the Early and the Middle Neolithic, and the Middle Copper Age.

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Bačo, P.: Obsidiánová industria – prehistorické sídliska. In: *Štátny Geologický Ústav Dionýza Štúra Bratislava*. Regionalne centrum Košice. Prírodovedecká Fakulta Uk Bratislava. Slovenska Asociácia Ložiskových Geológov, Kerkorund a.s. Košice. Východné Slovensko, 2003.

The presence of obsidian on prehistoric settlements in various forms is evidence of the oldest use of this raw material around its primary occurrences. Archaeologically dated settlements belong to the younger Aurignacian and the Gravettian, which means that this area was inhabited more than 25,000 years ago. and obsidian tools are the dominant artifact of this settlement. It is amazing to imagine that we can touch such an industry. It is also astonishing how they were able to work on this material and certainly used it for decorative purposes.

Bačo, P., Bačová, Z.: Autochtónne výskyty vulkanických skiel spojené s neogénnym vulkanizmom na východnom Slovensku. In: Žáár, O., Gragor, M. (eds.): 3. *Geologicko-Paleontologicko-Archeologická Diskusia 2014*. Výpovedná hodnota, kompatibilita a porovnateľnosť údajov získaných povrchovým prieskumom a výskumom. Bratislava, 2014, 8.

Occurrences of volcanic glass in eastern Slovakia are mainly genetically associated with acidic volcanic products. It is part of the bimodal andesite of rhyolite volcanism of the Upper Baden to the Lower Pannon. Rhyolithic and rhyodacitic volcanism is characterized by pyroclastic rocks in the form of tuffs and pumice tuffs, to a lesser extent with the presence of juvenile and lithic plumes and various forms of intrusive, especially extrusion, bodies with a unique passage into lava flows. In the Brehova area, the technical work revealed the positions of the argilitised volcanoclastic rocks with obsidian fragments. Only the nuclei of obsidian are present in this position, without the presence of splinters. The glassy facies and the pure volcanic glass were verified by drilling work under the upper andesite extrusion body Big Hill north of Brehov. Based on these facts we assume a primary-autochthonous position of obsidians in altered volcanoclastics. Their occurrence is autochthonous also in relation to their collection and subsequent use for the production of obsidian industry. The radiometric dating of similar nuclei of obsidian from Hrane (here, however, from anthropogenic positions) advises the emergence of these glasses at the bottom of Upper Baden.

Bačo, P., Kaminská, Ľ., Lexa, J., Pécskay, Z., Bačová, Z., Konečný, V.: Occurrences of Neogene volcanic glass in the Eastern Slovakia – Raw material source for the stone industry. *Anthropologie* 55/1/2 (2017), 207–230.

In Eastern Slovakia obsidians were used most extensively during the Late Palaeolithic and Neolithic. Natural occurrences of obsidian are linked with products of rhyolite/rhyodacite volcanism, where they associate with perlite. Viničky, Malá Bara and Brehov are the known natural occurrences. Considering the present state of knowledge, the Brehov locality is a primary source of secondary obsidian accumulations in Quaternary diluvial/fluvial deposits, partially covered by eolian sands, in the area of Brehov and Cejkov. Some of the macroscopic attributes, especially surface sculpture, of the obsidian cores from archeological sites resemble more those from the secondary accumulations. Conventional K/Ar dating of obsidians from natural occurrences and archeological sites implies multiple ages of natural sources. However, dating of obsidians at archeological sites points rather to a single source, or yet unknown source in addition to the secondary accumulations. Obsidians from at least two phases of rhyolite volcanic activity have been utilized for production of obsidian industry. Obsidians from the secondary accumulations in the area of Brehov and Cejkov apparently dominate at archeological sites and probably are equivalent to the subgroup C1a of the Carpathian obsidians.

Bánesz, L.: Cejkov II-III, nové paleolitické stanice s obsidiánovou industrious/Cejkov II-III, a new paleolithic site with obsidian industry. *Archeologické rozhledy* 11 (1959), 769–780, 801–802.

Not far from the Tokaj Mountains located the Upper Palaeolithic site Cejkov I, which is well known since 1932 thanks to the care of Š. Janšák. The paper focused on the recently discovered two new paleolithic sites, where also found obsidian industry. Both sites were located on the northern slope of a mountain range called Zemplinski ostrov.

Bánesz, L.: Výskum paleolitickej stanice Cejkov I v roku 1961/The research at the Paleolithic site Cejkov I in 1961. *Archeologické rozhledy* 14/6 (1962), 753–761.

The research of the Palaeolithic site at Cejkov continued. In some probes obsidian and chert artefacts were found, most of them in the stratigraphical position. Finds were found in the fifth probe. On the basis of the finds it can be said that the main settlements were on the ridge, where a lot of artefacts and animal bones were found as early as 1960.

Bánesz, L.: D'alší výskum na paleolitickej stanici Cejkov I/The further exploration of the Paleolithic site Cejkov. *Archeologické rozhledy* 16/3 (1964), 317–323.

During excavations in 1962, finds from the Early Gravettian, Gravettian and Aurignacien–Szeletien periods were recovered in stratigraphic position on the southern slope of the hill. The paper summarized the new excavation features and the lithic materials.

Bánesz, L.: Gravettské súvrstvia s obsidiánovou a pazúrikovou industriou v Kašove a Cejkove. *Archeologické rozhledy* 21/3 (1969), 281–290.

This paper summarized the succession of gravel layers with obsidian and flint industries in Kašov and Cejkov. The Archaeology Institute of the Slovak Academy of Sciences excavated at Kašov I in 1967, where two independent layers containing paleolithic finds. The lower layer was limited to an area of 12 by 8 m and is characterized by a larger quantity of flint tools while obsidian objects predominate in the superimposed layer. Both strata produced a considerable number of composite tools and are dated, from the point of view of research carried out on the surface, which confirmed the serious nature of the lithic industry identified there.

Bánesz, L.: Hromadný nález obsidiánovej suroviny na gravettskom sídlisku v Cejkove, okr. Trebišov. *Archeologické rozhledy* 26/1 (1974), 51–54.

During the rescue excavations in 1969, we have discovered depot find in the loess of the Würm 3 horizon comprising 41 pieces of obsidian. For some obsidian nodules, the knapping surface for detaching flakes was already prepared. The obsidian depot is shedding light on how the habitation site in Cejkov was supplied with obsidian. The location of the depot is about 5 km from the site. The collected material was prepared for processing, already tested and show the first phase of elaboration. The depot indicates that the nodules collected were brought to the site in one batch. Though the obsidian hoard was probably an element of regular supply, we cannot exclude – especially in the case of more distant settlements – barter trade.

Bánesz, L. Hromada, J., Desbrosse, R., Margerand, I., Kozłowski, J. K., Sobczyk, K., Pawlikowski, M.: Le site de plein air du Paléolithique Supérieur de Kašov 1 en Slovaquie Orientale. *Slovenská Archeológia* 40/1 (1992), 5–28.

The Kašov excavation has demonstrated the existence of two Gravettian levels among six lithostratigraphic units. Excavation was carried on by L Bánesz during 20 years (between 1960 and 1984). In the lower strata, there was an important and characteristical production of artefacts – mainly from flint (imported from southern Poland) – from Gravettian culture (968 artefacts in which 171 tools). There are less typical Gravettian features in the upper one where 43450 artefacts in which 3963 tools (mainly from obsidian) were distinguished. Spatial and technological analysis show many clusters (Kchemenitsa): – small concentrations (<100 pieces) with majority of tools – large concentrations (>100 Pieces) with many flakes and fragments.

Biagi, P., De Francesco, A.M., Bocci, M.: New Data on the archaeological obsidian from the Middle-Late Neolithic and Chalcholitic sites of the Banat and Transylvania (Romania). In: Kozłowski, J. K., Raczky, P. (eds.): *The Lengyel, Polgár and related cultures in the Middle/Late Neolithic in Central Europe*. The Polish Academy of Arts and Sciences Kraków – Eötvös Loránd University Institute of Archaeological Sciences Budapest, Kraków, 2007, 309–326.

This paper presents preliminary results obtained from the analysis of archaeological obsidian specimens from seven Middle Neolithic-Chalcolithic sites from the Banat and Transylvania (Romania). The XRF characterisation has shown that the Slovak Carpathian 1 source was almost exclusively exploited during both these periods. The typological analysis of the assemblages has demonstrated that the excavation retrieving methods are of fundamental importance in the study of the way this raw material circulated and the understanding of the activities carried out within each single site during a period of some 1000 radiocarbon years, from the late seventh to the late sixth millennium uncal. BP. These preliminary results fill a gap in our knowledge of the obsidian movements across the Carpathian Basin, which was badly known until a few years ago.

Biagi, P., Gratuze, B., Boucetta, S.: New data on the archaeological obsidians from the Banat and Transylvania. In: Spataro, M., Biagi, P. (eds.): *A Short Walk through the Balkans: the First Farmers of the Carpathian Basin and Adjacent Regions*. Società Preistoria Protostoria Friuli-V.G., Trieste, Quaderno 12, 2007, 129–148

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, Kašov: Carpathian 1) and Hungarian (Mád: Carpathian 2E), Tokaj deposits, which both started to be exploited on a very small scale.

Biagi, P., Gratuze, B., Kiosak, D. V., Tubolze, O. V., Popandopulo, Z. H.: The Neolithic Obsidians from Southeastern Ukraine: First Characterization and Provenance Determination. *Anadolu/Anatolia* 40 (2014), 1–20.

This paper discusses the results obtained from the characterization of six obsidian samples from the Neolithic sites of Lysa Gora and one from Semenovka 1, in southeastern Ukraine. They show that obsidians of different sources were utilized by the inhabitants of Lysa Gora, among which are Baksan (Russian Federation), Sjunik (Armenia) and another undefined source, while the provenance of the bladelet fragment from Semenovka 1 is of particular interest since it comes from one of the Göllüdağ outcrops in Central Anatolia. The first characterization of Ukrainian specimens fills a gap in our knowledge in the distribution of the archaeological obsidians in a wide region delimited by the Carpathians, in the west, and the Caucasus, in the east. They contribute to the interpretation of the models of their procurement and circulation in the steppe region northwest of the Azov Sea during the Neolithic.

Bigazzi, G., Neto, J. C., Norelli, P., Osorio Araya, A. M., Paulino, R., Poupeau, G., Stella de Navia, L.: Dating of Glass: The Importance of Correctly Identifying Fission Tracks. *Nuclear Tracks and Radiation Measurements* 15/1–4 (1988), 711–714.

Comparing age determinations by persons with different degrees of experience in FT dating shows that induced track counts are in good agreement but spontaneous track densities determined by beginners disagree with those determined by experienced persons. Proper identification of fission tracks appears to be of prime importance in glass samples; reliable data are the result of experience and careful selection of samples.

Bigazzi, G., Márton, P., Norelli, P., Rozoznik, L.: Fission Track Dating of Carpathian Obsidians and Provenance Identification. *Nuclear Tracks and Radiation Measurements* 17/3 (1990), 391–396.

Rhyolitic obsidians were sampled from the Tokaj Mountains (Hungary) and the neighbouring Zemplin Hills (Slovakia) for dating by the fission track (FT) method. The FT ages are found to cluster around I0 and 15Ma, respectively. On this basis "Carpathian" obsidians can be deafly distinguished from their Mediterranean counterparts. Three types of artifacts have been identified: two with sources in the Zemplin Hills and the third with a source in the Tokaj Mountains.

Bigazzi, G., Biró, K. T., Oddone, M.: Instrumental analysis I. The Carpathian sources of raw material for obsidian tool-making. (Neutron activation and fission track analyses on the Bodrogkeresztúr-Henye Upper Palaeolithic artefacts). In: Dobosi, T., V. (ed.): *Bodrogkeresztúr-Henye (NE-Hungary) Upper Palaeolithic site*. Magyar Nemzeti Múzeum, Budapest, 2000, 221–240.

The characteristics of the Carpathian obsidians have been analysed by fission track dating method and by instrumental neutron activation analysis. Chemical analysis and geological dating techniques together discriminate the sources of the Tokaj Mountains (Carpathian I, II) from other sources located in the Mediterranean and in Anatolia. Although part of the original primary sources cannot be located today, the best quality glass preferentially used by prehistoric man for tool-making comes in all probability from Eastern Slovakia. Prehistoric exploitation of the Tokaj obsidian sources started in early times, and the Upper Paleolithic site Bodrogkeresztúr-Henye had a remarkable role in this process.

Biró, K. T.: A Kárpát medencei obszidiánok vizsgálata / Investigation of obsidian from the Carpathian Basin. *Archaeológiai Értesítő* 108 (1981), 194–205.

Archaeometrical study of the Carpathian obsidian source area has solved the problem of identification of obsidian found in the Tokaj-Eperjes Mountains, namely in South-Eastern Slovakia (Carpathian I. type) and in the surroundings of Erdőbénye (Carpathian II). The analyses were carried out by O. Williams, by means of neutron activation. Here some additional data given concerning the chemical analysis data, optical emission spectroscopic data and petrographical thin sections of the Carpathian I–II, source collected material. Chemical analysis data corroborate William's grouping, while, on the other hand, it provides a basis which to compare Carpathian I–II analysis data to other chemical analysis results obtained from archaeological obsidian finds published earlier in the literature.

Biró, K. T.: Hydration rates of the Carpathian Obsidians from Archaeological Lithic assemblages. In: Pécsi, M. (ed.): *INQUA XII Quaternary Studies in Hungary*. INQUA Hungarian National Committee – Magyar Tudományos Akadémia Földrajztudományi Kutató Intézet, Budapest, 1982, 135–144.

In the 1960's L. Vértes compiled a set of obsidian samples, from Middle Palaeolithic to Early Copper Age and transferred it the Geochemical Laboratory of the Hungarian Academy of Sciences for exploring potentials of obsidian hydration dating. The actual measurements were performed by K. Biró in the late seventies and published on the occasion of INQUA XII.

Biró, K. T.: Az obszidián archaeometriai vizsgálata / Archaeometrical investigation of obsidian. *Régészeti Továbbképző Füzetek* 1 (1982), 56–64.

Obsidian has special significance in both the material culture of prehistoric people and the subject of investigation for researchers of prehistoric cultures. The reason for this can be found in the specific qualities, formation and characteristics of the material. Namely obsidian is a quenched lava in which the constituting compounds freeze without crystallization. It is produced under specific conditions therefore it is relatively rare. Its chemical composition can vary widely but remains strictly homogeneous on the same source offering the possibility for provenancing, i.e. source characterisation, even for distant items. The special qualities made obsidian a desirable commodity for prehistoric people; its chemical and structural qualities make it very useful for archaeometrical investigation including archaeological and geological dating.

Biró, K. T.: Distribution of obsidian from the Carpathian Sources on Central European Palaeolithic and Mesolithic sites. *Acta Archaeologica Carpathica* 23 (1984), 5–42.

This paper summarizes results of systematical survey for obsidian in the most important Hungarian museum collections for Palaeolithic stone artefacts, i.e., the Hungarian National Museum and the Herman Ottó Museum, Miskolc. The role of obsidian in the Hungarian Palaeolithic is important but typically not dominant. Obsidian use is only one factor in a vast system of prehistoric economy.

Biró, K. T.: Prehistoric American stone tools in the collection of the Hungarian Ethnographic Museum. Néprajzi Értesítő. *A Néprajzi Múzeum Évkönyve* 74 (1992), 151–187.

A major collection of 'Palaeo-Indian' stone tools has been donated to the International Collection of the Hungarian Ethnographical Museum from Oregon, U.S.A. The assemblage was collected by a private collector at the locality Coffeepot Flat near the Chewaucan River, South-Central Oregon, at several sites and during a long period. A subsequent professional archaeological survey of the region indicated at least 50 settlements of various character from a wide temporal range (8000 B.C–1850 A.D.). Key finds of the region, chronologically significant projectile points, were unfortunately rare in the reach of the archaeological expedition, selected previously by the 'hobbyistic collecting activities' of private collectors. The assemblage presented to the Hungarian Ethnographical Museum contains, almost exclusively, choice pieces missed during the professional field surveys. This paper aims at presenting these beautiful and chronologically significant lithics, with an eye on the special circumstances resulting in one of the last effective hunter-gatherer economies of the World.

Biró, K. T.: A kárpáti obszidiánok: legenda és valóság. *Archeometriai Műhely/Archaeometry Workshop* 1/1 (2004), 3–8.

This paper is intended to give a review on the study of Carpathian Obsidian. The name implies the only source region in Central Europe, for long, the only source of archaeological obsidian in Continental Europe. Their archaeological, as well as geological research started in the sixties of the 19th century by the activity of pioneering personalities of Hungarian archaeology, geology and archaeometry. By the late 1970-ies, separation of Carpathian obsidian sources from other sources of European and other Mediterranean sources could be achieved (investigations of Warren and Williams), and intensive studies continued in the past decades. In spite of several publications devoted to the subject, there are still a lot of clearly erroneous views lingering in technical literature concerning the location of the sources and allocation of archaeological specimens. The first review of the author on the Carpathian obsidian was published in 1981: in the meantime, several research groups performed smaller or bigger research series on related finds, using various methods of analysis (NAA, EDS, XRF, FTD, PIXE-PIGE and recently, PGAA). Collection of obsidian distribution was completed using reference data as well as analysis of various assemblages dating from Middle Palaeolithic to Iron Age. Distribution maps were compiled for specific periods using percentage values. Access strategies, political implications could be claimed on the basis of changes in distribution areas.

Biró, K. T.: Carpathian Obsidians: Myth and reality. In: *Proceedings of the 34th International Symposium on Archaeometry*, 3–7 May 2004, Zaragoza, Spain. Institution Fernando el Catolico 2006, 267–278. (E-book, http://www.dpz.es/ifc/libros/ebook2621.pdf)

This paper is intended to give a review on the study of Carpathian obsidian. The name implies the only source region in Central Europe, for long, the only source of archaeological obsidian in Continental Europe. Their archaeological, as well as geological research started in the sixties of the 19th century by the activity of pioneering personalities of Hungarian archaeology, geology and archaeometry. By the late 70-ies, separation of Carpathian obsidian sources from other sources of European and other Mediterranean sources could be achieved (investigations of Warren and Williams), and intensive studies continued in the past decades. In spite of several publications devoted to the subject, there are still a lot of clearly erroneous views lingering in technical literature concerning the location of the sources and allocation of archaeological specimens. The first review of the author on the Carpathian obsidian was published in 1981: in the meantime, several research groups performed smaller or bigger research series on related finds, using various methods of analysis (NAA, EDS, XRF, FTD, PIXE-PIGE and recently, PGAA). Collection of obsidian distribution was completed using reference data as well as analysis of various assemblages dating from Middle Palaeolithic to Iron Age. Distribution maps were compiled for specific periods using percentage values. Access strategies, political implications could be claimed on the basis of changes in distribution areas.

Biró, K. T.: Az obszidián kultúrtörténete. In: Baráz, Cs., Kiss, G. (szerk.): *A Zempléni Tájvédelmi Körzet*. [A Bükki Nemzeti Park Igazgatóság Monográfiái 3] Bükki Nemzeti Park Igazgatóság, Eger, 2007, 279–282.

The paper summarizes formation, physical qualities, natural occurrences of obsidian for the general public. It deals specifically with sourcing and use of the Tokaj obsidians as important raw material of the Zemplén area. Highlight of archaeological and ethnographical obsidian use are presented.

Biró, K. T.: Carpathian Obsidians: State of Art of Central European Obsidian Research (in Japanese). In: Yamada, M., Ono, A. (eds.): *Lithic raw material exploitation and circulation in Prehistory. A comparative perspective in diverse paleoenvironments*. Series: Etudes et recherches archéologiques de l'Université de Liège No. 138., Université de Liège, Service de préhistoire & Centre de recherches archéologiques. 2014, 47–69.

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.

Biró, K. T.: „Némi derű". Rómer Flóris és a kőeszközök kutatása / "Some Gaiety". Flóris Rómer and the study of the stone implements. *Arrabona* 51 (2013) [2015], 63–86.

An important element of the multifaceted activity of Flóris Rómer was the Prehistoric time, especially the investigation of the various lithic tools. In contrast to "antiquarian", "value-oriented" and "cult of antiquities" approach, he recognized the historical significance of the lithic ground stones and tools and he described the possible and the most important research ways of these artefacts. These directions were: the morphology, the raw material, the technology of the tool making procedure and the approach of the ethnoarchaeology. He accompanied the first step of the lithic tools research from he recognized the lack, during the search and to the first integrated result which were significant in an international way also.

Biró K. T., Kasztovszky, Zs.: Obsidian Studies Using Nuclear Techniques in Hungary. *Science for Heritage Newsletter* 1/1 (2003), 6–9.

Obsidian is a success story in lithic provenance studies. The beauty, rarity and adaptability of the material for the purpose of making stone tools made it popular and widely known both in prehistory, folklore and studies. 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. 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 will, by the advance of geological times, crystallize starting from the surface and turn into felsitic volcanic rock with growing number of crystallites and, later, crystals of zeolite and feldspar.

Biró K. T., Pozsgai, I.: Obszidián hidrációs kérgének vizsgálata kormeghatározás céljából / Obsidian hydration rind measurement for archaeological dating. *Archaeológiai Értesítő* 109 (1982), 124–132.

Obsidian hydration dating is a modern method of scientific dating in archaeology, independent of traditional historical and typological dating techniques. It. was developed in the early sixties, along with geochemical and glass structure studies in the U.S.A. In our paper we will describe the hydration phenomenon and summarize the experiences of hydration dating obtained during archaeological dating, measurement techniques, and sources of error and their possible elimination on the basis of the technical literature. For a long time, Hungarian adaptation of the method has been hindered by technical difficulties. In our efforts to measure the thickness of the hydration layer, we found that traditional thin-section technique failed to preserve the hydration rind. Furthermore, the rind embedded in an artificial resin, optical and abrasional distortion caused an error of 50% of the measured thickness, especially in the case of relatively thin (1–2 μm) hydration rinds characteristic of Neolithic, Carpathian I type obsidian implements deposited in caves. In order to achieve a high accuracy measurement technique, we elaborated a new method for hydration rind measurements, which is, at the same time, suitable for source characterization. We used a scanning electron microscope for this purpose, and, exploiting further potentials of the electron microscope, we performed electron microprobe analysis on the obsidian samples. We detected chemical differences between the hydrated glass and the inner intact structure, and we separated Carpathian I and Carpathian II type obsidian samples. Our results agree well with the known results of some previous methods for Carpathian obsidian source characterization and examinations concerning the hydration phenomenon.

Biró K. T., Pozsgai, I.: Obszidián lelőhely-azonosítás elektronsugaras mikroanalízis segítségével / Obsidian characterization by electron microprobe analysis. *Iparrégészet/Industrial Archaeology* 2 (1984), 25–37.

In the course of analysing obsidian preparata for hydration rind measurements, microprobe analyses were performed on archaeological material from several cave sites. The artefacts were identified on macroscopic inspection as belonging to Carpathian 1 (Slovakian) and Carpathian 2 (Hungarian) types. The EDS spectra corroborated the observed differences. The most distinctive elements were silicon and iron, respectively. More analytical studies are planned in near future.

Biró, K. T., Vladár, A.: Raw material analysis of the Oregon – Coffeepot flat lithic assemblage. Néprajzi Értesítő. *A Néprajzi Múzeum Évkönyve* 74 (1992), 189–202.

The lithic assemblage of the Coffeepot Plain, Oregon (USA) is deposited in the Hungarian Ethnographical Museum. The material was donated to the Museum by Nicholas Salgó, and comprises over 1300 items. The detailed typological presentation of the material is given by K. Biró, including macroscopical determination of the raw material. The overwhelming majority of the artifacts were made of obsidian. There were 13 macroscopical varieties separated among the obsidian artifacts according to colour, pattern and transparency. As it has been emphasized in connection with the typological study of the assemblage, it is obviously difficult to interpret achaeological problems of geographically remote and unfamiliar assemblages. This is even more true for an adequate provenance study of the material. Being aware of the limitations resulting from the lack of field information and improper amount of references we tried to apply our routine methods of analysis to the study of the raw material of the Salgó-Collection.

Biró K. T., Pozsgai, I., Vladár, A.: Electron beam microanalyses of obsidian samples from geological and archaeological sites. *Acta Archaeologica Academiae Scientiarum Hungaricae* 38 (1986), 257–278.

This paper summarizes the obsidian characterization studies performed conjointly by the Hungarian Geological Institute and the Institute for Applied Physics since 1981. The Central European obsidian occurrences are described and the associated geological and archaeological material is analysed in detail. These sources are referred to, after the terminology introduced by O. Williams, as "Carpathian obsidian sources", in spite of some misleading connotations of the term. Comparative material from the most important European obsidian sources were examined and a

number of archaeological obsidian finds, mainly from the territory of Hungary. The methods applied for the characterization of the samples were EDS (electron energy dispersive X-ray spectroscopy) and ED-XRF (energy dispersive X-ray fluorescence). The quantitative evaluation of the results were supported, as control method, by wet chemical analyses of the main components. The applied procedure seems sensitive enough for the examination of archaeological samples, requiring, at the same time, relatively short time and low cost.

Biró K. T., Pozsgai, I., Vladár, A.: Central European obsidian studies. State of affairs in 1987. *Archaeometrical Research in Hungary* 1 (1988), 119–130.

Continuation of obsidian studies by EDS (electron energy dispersive X-ray spectroscopy) and ED-XRF (energy dispersive X-ray fluorescence) in the collaboration of the Hungarian Geological Institute and the Institute for Applied Physics published in the first collective volume on archaeometrical research in Hungary.

Biró, K. T., Elekes, Z., Gratuze, B.: Instrumental analysis II. Ion beam analyses of artefacts from the Bodrogkeresztúr-Henye lithic assemblage. In: Dobosi, V. (ed.): *Bodrogkeresztur-Henye (NE-Hungary) Upper Palaeolithic Site*. Magyar Nemzeti Múzeum, Budapest, 2000, 241–245.

In frames of a collaboration project between the Hungarian National Museum and the Institute of Nuclear Research, Debrecen (ATOMKI), ion beam analytical techniques were used for provenancing geological and archaeological samples of a, obsidian b, radiolarite c, control samples of various other local materials (limnic quartzite, „stone marrow"). PIGE and PIXE methods were used for analysis in the ATOMKI; additionally, LA-ICP was used for the analysis of obsidian samples in Orléans, France. Identification of obsidian samples proved to be effective as known for several analytical techniques already; analysis of radiolarite samples represent preliminary state of research with a lot of open questions. Details of results on geological source areas and efficiency of characterisation are given elsewhere. In this paper, the data relevant to the Bodrogkeresztúr Upper Palaeolithic site are presented.

Biró, K. T., Markó, A., Kasztovszky, Zs.: 'Red' obsidian in the Hungarian Palaeolithic characterisation studies by PGAA. *Praehistoria* 6 (2005), 1–11.

Red obsidian is a rare commodity in the Carpathian Basin. It is known to occur among the outcrops only at C2T (Tolcsva environs) sources, and only in very small quantities. In the archaeological material, only sporadical occurrences were observed. As red obsidian is more common and better known from Eastern Mediterranean sources (notably Armenia and in subordinate quantity, Anatolia) the origin and characterisation of these pieces gave ground to a specific study. For the investigation of red obsidians, a non-destructive multielement nuclear analytical technique, prompt gamma activation analysis (PGAA) was used that has recently proved to be adequate for provenancing obsidian. The investigated red obsidians show similar chemical composition to the black obsidians found at the same source. Differences altogether are not very big and mainly observable in some diagnostic elements. Principal Component Analysis (PCA) and bivariate plots were used to distinguish between obsidian source regions and allocate newly analysed red obsidian to known source groups. As a result, we can establish that all archaeological pieces known so far come from the local sources.

Bonsall, C., Gurova, M., Elenski, N., Ivanov, G., Bakamska, A., Ganetsovski, G., Zlateva-Uzunova, R., Slavchev, V.: Tracing the source of obsidian from prehistoric sites in Bulgaria. *Bulgarian e-Journal of Archaeology* 7/1 (2017), 37–59.

Portable X-ray fluorescence (pXRF) spectrometry was used to obtain source determinations for 11 obsidian artefacts from five archaeological sites in Bulgaria. The results show that all the archaeological specimens can be linked to obsidian sources in the Carpathian Mountains in the border region between Hungary and Slovakia. Obsidian from the C2E source in Hungary occurred in very early Neolithic contexts at Dzhulyunitsa, while the majority of samples from later contexts at Ohoden, Dzherman and Varna came mainly from the Slovakian (C1) source. The data hint at a shift from the use of C2 obsidian in the Neolithic before 5900 cal BC, to a preference for C1 obsidian in later periods – however, more finds and better contextual and chronological data are required to verify this trend.

Bonsall, C., Elenski, N., Ganetsovski, G., Gurova, M., Ivanov, G., Slavchev, V., Zlateva-Uzunova, R.: Investigating the provenance of obsidian from Neolithic and Chalcolithic sites in Bulgaria. *Antiquity* 91/356 (2017), 1–6.

Portable energy-dispersive X-ray fluorescence (pXRF) has become a widely used tool for the chemical characterisation (source identification) of obsidian found in archaeological contexts. While laboratory techniques such as neutron activation analysis (NAA) and inductively coupled plasma mass spectrometry (ICP-MS) can analyse more elements and have lower detection limits, pXRF can

provide quantitative data of sufficient resolution to be able to match obsidian artefacts with their volcanic sources. At the same time, pXRF offers several advantages for obsidian research: (i) it can be deployed 'in the field' (i.e. on site or in a museum) without the need to bring samples back to a laboratory for analysis; (ii) information on elemental composition can be obtained relatively quickly; and (iii) measurements require no special preparation of samples and cause no visible damage to materials. The research outlined here forms part of a wider study of archaeological obsidian in south-eastern Europe involving archaeologists from Bulgaria, Romania and the UK, with the aim of reconstructing changes in patterns of procurement, production and use of obsidian between the Middle Palaeolithic and the Iron Age.

Bugoi, R., Constantinescu, B., Neelmeijer, C., Constantin, F.: The potential of external IBA and LA-ICP-MS for obsidian elemental characterization. *Nuclear Instruments and Methods in Physics Research Section* B 226 (2004), 136–146.

Combined external Ion Beam Analysis (IBA) measurements, consisting of Proton Induced X-ray Emission–Proton Induced Gamma-ray Emission–Rutherford Back-Scattering (PIXE-PIGE-RBS) have been performed on several obsidian fragments with archaeological significance at the Rossendorf tandem accelerator using a 3.85 MeV proton beam. A comparison was made between these external IBA results and the ones previously obtained on the same obsidian samples using Laser Ablation–Inductively Coupled Plasma–Mass Spectrometry (LA-ICP-MS). The purpose of the study was to assess the potentiality of external IBA for provenance studies on archaeological obsidian, especially as a non-destructive alternative to the LA-ICP-MS method. As an example, the source attribution of an archaeological obsidian fragment from Transylvania to Tokay Mountains/Slovakian range flow is discussed.

Burgert, P.: Štípaná industrie z obsidiánu v Čechách/Chipped industry from obsidian in Bohemia. *Archeologické Rozlhedy* 67 (2015), 239–266.

Chipped industry from obsidian in Bohemia. The work provides an overview of Bohemian finds of prehistoric chipped artefacts made from obsidian. Attention is also paid to the Late Neolithic period, when the share of this raw material in Bohemian assemblages culminates and, at the same time, the finds can be more accurately dated. Two of the richest assemblages, which come from Smiřice and Plotiště nad Labem near Hradec Králové, are analysed in detail. The work also expands its spatial framework to include the Svitavy region due to the close ties between this area and east Bohemia. Obsidian was processed at Stroked Pottery culture settlements in the form of nodules brought to the sites; based on the internal construction of artefacts, only a small number of pieces were extracted at the processing sites. The most probable source of raw material for Bohemian finds are Zemplínské vrchy (the Zemplín Highlands) in southeast Slovakia, while Tokajsko-Zemplínské vrchy (the Tokaj-Zemplín Highlands) in northeast Hungary are also possible, albeit less likely.

Burgert, P., Přichystal, A., Prokeš, L., Petřík, J., Hušková, S.: Původ obsidiánové suroviny v pravěku Čech / The origin of obsidian in prehistoric Bohemia. *Archeologické Rozhledy* 68 (2016), 224–234.

The paper presents the results of the first geochemical analysis conducted on prehistoric obsidian artefacts from Bohemia. Eleven samples from reliably dated contexts were chosen for the study. The vast majority of the analysed samples can be classified into the Neolithic period. The artefacts were analysed using two non-destructive geochemical methods: concentration values determined by portable X-ray fluorescence spectroscopy (pXRF) were calibrated using the results of laser ablation inductively coupled mass spectrometry (LA-ICP-MS). Based on the results, the origin of nine samples can, with the greatest degree of probability, be traced to Slovakia, the other two to Hungary.

Burgert, P., Přichystal, A., Prokeš, L., Petřík, J., Hušková, S.: The origin and distribution of obsidian in prehistoric Bohemia. *Bulgarian e-Journal of Archaeology* 7 (2017), 1–15.

This paper summarizes current knowledge of the distribution of obsidian in prehistoric Bohemia (Czech Republic). In terms of this raw material's distribution, Bohemia is a peripheral area, and it is also the westernmost part of its regular archaeological occurrence. Because of its rarity within the specified area, it is possible to identify this material quite easily even in earlier archaeological literature, and together with new discoveries, to create a coherent picture of its distribution. So far, only two locations in Bohemia have been described where the processing of raw obsidian material is documented. Both these sites are located in the eastern part of the study area; in terms of location these are the closest sites to the anticipated sources. The sites are dated to a later stage of the Stroked Pottery culture. Because no such processing sites are known from other periods, we believe it was mainly the distribution of entire

blanks and prepared cores that took place at that time. Furthermore, our study discusses the original sources of obsidian in terms of the region that is being monitored. In accordance with the aims of our investigation, the selected obsidian artefacts were subjected to geochemical analysis to identify their origins. The peak of the distribution is the period of the Stroked Pottery culture (4900–4500/4400 cal BC). The basic outcome of the geochemical analysis is the identification of at least two sources of raw material in the Carpathian source area.

Cann, J. R., Renfrew, C.: The Characterization of Obsidian and its application to the Mediterranean Region. *Proceedings of the Prehistoric Society* 30 (1964), 111–133.

Evidence of contact between cultural groups is of great importance to the study of prehistory. Although the development of absolute dating methods has decreased our dependence on the discovery of such contacts for chronology, they are essential material when the origin and spread of culture is being studied. In the past, cultural contacts have generally been demonstrated by typological similarities of artifacts, but unfortunately many typological comparisons are open to discussion, and it can be exceedingly difficult to be certain of direct contact by this means alone. The importance in this respect of the study of raw materials used in places far from their place of origin and presumably deliberately imported has long been realized. Recently more attention has been paid to the careful characterization of such materials; the detection, that is, of properties of the specimen under study which are characteristic of material from particular sources. By this means it is often possible to assign a source to a given specimen. The petrological identification of British neolithic stone axes is perhaps the most comprehensive archaeological characterization study yet undertaken. Demonstrations of trading links made by such methods, if based on a sure identification and a comprehensive survey of possible sources, are not open to the criticism and doubt which may be directed at typological similarities. The variety of techniques now available for the analysis and identification of materials makes this field a promising one for the archaeologist.

Carter, T.: The contribution of obsidian characterization studies to early prehistoric archaeology In: Yamada, M., Ono, A. (eds.): *Lithic raw material exploitation and circulation in Prehistory. A comparative perspective in diverse paleoenvironments*. Series: Etudes et recherches archéologiques de l'Université de Liège No. 138., Université de Liège, Service de préhistoire & Centre de recherches archéologiques. 2014, 23–33.

This paper details the interpretative role obsidian characterisation studies can play in earlier prehistoric archaeology. It reviews recent contributions to debates on early hominine cognitive development and social complexity, the question of Neanderthal mobility, and how obsidian sourcing is shedding light on colonisation processes globally. Methodologically it is suggested that by adopting a more holistic chaîne opératoire analytical framework, which integrates an artefacts' elemental data with its techno-typological attributes, we can maximise the interpretative potential of our data, and provide a more powerful means of reconstructing past networks of interaction, or 'communities of practice'.

Çetin-Draskovits, D.: *Obsidiane ausgewählter steinzeitlicher Fundstellen in Ostösterreich*. Diplomarbeit der Historisch-Kulturwissen-schaftlichen Fakultät der Universität Wien, 2013.

Obsidians and their significance in prehistory have been an important field of research in archaeology since 1960's. They offer, like any other material of Prehistory, the possibility of adding a small piece of mosaic to the image of the study of human history. Their high esteem and wide distribution all over the world, even in areas where obsidian does not occur naturally, give an insight into prehistoric life. Very important is also the practical use of the obsidian for archaeology. After all, determinations of origin can trace the mobility and exchange paths of prehistoric human. Independent obsidian research, as it is known from the Mediterranean region or the Carpathian region, does not exist in Austria. This PhD dissertation attempts to take a first modest step in this direction.

Chirica, V., Kacsó, C., Văleanu, M.: Contribuții privind prezența obsidianului, ca materie primă pe teritoriul României / Contribution concernant la présence de l'obsidiane entant que matière première sur le territoire de la Roumanie). *Carpica* 27 (1998), 9–20.

Although obsidian tools have been discovered in the paleolithic deposits of Țara Oașului (Aurignacian and Gravettian), it is considered possible that this raw material comes from natural deposits, located in Hungary, Slovakia and Ukraine. Recent research carried out on the territory of the municipality Maramureş of the department Maramureş has revealed the existence of kidneys, clouds, chips and primary products of debiting. In conclusion, there are also on the territory of Romania, more precisely in Țara â (the Country of Țara) deposits of obsidian used by the paleolithic communities at the size of the tools.

Comşa, E.: L'usage de l'obsidienne a l'epoque neolithique dans le territoire de la Roumanie. *Acta Archaeologica Carpathica* 11 (1969), 5–15.

Review of archaeological obsidian finds from the Neolithic period on the territory of Romania.

Constantinescu, B., Bugoi, R.: Obsidian provenance studies of Transylvania's Neolithic tools using PIXE, micro-PIXE, PIGE, RBS and XRF. *Studia Universitatis Babeş-Bolyai, Geologia* [Special Issue, MAEGS – 16 Univ. Babeş-Bolyai] (2009), 77–78.

Obsidian is a natural volcanic glass, which was widely used for prehistoric stone tools and traded over long distances. In the case of Transylvania (the North-Western part of Romania), the sources of the prehistoric tools are supposed to be Tokaj Mountains, Greek islands, Armenia and Turkish-Asia Minor. We used PIXE and XRF to analyse various obsidian tools from the above sources. The two-dimensional scatter plots of Ti/Mn versus Rb/Zr and Ba/Ce versus Y/Zr were considered as source indicators. On the basis of these classifications, the majority of the Transylvania's obsidian prehistoric tools were determined as coming from either Hungarian or Slovakian Tokaj Mountains.

Constantinescu, B., Bugoi, R., Sziki, G. Á.: Obsidian provenance studies of Transylvania's Neolithic tools using PIXE, micro-PIXE and XRF. *Nuclear Instruments and Methods in Physics Research Section* B 189 (2002), 373–377.

Obsidian is a natural volcanic glass, which was widely used for prehistoric stone tools and traded over long distances. In the case of Transylvania (the North-Western part of Romania), the sources of the prehistoric tools are supposed to be Tokaj Mountains, Greek islands, Armenia and Turkish-Asia Minor. We used PIXE and XRF to analyse various obsidian tools from the above sources. The two-dimensional scatter plots of Ti/Mn versus Rb/Zr and Ba/Ce versus Y/Zr were considered as source indicators. On the basis of these classifications, the majority of the Transylvania's obsidian prehistoric tools were determined as coming from either Hungarian or Slovakian Tokaj Mountains.

Constantinescu, B., Cristea-Stan, D., Kovács, I., Szőkefalvi-Nagy, Z.: Provenance studies of Central European Neolithic obsidians using external beam milli-PIXE spectroscopy. *Nuclear Instruments and Methods in Physics Research* B 318 (2014), 145–148.

External beam milli-PIXE technique was used for the determination of the elemental concentration ratios in some Prehistoric obsidian tools found in Transylvania, in the Iron Gates region near Danube, as well as on a few relevant geological obsidian samples from Slovak Tokaj Mountains, Lipari, Armenia. As provenance ''fingerprints'' the Ti to Mn and Rb to Zr ratios were used. The results confirm that the Transylvanian Neolithic samples have a Slovak Tokaj Mountains provenance. For Iron Gates samples, there are at least two different geological sources: for Late Neolithic tools, the origin is also the Slovak Tokaj Mountains but for Late Mesolithic–Early Neolithic samples, the sources are clearly different, possibly of the Hungarian Tokaj Mountains or the Balkan–Aegean origin.

Culicov, O. A., Frontasyeva, M. V., Daraban, L., Ghiurca, V.: I.N.A.A. at Dubna Nuclear Reactor Trace Element Characterization of Obsidian Found in Romania. *Studia Universitatis Babeş–Bolyai, Physica* 54/2 (2009), 41–50.

We measured the significant elements for provenance studies of obsidians by INAA at IBR-2 pulse reactor from, JINR, Dubna, Russia. The aims of this study are to identification an obsidian source in Oraşu Nou (Maramures country from Romania). Comparatively with geological studies, the results of correlation and dendrological diagrams of the analyzed elements from irradiated samples are presented in this paper. Until now the geologist assumed that the obsidian from Oaş area is of a new source. But this isn't confirmed by our experimental results. By this we can say that in Paleolithic these materials were extracted from Slovakia and they were brought by the river Tisa and exchanged for any kind of products.

Culicov, O. A., Frontasyeva, M. V., Daraban, L.: Characterization of obsidian found in Romania by neutron activation method. *Romanian Reports in Physics* 64/2 (2012), 609–618.

Significant elements for provenance studies on obsidians were measured by INAA at IBR-2 pulse reactor from JINR, Dubna, Russia. The aims of this study were to identify an obsidian source in Oraşu Nou (Maramures County, Romania). Comparatively with geological studies, new results of correlation and dendrological diagrams of the analyzed samples are presented. So far, the geologists assumed that the obsidian from Oaș area (from Romania) is a new source, but this was not confirmed by our experimental results. We can therefore conclude that in Paleolithic these materials were extracted from Slovakia and were brought by the river Tisa and exchanged for any kind of products.

De Francesco, A. M., Crisci, G. M., Bocci, M.: Non-destructive analytic method using XRF for determination of provenance of archaeological obsidians from the Mediterranean area: a comparison with traditional XRF methods. *Archaeometry* 50/2 (2008), 337–350.

A non-destructive analytical method using wavelength dispersive X-ray fluorescence (WDXRF) that allows the establishment of the provenance of archaeological obsidians was developed and a comparison with the classical XRF method on powders is discussed. Representative obsidian samples of all the geological outcrops of archaeological interest of the Mediterranean area, were analysed with the normal procedures used in rock analysis by XRF (crushing, powdering and pelletizing). The non-destructive XRF analysis was instead conducted on splinters taken from the original geological pieces, with the shape deliberately worked to be similar to the refuse usually found at archaeological sites. Since the analysis was conducted on the raw geological fragment, intensity ratios of the suitably selected chemical elements were used, instead of their absolute concentrations, to avoid surface effects due to the irregular shape. The comparison between concentration ratios and the intensity ratios of the selected trace elements show that the different domains of the chemical composition, corresponding to the geological obsidians of the source areas, are perfectly equivalent. In the same way, together with the geological splinters, complete archaeological obsidians, from Neolithic sites, may be analysed and their provenance may be determined.

De Francesco, A. M., Bocci, M., Crisci, G. M.: Application of non-destructive XRF method to the study of the provenance for archaeological obsidians from Italian, Central European and South American sites. *Quaternary International* 468 (2018), 101–108.

This paper presents the results of the attribution of approximately 1700 artifacts, from Italian, Central European and South American sites to the geological obsidian sources. The provenance was determined using the non-destructive X-ray Fluorescence (XRF) analytical method, based on the secondary X-ray intensity proposed by Crisci et al. (1994) and optimized by De Francesco et al. (2008). In the first phase of the research, to test the non-destructive XRF method, the analysis on entire obsidian fragments (similar to archaeological waste) was initially carried out on 60 samples representative of all the geological outcrops in the Mediterranean region. The secondary X-ray intensities obtained by non-destructive XRF on whole pieces were compared with the results using the XRF method on powders, carried out on the same samples (major elements, and selected trace elements, such as Nb, Y, Zr, Rb and Sr) as exhaustively described in De Francesco et al. (2008). These five trace elements were sufficient to characterize (by both methods) the different places of obsidian origin, because they are particularly indicative of the genetic processes that produced obsidian. The provenance of the obsidian artifacts was determined by comparing the X-rays intensity ratios of the selected elements with those obtained on the entire fragments of the obsidian sources in the Mediterranean.

Dobosi, V.: Obsidian use in the Palaeolithic in Hungary and adjoining areas. *Natural Resource Environment and Humans* 1 (2011), 83–95.

Summary of Palaeolithic obsidian use in Hungary with special regard to the Upper Palaeolithic period.

Dobrescu, R., Tuffreau, A.: L'Oaş et le Maramureş: la limite orientale de l'utilisation de l'obsidienne dans l'Europe centrale au paléolithique supérieur. In: Bodi, G., Danu, M., Pîrnău, R. (eds.): *De Hominum Primordiis. Studia in Honorem Professoris Vasile Chirica*. [Scripta archaeologica et historica Dacoromaniae 7] Editura Universității "Alexandru Ioan Cuza", Iaşi, 2013, 63–86.

The presence of obsidian is quite frequent in northwestern Romania where it represents an important part of the raw materials that have been chosen for the manufacture of tools. However, the question of its origin, local or exogenous, remains unresolved. It remains important to better appreciate the extent of cultural choices. The analysis of the lithic industries of Remetea Şomoş I and Buşag provides partial answers to these questions.

Dobrescu, R., Tuffreau, A., Bonsall, C.: L'utilisation de l'obsidienne au Paléolithique supérieur dans le nord-ouest de la Roumanie/The use of obsidian during the Upper Paleolithic in Northwest Romania. *L'Anthropologie* 122 (2018), 111–128.

Obsidian artefacts are numerous in the Upper Paleolithic sites of Northwest Romania. The use of obsidian begins during the Aurignacian and continues during the Gravettian, All the stages of the lithic reduction sequence are present. The obsidian tools are numerous in some sites. Non-destructive chemical analysis by X-ray fluorescence (XRF) was performed on 232 obsidian artefacts from five sites: Buşag, Remetea Şomoş I, Calineşti I, Boineşti and Turulung. The results show that Early/Middle Upper Paleolithic people in

northwest Romania acquired their obsidian, directly or indirectly, from sources on the western flank of the Carpathians, up to 170 km away.

Durrani, S. A., Khan, H. A., Taj, M., Renfrew, C.: Obsidian source identification by fission track analysis. *Nature* 233 (1971), 242–245.

Fission track analysis has been used to determine the age and uranium content of obsidians from sources in southeast Europe and Anatolia, and from archaeological deposits in mesolithic levels at the Franchthi Cave in southern Greece. It is confirmed that the Franchthi obsidian came from the Aegean island of Melos. This is the earliest positive indication available for maritime travel, and carries the history of seafaring back a thousand years.

Eder, F. M.: *OLDAPS – Obsidian Least Destructive Analytical Provenancing System: An application study*. Dissertation an der Technischen Universität Wien, Dissertation, Fakultät für Physik, Technischen Universität, Wien, 2013.

The natural volcanic glass obsidian is one of the classical objects of archaeometric analyses. Obsidian is generally described as a relatively homogeneous material and although the number of applicable geological sources is limited, numerous obsidian finds have been found all over the world far away from any natural outcrop. Reliable provenancing by means of the highly specific chemical composition, the "chemical fingerprint", can provide information about trading routes, extension of territory, long-distance contacts and the mobility of prehistoric people. Several museum collections contain large numbers of unidentified obsidian finds. Therefore, a novel scientific approach for provenancing obsidian artefacts found in archaeological contexts is demanded. The establishment of the OLDAPS contributes to both conservation and prehistoric research by ensuring a minimum of destruction to gain a maximum of information. Obsidian samples of seven archaeologically relevant geological obsidian sources in Central and Southern Europe were characterized by the application of three different methods: NAA, IBA, PIXE, PIGE and LA-ICP-MS. The reproducibility and accuracy of analytical data is demonstrated by the excellent agreement between determined analytical results and certified values of glassy reference material BAM-S005B. The combination of methods shows a maximum element spectrum composed of 42 elements and reveals the most characteristic – key elements –, in particular Ti, Co, As, Rb, Ba, Eu and U, by which all seven obsidian sources are clearly discriminable.

Elekes, Z., Uzonyi, I., Gratuze, B., Rózsa, P., Kiss, Á. Z., Szöőr, Gy.: Contribution of PIGE technique to the study of obsidian glasses. *Nuclear Instruments and Methods in Physics Research Section* B 161 (2000), 836–841.

An application of the particle induced gamma-ray emission (PIGE) method with the use of a CLOVER-Ge-BGO detector system for the analysis of source materials of obsidians of archaeological use is reported in this work. Grouping and association of samples resulted via various magmatic processes, with diverse provenances, is detailed based on the light element concentration data. A comparison of PIGE with the laser ablation ± inductively coupled plasma ± mass spectrometry (LA±ICP±MS) on heavier elements is presented.

Francaviglia, V. M.: Les gisements d'obsidienne hyperalcaline dans l'ancien monde: étude comparative. *Revue d'Archéométrie* 14 (1990), 43–64.

A comparative study of peralkaline obsidian sources of Pantelleria, Turkey, Yemen, Ethiopia and Tibesti have been carried out. Attempts have been made to establish the provenance of Neolithic and Bronze Age obsidian artifacts from The Yemen Arab Republic (Jabal Qufrân, Sirwâh, Miswah, Najid al-Abyadh, Wsdî Yanâ'im, Yalâ and the coastal plain of Tihâmah), from the Saudi Tihâmah, the Farasân Islands, the Koka Lake shore (Shoa, Ethiopia) and the Tibesti Massif. Finally, the origin of the obsidian of a statuette from a Tell al-'Amârnah tomb (18th dynasty) has been investigated. The hypothesis proposed by archaeologists, that might have been some obsidian trade across the Red Sea in Neolithic times, is supported: the majority of the obsidian artifacts found in coastal archaeological sites of the Yemeni and Saudi Tihimah, as well as on the Farasân islands and in the Yemeni highland does not originate from the well-known great Yemeni obsidian sources. The provenance of the raw material of the Tell al-'Amârnah statuette remains unknown. Overlap in chemistry of peralkaline volcanic provinces – even those distant from each other – is considerable and causes uncertainty in provenance studies.

Freund, K. P.: An assessment of the current applications and future directions of obsidian sourcing studies in archaeological research. *Archaeometry* 55/5 (2013), 779–793.

This paper thematically characterizes a large body of recent obsidian sourcing discourse as a means of highlighting the current place of obsidian provenance studies in larger archaeological discourse. It is shown that the field of obsidian

sourcing is flourishing, with a clear upward trend in the number of published studies in the past decade. This paper further argues that sourcing is a means to an end, a way to determine where artefacts originate, and thus a means of addressing broader archaeological problems. Through this contextual framework, obsidian sourcing studies – and indeed all provenance studies – are seen as relevant because they transcend the increasingly specialized world of archaeological discourse.

Gábori, M.: Az őskori obszidián-kereskedelem néhány problémája / Quelques problèmes du commerce de l'obsidienne á l'age préhistorique / Some problems of the obsidian trade in prehistoric times. *Archaeologiai Értesítő* 80 (1950), 89–103.

Primitive forms of trade follow the evolution of economic life; in prehistoric times, as well as among today's primitive peoples, they follow a particular path of development. In the prehistoric age it is necessary to attach great importance to the trade of obsidian which, in all probability, was the first commodity of our country. In Central Europe it is only found in the Tokaj region; the remoteness of the other deposits therefore allows us to determine the starting point of this trade and also to determine the people who were in charge of it. In Hungary obsidian is demonstrable from the cultures of the Upper Aurignacian Palaeolithic and Magdalenian; its absence in the Solutrean period must be explained by the penetration of certain foreign ethnic groups. Neolithic man used obsidian more often. It is mainly used by the people representing the culture of Bükk; it is at this time that the transport of obsidian takes a certain expansion. Obsidian can be seen in Transylvania; to the west its traces can be seen as far as the Mura region, to the north as far as the territory of Poland and Bohemia. During the copper age, because of the new commercial possibilities, conditioned by the use of metal, the transport of obsidian took on proportions hitherto unknown.

Gale, N. H.: Mediterranean obsidian source characterisation by strontium isotope analysis. *Archaeometry* 23 (1981), 41–51.

Attempts by scientists to establish the geographical and geological sources of materials used by prehistoric man have a long history. In the eighteenth-century Halley and Stukeley used the microscope and simple petrological examination in an attempt to establish the origin of the rock used to build Stonehenge. Later the modern application of thin section petrography to finding the source of pottery was pioneered by Washington (1895). The volcanic glass obsidian was important to some Paleolithic, Neolithic and Early Bronze Age cultures principally for its use to make tools and weapons, though it was also used to make vessels and statuettes. As a material of value, it was widely traded, and so reliable methods of establishing its provenance are important in establishing ancient patterns of trade and have engaged the attention of archaeologists, prehistorians and scientists from at least 1892.

Glascock, M. D., Barker, A. W., Draşovean, F.: Sourcing Obsidian Artifacts from Archaeological Sites in Banat (Southwest Romania) by X-ray Fluorescence. *Analele Banatului* 23 (2015), 45–50.

This article concerns the chemical analysis by X-ray fluorescence and source determination for five obsidian artifacts from archaeological sites in Banat (Southwest Romania). The results show that all of the artifacts could be assigned to an obsidian source located in the Košice region of Slovakia. The specific source is known as Cejkov and it is a sub-source of the Viničky source.

Glascock, M. D., Barker, A. W., Bărbat, I. A., Bobînă, B., Draşovean, F., Virag, C.: Sourcing Obsidian Artifacts from Archaeological Sites in Central and Northwestern Romania by X-ray Fluorescence. *Ephemeris Napocensis* 27 (2017), 175–186.

The new data add to our previous knowledge regarding the sources of obsidian in Banat and Transylvania. If in Transylvania, with the exception of the initial period of the Neolithic, when obsidian comes only from the Mád Kakashegy source, all obsidian tools in the Neolithic, Eneolithic and Bronze Age cultures were made with obsidian from the Eastern Slovak source of Cejkov-Viničky. A somewhat similar situation was also observed in Banat where the Eastern Slovak source is predominant in all the investigated cultures.

Gratuze, B.: Obsidian characterization by laser ablation ICP-MS and its application to prehistoric trade in the Mediterranean and the Near East: sources and distribution of Obsidian within the Aegean and Anatolia. *Journal of Archaeological Science* 26/8 (1999), 869–881.

For geological studies, interest in mass spectrometry with an inductively coupled plasma as an ion source and its association with laser ablation as a sample introduction technique (LA-ICP-MS) has steadily increased during the past few years and is now being developed in other fields such as archaeology. After a description of the analytical procedure and the calculation method, we show the potential of this technique to characterize, almost non-destructively, archaeological artefacts. Among the 70 elements that could be routinely analysed by LA-ICP-MS

with detection limits below the ppm level, we choose to determine the more critical ones in order to evaluate the geochemical models of the magmatic process (major elements, rare earths and some transition elements).

Grolig, D.: Mineraliensammeln in Nordost-Ungarn: Das Tokajer Gebirge. *Der Steirische Mineralog* 26 (2012), 13–26.

For a few years now, we have been happy to undertake holiday and group trips to Hungary, mainly to the northeast of the country. Hungary is home to numerous mineralogically interesting areas, but our favourite areas are the Mátra and especially the Zemplén (Tokaj) mountains. This preference is not only based on the mineral wealth of the region, but is also due to the charming surroundings and the knowledge of the historical background of the former mining region.

Hancock, R. G. V., Carter, T.: How reliable are our published archaeometric analyses? Effects of analytical techniques through time on the elemental analysis of obsidians. *Journal of Archaeological Science* 37 (2010), 243–250.

To assess the analytical accuracies and precisions of archaeometric elemental analyses by different techniques, a relatively homogeneous material such as obsidian must be studied. An assessment of published elemental concentration data from two Anatolian obsidian sources shows that while in most cases analytical accuracy is as high as is commonly expected, in some cases it is not. It also shows that the dispersions of elemental concentration data (indicators of analytical precisions) coming from modern analytical procedures are akin to the estimated homogeneity of the obsidian. Based on this latter observation, if one has element dispersion data from a single analytical technique, with a single source of obsidian as a control, data sets that contain multiple, but similar sources of obsidian may be differentiated.

Hillebrand, J.: A nyirlugosi obsidiannucleus depotleletről / On the Nyirlugos obsidian core depot find. *Archaeológiai Értesítő* 42 (1928), 39–42.

This paper focuses on the Nyírlugos obsidian depot find, which is deposited in the Prehistoric Collection of the Hungarian National Museum. The obsidian core depot found very close to Debrecen in 1923. The archaeological context was mostly unidentified, because this appeared by chance, however F. Tompa suggested this could be belong to the Late Neolithic and Early Copper Age periods. The 12 pieces of obsidian core mean a big value which is quite unique in Central Europe.

Hovorka, D.: Prehistoric transeuropean transport of stone tools. On examples of jadeitite and obsidian implements. *Acta Archaeologica Academiae Scientiarum Hungaricae* 61/1 (2010), 49–56.

In presented paper transcontinental transport of stone tools in the Neolithic/Aeneolithic is described. Attention is paid namely on the west–east transport of jadeitite axes from the Piedmont in the Western Alps to Central Europe, and east-west transport of the obsidian implements from Zemplin county (E-Slovakia and NE-Hungary) to the western part of Germany, as well. In both cases, transport, most probably of ready-made implements on a distance more than 1000 km, is discussed.

Hovorka, D., Illášová, L.: The Tokaj Mts. Obsidian – its use in Prehistory and Present Application. In: *Scientific Annals, School of Geology*. Aristotle University of Thessaloniki, Proceedings of the XIX CBGA Congress, Thessaloniki, [Greece Special volume 100] 2010, 385–390.

Homogeneous acid volcanic glass of low water content has been an object of human attention since the prehistory. There exist archaeological evidences dealing with the use of obsidian from the Tokaj Mts. (eastern Slovak Republic and the north-eastern part of Hungary, as well) Late Tertiary volcanic province in the Late Palaeolithic. There at present exist attempts to use it as a jewellery raw material. Obsidian namely in combination with silver, nickel alloys and gold can be effectively used as a modern jewellery material.

Hughes, R., Ryzhov, S.: Trace element characterization of obsidian from the Transcarpathian Ukraine. *Journal of Archaeological Science: Reports* 19 (2018), 618–624.

Non-destructive energy dispersive X-ray fluorescence (EDXRF) analysis was conducted on geological obsidian references samples from Carpathian 3 localities within the territory of the Ukrainian Transcarpathia. These data augment the trace element "signature" for this chemical variety of obsidian, which we applied to compare with trace element data determined on obsidian artifacts from nearby archaeological sites. The results: 1) document the local use and importance of Carpathian 3 obsidian, and 2) show use of non-local (Carpathian 1) volcanic glass at local geological outcrops of Carpathian 3 obsidian, suggesting prehistoric conveyance of Carpathian 1 volcanic glass in to Ukrainian Transcarpathian archaeological sites during the Upper Paleolithic period.

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Hughes, R. E., Werra, D. H.: The source of Late Mesolithic obsidian recovered from Rydno XIII/1959, Central Poland. *Archaeologia Polski* 59/1–2 (2014), 31–46.

More than 40 years ago R. Schild reported the presence of obsidian and Vistulian lithics at Rydno XIII/1959 in central Poland, and speculated that the geological source for the obsidian lay in the Tokay region of Hungary. Non-destructive energy dispersive X-ray fluorescence analysis was conducted recently on the Rydno XIII obsidian artifacts, and the data generated support R. Schild, M. Marczak and H. Królik's suggestion (1975). The geological source of obsidian from a late Mesolithic site in Poland has been documented for the first time by instrumental data results.

Hughes, R. E., Werra, D. H., Sulgostowska, Z.: On the sources and uses of obsidian during the Paleolithic and Mesolithic in Poland. *Quaternary International* 468 (2018), 84–100.

Eighty-six obsidian artifacts from twenty Paleolithic and Mesolithic archaeological sites in Poland were analyzed using non-destructive energy dispersive X-ray fluorescence (EDXRF) analysis and assigned to parent geological obsidian source (chemical type). Results of the study the first country-wide survey of its kind support the conclusion that the geological source of obsidian remained largely unchanged for thousands of years, that obsidian use appears to have been minimal throughout the Paleolithic and Mesolithic regardless of distance to source, that obsidian artifacts were used to perform the same functions as their non-obsidian (flint and radiolarite) counterparts, and that the distinct visual properties of volcanic glass may have contributed to its recognition as unique and exotic in different social contexts.

Janšák, S.: *Praveké sidliska s obsidianovou industriou na Vychodnom Slovensku*. 1935, 1–193.

A basic monograph on sources and archaeological distribution of Slovakian obsidians.

Kabaciński, J., Sobkowiak-Tabaka, I., Kasztovszky, Zs., Pietrzak, S., Langer, J. J., Biró, K. T., Maróti, B.: Transcarpathian influences in the Early Neolithic of Poland. A case study of Kowalewko and Rudna Wielka sites. *Acta Archaeologica Carpathica* 50 (2015), 5–32.

The aim of the paper is to present and discuss traces of a long-distance contacts of the Early Neolithic Linear Band Pottery Culture registered at two sites, of which one is located in the Polish Lowland and second in the uplands of the southern Poland. They are manifested by the presence of obsidian finds and application the wood-tar substances, both of which being considered as a Transcarpathian phenomenon. The paper focuses on determination of characteristic chemical elements of obsidian artefacts from the two Polish Early Neolithic localities using non-invasive Prompt Gamma Activation Analysis (PGAA) as well as on a physicochemical analysis of composite organic-mineral substances found on pottery. The results of the analyses allow a discussion on the relationships between the Early Danubian societies inhabiting territories located on both sides of the Carpathians.

Kaminská, Ľ.: Význam surowinowej základne pre mladopaleolitickú spoločnost vo východokarpatskej oblasti. *Slovenská Archeológia* 39 (1991), 7–58.

This is an outline of the present state of Upper Palaeolithic studies with emphasis on the raw material composition of stone industries in eastern Slovakia and adjacent regions, i.e. in north-east Hungary, north-west Romania, Trans-Carpathian Ukraine, and southern Poland. The most significant kinds of stone raw materials and their deposits are considered as well as the employment of raw materials of Upper Palaeolithic cultures in the east Carpathian region.

Kaminská, Ľ., Duda, R.: K otázke vyznamu obsidiánovej suroviny v paleolite Slovenska. *Archeologické Rozlhedy* 37 (1985), 121–129.

Description of quasi-sources (large scale Palaeolithic workshops) and geological build-up of the Slovakian obsidian source area.

Kasztovszky, Zs.: Obszidián kőeszközök a Kárpátokon innen és túl – Tűz es víz talalkozasa. *Élet és Tudomány* 2 (2014), 38–40.

Popular scientific paper on the potentials of source characterisation and provenance studies. The author emphasizes the practical knowledge of prehistoric man on raw materials suitable for the production of tools, e.g. obsidian, and proofs of long distance trade.

Kasztovszky, Zs., Biró, K. T.: A kárpáti obszidiánok osztályozása prompt gamma aktivációs analízis segítségével: geológiai és régészeti mintákra vonatkozó első eredmények. *Archeometriai Műhely/Archaeometry Workshop* 1/1 (2004), 9–15.

Obsidian is one of the classical subjects of archaeometrical analyses. Most analytical methods however will require destruction or preparation of the sample equal to destruction. Therefore, most of

the choice pieces are not to be analysed by these methods. PGAA is suitable for analysing the pieces without destruction and without any residual radioactivity. The pieces were placed into the analytical equipment without any special preparation, intact and naturally, without any destruction or sampling. 2×2 cm2 of the sample surface was irradiated by a cold neutron beam of 5×107 cm-2s-1 flux. Since neutrons penetrate the whole sample, the information we get reflects the bulk composition of the material, which is very advantageous for the glassy, homogeneous volcanic glass (obsidian). The question is how distinctly we can separate different source regions according to the detected components, and how effectively we can allocate the archaeological pieces into the resulting data sets. Our results of two measurement series seem promising, however we are working on extending our database of PGAA measurements concerning archaeological, as well as geological obsidian samples. Geological samples from all the important known obsidian sources of the Mediterranean region were measured with special regard to Central European (Carpathian I, II) sources, as well as archaeological sources mainly from Hungary.

Kasztovszky, Zs., Biró, K. T.: Fingerprinting Carpathian Obsidians by PGAA: First results on geological and archaeological specimens. In: *Proceedings of the 34th International Symposium on Archaeometry*, 3–7 May 2004, Zaragoza, Spain. Institution Fernando el Catolico 2006, 301–308. (E-book, http://www.dpz.es/ifc/libros/ebook2621.pdf)

Obsidian is one of the classical subjects of archaeometrical analyses. Major and trace-element data can provide indispensable information on the provenance of valuable archaeological objects. Most analytical methods however will require destruction or preparation of the samples equal to destruction. Therefore, most of the choice pieces are not to be analysed by these methods. Prompt Gamma Activation Analysis (PGAA) is in principle suitable for analysing various kinds of pieces without destruction and without any residual radioactivity. The method is based on the detection of γ-photons originated in (n, γ) reaction. The question is how distinctly we can separate different source regions according to the detected components, and how effectively we can allocate the archaeological pieces into the resulting data sets. We had previous experience on provenancing various chipped stone raw materials, like Szeletian felsitic porphyry and various kinds of grey silex (radiolarite, flint, hornstone). PGAA proved to be effective for the former while with silex, we have to refine our method.

Kasztovszky, Zs., Težak-Gregl, T.: Kora-neolitikus radiolarit és obszidián kőeszközök vizsgálata prompt gamma aktivációs analízissel / Prompt gamma activation analysis of Early Neolithic radiolarite and obsidian stone tools. In: Ilon G. (szerk.): *ΜΩΜΩΣ VI. – Őskoros kutatók VI. Összejövetele. Nyersanyagok és kereskedelem.* Kulturális Örökségvédelmi Szakszolgálat – Vas megyei Múzeumok Igazgatósága, Kőszeg, 2009, 189–196.

In the earliest phase of the Neolithic, both obsidian and radiolarite are important markers of the movements of goods and people trading them. Obsidian is a favourite subject of archaeometrical studies. Radiolarite is of comparable significance, however, much less analyzed yet. There is no local obsidian on the territory of Croatia: import, however, may originate from both the Carpathian Basin and the Mediterranean region. The importance of radiolarites is adequately demonstrated in Hungary by now. It is apparent, however, that there used to be essential local supply of various radiolarites in Croatia, too. In addition, a considerable supposed import from the territory of today's Hungary is supposed. Thus, we wish to find objective discrimination features to define these supply zones and the border of these zones. The research is done in the frame of a 2008–2009 Croatian–Hungarian project and funded by Hungarian Science and Technology Foundation (TéT) and Croatian Ministry of Science, Education and Sport, with the aim of sampling and identification of potential obsidian and radiolarite sources in Croatia and in Hungary, as well as non-destructive investigation of archaeological stone tools. The basic analytical method is Prompt Gamma Activation Analysis.

Kasztovszky, Zs., Biró, K. T., Markó, A., Dobosi, V.: Cold Neutron Prompt Gamma Activation Analysis – a Non-Destructive Method for Characterization of High Silica Content Chipped Stone Tools and Raw Materials. *Archaeometry* 50/1 (2008), 12–29.

Recently, several archaeometrical projects have been started on the prehistoric collection of the Hungarian National Museum. Among the analytical methods applied, non-destructive prompt gamma activation analysis has a special importance. We have also tested the potential of this method on chipped stone tools, with the aim of determining their exact provenance. On the basis of major and trace element components, characterizations of stone tools and their raw materials – silicites (flint, chert, radiolarite and hornstone) as well as volcanites (felsitic porphyry and obsidian) – were performed. We discuss some important results concerning each group, as case studies. Compiling

the data set of different PGAA analysis series, compositions of 110 samples are reported, including 76 archaeological pieces. In the future, we plan to extend the number of investigated objects in each class.

Kasztovszky, Zs., Biró, K. T., Markó, A., Dobosi, V.: Prompt gamma activation analysis for non-destructive characterization of chipped stone tools and raw materials. *Journal of Radioanalytical and Nuclear Chemistry* 278/2 (2008), 293–298.

Several archaeometrical projects were started on the prehistoric collection of the Hungarian National Museum. Among the analytical methods applied, non-destructive prompt gamma activation analysis (PGAA) has a special importance. Based on major- and trace components, characterization of stone tools and their raw materials were performed. Until now, 160 pieces from Carpathian Basin and from the surrounding area (Romania, Croatia, Ukraine, Poland and the Mediterranean region) have been analyzed, including both archaeological and geological pieces. Obsidian and Szeletian felsitic porphyry objects adequately separable with PGAA. Identification of high silica silex categories, however, is much more difficult.

Kasztovszky, Zs., Biró, K. T., Markó, A., Dobosi, V.: Pattintott kőeszközök nyersanyagainak roncsolásmentes vizsgálata prompt-gamma aktivációs analízissel. *Archeometriai Műhely/Archaeometry Workshop* 6/1 (2009), 31–38.

Since 2001, several archaeometrical projects were started on the prehistoric collection of the Hungarian National Museum. The aims of the investigations were to distinguish between macroscopically similar or inadequately identified types of rocks. Further aim is to associate the archaeological finds with potential raw material sources. Among the analytical methods applied, non-destructive Prompt-gamma Activation Analysis has a special importance. Based on major and trace elements, characterisation of stone tools and their raw materials were performed. Until now, more than 300 pieces of various materials (i.e. flint, radiolarite, Szeletian felsitic porphyry, obsidian, etc.) from the Carpathian Basin and from the surrounding areas (Romania, Croatia, Ukraine, Poland and the Mediterranean region) have been analysed, including both archaeological and geological pieces. The characterisation of obsidian and Szeletian felsitic porphyry objects by PGAA is seemingly effective while the identification of the high silica content siliceous rocks, however, is much more difficult.

Kasztovszky, Zs., Szilágyi, V., Biró, K. T., Težak-Gregl, T., Burić, M., Šošić, R., Szakmány, Gy.: Horvát és bosnyák régészeti lelőhelyekről származó obszidián eszközök eredetvizsgálata PGAA-val / Provenance study of Croatian and Bosnian archaeological obsidian artefacts by PGAA. *Archeometriai Műhely/Archaeometry Workshop* 6/3 (2009), 5–14.

In 2008–2009 we started to work on archaeological obsidians from Croatia and Bosnia-Herzegovina within the frame of a Croatian–Hungarian project. The main objective of our work was to perform a provenance study of these obsidian artefacts. The chemical compositions of the systematically collected samples have been determined non-destructively with Prompt Gamma Activation Analysis. Obsidian is among the important raw materials of prehistoric tool production in the Carpathian Basin, and a popular subject of archaeometric studies. According to previous studies, three main groups could be separated. The main categories are the transparent-translucent Carpathian 1 (C1 – Slovakian) type, the non-transparent Carpathian 2 (C2 – Hungarian) and the Carpathian 3 (C3) type from Ukraine. In order to determine the origin of obsidian raw materials, we have analysed Carpathian (C1 and C2) and Mediterranean (Melos, Lipari, Sardinia) geological samples as well as archaeological pieces from Hungary and Romania. Our PGAA database on obsidian is continuously expanding with the new analytical results. In our earlier studies, we concluded that PGAA is suitable for differentiating between various Carpathian and the Mediterranean obsidians. Adding Croatian and Bosnian archaeological obsidian data to our library, we found that some of them can be best identified as C1 (Slovakian) and some are chemically similar to the Lipari obsidians.

Kasztovszky, Zs., Biró, K. T., Kis, Z.: Prompt Gamma Activation Analysis of the Nyírlugos obsidian core depot find. *Journal of Lithic Studies* 1/1 (2014), 151–164.

The Nyírlugos obsidian core depot find is one of the most important lithic assemblages in the collection of the Hungarian National Museum. The original set comprised 12 giant obsidian cores, of which 11 are currently on the permanent archaeological exhibition of the HNM. One of the cores is known to be in Debrecen. The first publication attributed the hoard, on the strength of giant (flint) blades known from the Early and Middle Copper Age Tiszapolgár and Bodrogkeresztúr cultures, to the Copper Age. In the light of recent finds it is more likely to belong to the Middle Neolithic period. The source area was defined as Tokaj Mts., about 100 km to the NW from Nyírlugos. The size and beauty of the

exceptional pieces exclude any invasive analysis. Using Prompt Gamma Activation Analysis (PGAA), we can measure major chemical components and some key trace elements of stone artefacts with adequate accuracy to successfully determine provenance of obsidian. Recent methodological development also facilitated the study of relatively large objects like the Nyírlugos cores. The cores were individually measured by PGAA. The results show that the cores originate from the Carpathian 1 sources, most probably the Viničky variety (C1b). The study of the hoard as a batch is an important contribution to the assessment of prehistoric trade and allows us to reconsider the so-called Carpathian, especially Carpathian 1 (Slovakian) sources.

Kasztovszky, Zs., Biró, K. T., Szilágyi, V., Hajnal, A., Özvegy, K., Szekeres, Á.: Provenance study of archaeological obsidian using non-destructive Prompt Gamma Activation Analysis (poster presentation). In: *Synchrotron radiation and neutrons in art and archaeology*. (SR2A-2014), Paris, 9–12 September 2014.

Poster presented on the conference SR2A on results of PGAA measurements of lithic assemblages from Voivodina, environs of Szabadka (Subotica) with archaeological obsidian from the surface collection of K. Özvegy.

Kasztovszky, Zs., Lázár, K., Kovács Kis, V., Len, A., Füzi, J., Markó, A., Biró, K. T.: A novel approach in the mineralogy of Carpathian mahogany obsidian using complementary methods. *Quaternary International* 467 (2018), 332–341.

Carpathian obsidians can have various macroscopic features. They are typically black or grey and their transparency ranges from clear to opaque. The Tolcsva source, very rarely, can yield brown or red ('mahogany' type) obsidian. Archaeological, as well as geological pieces of mahogany obsidian were previously identified and characterised using PGAA. In 2007, the exact location of the red variant's outcrop was identified on the Szokolya hill (Tolcsva). The aim of this study was to better understand the possible reasons for the colouring of red obsidian. A novel approach was applied, using multiple methods for the analysis of the samples. For comparison, other Carpathian type, namely black obsidian from Tolcsva, and red obsidian from Bogazköy (Anatolia) were also studied. Besides the PGAA measurements of the bulk elemental composition, Mössbauer spectroscopy and TEM were used to study the samples in order to identify the presence of ferrous or ferric iron. With the help of SANS, the bulk nanostructures of the samples have been investigated and their surface or volume fractal dimensions have been determined. Black obsidians showed isotropy, while mahogany samples displayed a considerable anisotropy in the bulk pore orientation. According to our results, a large amount of the iron is dominantly located in different phases in the case of mahogany and black obsidians. Based on the summarised results, the differences between the red and black variants can be also explained by the different oxidation states of the Fe-ions, which may explain the colour difference.

Kasztovszky, Zs., Maróti, B., Harsányi, I., Párkányi, D., Szilágyi, V.: A comparative study of PGAA and portable XRF used for non-destructive provenancing archaeological obsidian. *Quaternary International* 468 (2018), 179–189.

Prompt Gamma Activation Analysis has successfully been applied to provenance research on Carpathian obsidians. The effectiveness of PGAA and a portable XRF device in discriminations of Carpathian, Lipari, Sardinia and Melos origin obsidians was compared on 75 representative geological samples obtained from the Lithotheca Collection of the Hungarian National Museum. Bivariate analyses and Principal Component Analysis have been made based on the individual PGAA and XRF data, as well as on the combination of both data types. Instrumental Neutron Activation Analysis was also applied on a group of 17 samples. The advantages and disadvantages of each method are discussed to determine the best possible way of investigations to fingerprint and characterize long-distance trade items with minimal damage to the samples.

Kilikoglou, V., Bassiakos, Y., Grimanis, A. P., Souvatzis, K., Pilali-Papasteriou, A., Papanthimou-Papaefthimious, A.: Carpathian Obsidian in Macedonia, Greece. *Journal of Archaeological Science* 23/3 (1996), 343–349.

The excavations at Mandalo in Macedonia, Greece, have produced a remarkably high number of obsidian objects, dated to the late Neolithic and early Bronze Age. Eleven of these samples were analysed by instrumental neutron activation for 19 minor and trace elements, in order to determine their provenance. It was found that all Neolithic and one Bronze Age samples came from the Carpathian 1 source, while another Early Bronze Age sample came from the Demenegaki source in Melos. The overlap between Carpathian and Melian obsidian distributions is evidence for interactions of ancient Macedonia with central Europe and the Aegean. Also, according to this finding, the Carpathian distribution pattern has now been extended for another 400 km to the south, from Vinča to Mandalo.

Kilikoglou, V., Bassiakos, Y., Doonan, R. C., Stratis, J.: NAA and ICP analysis of obsidian from Central Europe and the Aegean: Source characterisation and provenance determination. *Journal of Radioanalytical and Nuclear Chemistry* 216/1 (1997), 87–93.

INAA and ICPES are compared for their discriminative power in obsidian source characterisation. Geological samples from the Aegean and Carpathian sources were analysed for Na, Sc, Fe, Co, Rb, Sb, Cs, Ba, La, Ce, Sm, Eu, Tb, Yb, Lu, Hf, Ta, Th, U by INAA and for B, Na, Mg, Al, K, Ca, Sc, Ti, Mn, Fe, Zn, Y, Yr, Cs, Ba, La, Ce, Sm, Eu, Gd, Tb, Yb, Lu, Hf by two ICPES procedures. It is shown that all techniques work successfully, however, INAA is more efficient in the chemical discrimination of neighbouring sources.

Kobulský, J., Žecová, K., Gazdačko, Ľ., Bačo, P., Bačová, Z., Maglay, J., Petro, Ľ., Šesták, P.: *Guidebook to Geological-Educational Map of the Zemplínske vrchy Mts.* Bratislava, 2014.

In addition to the interpretation of geological structure of the region the map gives information about the natural beauties of the region, history of the Zemplín region and tourist attractions. The Zemplínske vrchy Mts. Is situated in the Southern part of Eastern Slovakia. On its territory the Protected Landscape Area Latorica, 4 National Nature Reserves: Botiansky luh, Kašvár, Latonický luh and Kašvár, 11 Nature Reserves: Biele jazero, Boľské rašelinisko, Dlhé Tice, Horešské lúky, Krátke Tice, Poniklecová lúčka, Raškovský luh, Tarbucka, Veľké jazero, Zatínsky luh a Zemplínska jelšina, 4 protected grounds: Bešiansky polder, Boršansky les, Oborínske jamy a Veľký kopec and 13 protected areas NATURA 2000: Bešiansky polder, Bodrog, Boršiansky lesík, Čičarovský les, Horešské lúky, Kováčské lúky, Ladmovské vápence, Latorica, Oborínske jamy, Oborínsky les, Raškovský luh, Tarbucka and Veľký kopec. They stretch over the Košice county and two districts: Trebišov and Michalovce.

Kohút, M., Westgate, J. A., Pearce, N. J. G., Bačo, P.: Obsidiány Východného Slovenska – nové výsledky FT datovania v kontexte geologického vývoja kenozoického vulkanizmu Západných Karpát. *Mente et Malleo* 1 (2017), 32.

Eastern Slovakia obsidians - new ft data results in the context of the geological development of the kenozoic vulcanism of the western Carpathians. Obsidian is a volcanic magmatic rock that was formed by the rapid solidification of the mainly rhyolite melt, often referred to as "volcanic glass." It is generally known that, in addition to flint and other SiO2 raw materials, obsidian has been used to produce the stone industry, thereby helping to develop humanity in its history. They were archaeologists who deserved to shift the knowledge of the obsidians of the Carpathian Zemplín – Tokaj region. In addition to using modern geochemistry, they also provided the first fission track (FT) dating from this area – the Borsod Neolithic Site, although the 3.8 –3 years presented by them 4 Ma point to local overheating over PAZ without magnesia-volcanic linkage.

Kostrzewski, J.: Obsidian implements found in Poland. *Man* 30 (1930), 95–98.

Though no sources of obsidian have yet been discovered in Poland, implements of this mineral are frequent enough there, and extend far to the north. This article summarized the appearance of the obsidian in Poland by different time periods.

Lehoczky, T.: Obsidian lelet Bereg megyéböl. *Archaeológiai Értesítő* 1 (1868), 313–314.

Report on archaeological obsidian finds from Bereg county [in our times, part of Ukraine (ed.)].

Markó, A.: Obsidian in the Danube bend: Use of a long distance raw material in the Epigravettian period. In: Mangado, X., Crandell, O., Sánchez, M., Cubero, M. (eds.): *'On the rocks'* Abstracts volume – International Symposium on knappable materials. SERP - Universitat de Barcelona, 2015, 192.

Some of the few obsidian sources in continental Europe are found in the Carpathian Basin: in eastern Slovakia, in north-eastern Hungary and in Transcarpathian Ukraine. In an archaeological context, after the questionable data from the Lower Palaeolithic, the use of this raw material is clearly known from the last Interglacial period. In the millennia during and after the last Würmian Pleniglacial, a large part of Central Europe was more or less depopulated: from the areas north of the Carpathian chains and the Alps very few traces of the human occupation are known. In Hungary, however, a large number of hunting camps from this period have been excavated. The best-known cluster of sites is found in the Danube Bend, lying more than 200 km from the obsidian outcrops. The excavated assemblages from Pilismarót, Dömös, Szob and Verőce show various strategies of raw material use. The evidences of local reduction of the extra-local rocks together with the field observations and the analysis of the artefacts of other raw materials suggest short term occupations and increased mobility of Palaeolithic humans living in the period immediately following the coldest event of the last glacial period.

Markó, A.: Use of obsidian during the LGM: case studies from the pebble Gravettian sites in Hungary / Az obszidián felhasználása a kavicsgravetti leletegyüttesekben: esettanulmányok az utolsó hideg maximum idejéből. *Archeometriai Műhely/Archaeometry Workshop* 14/3 (2017), 131–142.

The few obsidian sources in continental Europe are found in the Carpathian basin: in eastern Slovakia, north-eastern Hungary and the Transcarpathian Ukraine. In archaeological context, after the questionable data from the Lower Palaeolithic, the use of this raw material is securely known from the last Interglacial period. During the last Würmian Pleniglacial and in a few millennia after it large part of Central Europe was more or less depopulated: very few traces of the human occupation were identified from the areas lying north of the Carpathians and the Alps. In Hungary, however, important sites of the Pebble Gravettian industry are known: at Ságvár, south of the lake Balaton two discrete artefact-bearing layers, at Mogyorósbánya in the NE part of the Transdanubia three relatively well-preserved settlement spots were excavated. The lithics from Szob, lying in the Ipoly valley in the Danube bend give supplementary data about this industry. The studied obsidian artefacts are mainly of the Slovakian variant, imported to the sites from more than 200 km; the Tolcsva and Mád types are represented only by single pieces. The majority of the artefacts are linked to the bladelet production, used as blanks for backed pieces. The bladelets were partly removed from cores, but burins of various forms are also considered as cores in technological point of view. Finally, some larger pieces were seemingly imported to the sites as ready-made tools (convergent scraper and end-scrapers).

Mateiciucová, I.: Worked stone: obsidian and flint. In: Whittle, A. (ed.): *The early Neolithic on the Great Hungarian Plain*. Investigation of the Körös culture site of Ecsegfalva 23, County Békés. [Varia Archaeologica Hungarica 21] Vol. II (2007), 677–720.

Over the course of the interdisciplinary archaeology project at Ecsegfalva (County Békés, Hungary), obsidian and flint artefacts were also recovered. This worked stone industry is important in the study of the Early Neolithic, since it is one of the few archaeological sources that were also produced and used in the preceding Mesolithic period. Its study can therefore not only reveal much about the customs, way of life and contacts of the Neolithic community, but by making comparisons with the worked stone artefacts of Mesolithic foragers, also permits statements about the origin of the traditions of Neolithic communities in specific regions. Until relatively recently, only small collections of worked or chipped stone artefacts from the Körös culture were known, and as a result it has been difficult to elaborate on their characteristics. Large scale archaeological research conducted in the 1970s, however, has enabled the collection of rich assemblages which have been the subject of numerous studies. A total of 485 chipped stone artefacts were recovered from the Körös culture settlement at Ecsegfalva 23. With the exception of Méhtelek–Nádas (Szatmár phase), this represents the largest assemblage recovered to date from the Körös culture.

McDougall, J. M., Tarling, D. H., Warren, S. E.: The Magnetic Sourcing of Obsidian Samples from Mediterranean and Near Eastern Sources. *Journal of Archaeological Science* 10 (1983), 441–452.

The magnetic properties of obsidians are examined for their potential in sourcing obsidian artifacts. The three simplest to determine magnetic parameters-initial intensity of magnetization, saturation magnetization and low field susceptibility- are found to be effective discriminants of many Mediterranean, Central European and near Eastern sources. Although the between-source precision is not as good as geochemical analyses of minor and rare-earth elements, the technique demonstrated the existence of new sources that were subsequently confirmed by minor element analyses. Unfortunately, some key sources do not appear to be readily distinguishable on these three simple magnetic parameters alone, although more sophisticated magnetic analyses may prove diagnostic. Despite this, it would appear that effective discrimination can be made in many cases, occasionally with more precision than minor element analyses. This technique therefore offers, as a minimum, a preliminary sourcing tool for use in many areas of the world, thus reducing the number of expensive geochemical analyses. Furthermore, its very low cost, non-destructive nature and speed open the possibility of quantitative evaluation of trade routes based on obsidian distributions, particularly as versions of the equipment are now suitable for use in the field.

Milic, M.: PXRF characterisation of obsidian from central Anatolia, the Aegean and central Europe. *Journal of Archaeological Science* 41 (2014), 285–296.

The obsidian sources of central Anatolia, the Aegean and central Europe have been studied in detail over the past 50 years. Various analytical techniques have been employed to discriminate artefacts from each of these and to reconstruct their zones of distribution. This paper presents a pXRF method that allows mass sampling of artefacts

focusing on three neighboring regions, particularly where these zones overlap. Successful discrimination of the obsidian source for products could be achieved using three-dimensional scatter plots of trace elements Rb/Sr/Zr. PXRF can thus be appreciated as a powerful tool in the region, enabling non-destructive on-site analyses in contexts where the export of artefacts is often difficult if not impossible. The ability to rapidly process large assemblages also has major implications for generating data-sets of sufficient resolution to transform archaeological interpretation.

Moutsiou, T.: *The Obsidian Evidence for the Scale of Social Life during the Palaeolithic*. Thesis for the Degree of Doctor of Philosophy February 2011. Dissertation, University of London – Department of Geography, London, 2011.

The research demonstrated a strong correlation between obsidian use and long distances. The choice of obsidian makes sense within a system of exchange in which hominines chose to obtain their materials from elsewhere in order to maintain social links with other, more distant, groups. I argue that the scale of obsidian movement, although conditioned by a number of climatic, ecological and anatomical constraints, is actually rooted in social grounds. I thereby reject theories that see behavioural modernity as a recent advance inhuman history and argue for modern behaviour as gradual process that was initiated in East-Africa at least as early as the Middle Stone Age.

Moutsiou, T.: Changing Scales of Obsidian Movement and Social Networking. In: Ruebens, K., Bynoe, R., Romanowska, I. (eds.): *Unravelling the Palaeolithic: Ten years of research at the Centre for the Archaeology of Human Origins*. (CAHO, University of Southampton). BAR International Series 2400 (2012), 85–95.

In this paper I argue that modern social behaviour can be observed in the ability to create and maintain extended social networks where relatedness is successfully sustained in absentia. Archaeologically, modern social behaviour can be detected through the investigation of raw material movement. By concentrating on rare materials it is possible to reconstruct the dimensions of the exchange networks involved in their circulation. Using this information, the scale of social interactions can be inferred. The greater the distances of raw material movement the more complex the behavioural abilities of the individuals involved in the transfers. Information from obsidian-bearing sites spanning the temporal framework of the Palaeolithic and located in two different ecological niches, namely Africa and Europe, will be presented. Using latitude as an exploratory model, the movement of obsidian is investigated. A correlation between obsidian use and long distances is observed. More importantly, the analysis provides strong evidence that obsidian is chosen and transferred significant distances irrespectively of latitude. Subsequently, I argue that the scale of obsidian movement, although conditioned by a number of ecological constraints, is actually rooted in social grounds. It is due to advanced behavioural abilities that obsidian moves and hominines interact and feel related even in absentia.

Moutsiou, T.: *The Obsidian Evidence for the Scale of Social Life during the Palaeolithic*. BAR International Series 2613 (2014), Oxford, Archaeopress.

Obsidian-bearing sites spanning the temporal framework of the Palaeolithic and located in Africa and Europe are analysed in this volume with the aim of elucidating the evolution of modern social behaviour. Obsidian is a rock that forms only under very special conditions; its geological sources are infrequent and distinguished from each other on the basis of unique chemical properties. As such it is possible to reconstruct the distances of its movement and use these data to infer the scale of social life during the Palaeolithic. A strong correlation between obsidian use and long distances is observed implying that the hominines involved in the circulation of the specific material were behaving in a socially modern way.

Nandris, J.: A re-consideration of the South-East European Sources of archaeological obsidian. *University of London Bulletin of the Institute of Archaeology* 12 (1975), 71–94.

This article describes the results of fieldwork on the sources of obsidian in south-east Europe, carried out as part of a programme including other archaeological and environmental research during a short period in the summer of 1974. The object of the part of the work devoted to obsidian was to characterize the geological sources of archaeological obsidian in south-east Europe, by obtaining samples from them for neutron activation analysis, as a preliminary to the analysis of archaeological specimens. This was the first occasion on which fieldwork in this area has been carried out with the aim of verifying the geological sources of obsidian, and it yielded unexpected negative evidence about them.

Novák, M.: Gravettienske osídlenie spodnej vrstvy Kašova I / Gravettien-Besiedlung der unteren Schicht Kašov I. *Slovenská Archeológia* 50/1 (2002), 1–52.

Upper Palaeolithic settlement of eastern Slovakia was concentrated to the Zemplínske vrchy hills surroundings in the time of Gravettian and Epigravettian cultures. On the open-air site in Kašov 1-Spálenisko two layers were found with finds corresponding to two settlement phases. The bottom layer is dated to the late phase of shouldered-points horizon that closed the Gravettian evolution on the territory of central Europe and use to be interpreted as a transitional and short-stay basic camp. Its rise is probably connected with migration of Late Gravettian hunters' groups, moving seasonally between the territory north of the Carpathian are and inner space of the Carpathian basin.

Oddone, M., Márton, P., Bigazzi, G., Biró, K. T.: Chemical characterisation of Carpathian obsidian sources by instrumental and epithermal neutron activation analysis. *Journal of Radioanalytical and Nuclear Chemistry* 240/1 (1999), 147–153.

Obsidian samples from the Tokaj Mountains (Hungary) and from the neighbouring Zemplin Hills (Slovakia) were analysed by instrumental and epithermal neutron activation analysis for obtaining a "fingerprint" for discrimination of potential natural sources of raw material that would permit tracing the origin of archaeological obsidian artefacts. These techniques fully discriminate the Zemplin Hills sources (Carpathian I, Eastern-Slovakia) and the Tokaj Mountain sources (Carpathian II, Northeastern-Hungary) as well as these Central European sources from those already studied of the Mediterranean basin and adjacent regions.

Osipowicz, G., Szelinga, M.: Analiza funkcjonalna obsydianowego lisciaka schylkowopaleolitycznego z wolodzi / Functional analysis of a late-palaeolithic obsidian tanged point from Wolodz, district Brzozów, Podkarpacie Voivodship. *Acta Archaeologica Carpathica* 39 (2004), 153–160.

A microscopic and computer examination of a Late Palaeolithic tanged point recovered from the surface layer of Site 7 at Wolodz, showed the presence of numerous irregular scratches and abrasions resulting from its exposure on site. Nevertheless, it was possible to identify traces of original wear, and on that basis to determine the uses of the tool. The authors concluded that the tanged point was used to scrape hides and owing to continued use its edge gradually acquired a regular, rounded profile. The tanged point must have also served as the point of a missile, most probably an arrowhead. This is indicated by the tongue-shaped negatives disfiguring the pointed cone and its base. The use of the artifact seems to have passed through two phases. Originally employed as a hide scraper, it was later remade into an arrowhead and some technological processing was necessary to adapt the object to its new function.

Orange, M., Le Bourdonnec, F.-X., Scheffers, A., Joannes-Boyau, R.: Sourcing obsidian: a new optimized LA-ICP-MS protocol. *STAR: Science & Technology of Archaeological Research* 2/2 (2016), 192–202.

The LA-ICP-MS is one of the most successful analytical techniques used in archaeological sciences. Applied to the sourcing of lithic raw materials, it allows for fast and reliable analysis of large assemblages. However, the majority of published studies omit important analytical issues commonly encountered with laser ablation. This research presents a new advanced LA-ICP-MS protocol developed at Southern Cross GeoScience (SOLARIS laboratory, Southern Cross University, Australia), which optimizes the potential of this cutting-edge geochemical characterization technique for obsidian sourcing. This new protocol uses ablation lines with a reduced number of assayed elements (specific isotopes) to achieve higher sensitivity as well as increased precision and accuracy, in contrast to previous studies working with ablation points and an exhaustive list of measured isotopes. Applied to obsidian sources from the Western Mediterranean region, the Carpathian basin, and the Aegean, the results clearly differentiate between the main outcrops, thus demonstrating the efficiency of the new advanced LA-ICP-MS protocol in answering fundamental archaeological questions. The measured isotopes have been carefully selected amongst the most efficient to discriminate between the different obsidian sources. This shortened list of isotopes achieves precise and accurate measurements with a higher sensitivity, and with the use of ablation lines, contributes to enhancing the potential of this geochemical characterization technique for obsidian sourcing.

Pollmann, H.-O.: *Obsidian-Bibliographie. Artefakt und Provenienz*. [Der Anschnitt, Zeitschrift für Kunst und Kultur im Bergbau, Beiheft 10] Verlag des Deutschen Bergbau-Museums, Bochum, 1999, 1–151.

A comprehensive bibliography of obsidian research world-wide by geographical regions.

Prokeš, L., Galinová, M. V., Hušková, S., Vaculovič, T., Hrdlička, A., Mason, A. Z., Neff, H., Přichystal, A., Kanický, V.: Laser microsampling and multivariate methods in provenance studies of obsidian artefacts. *Chemical Papers* 69/6 (2015), 761–778.

The provenance of obsidian artefacts and raw materials was studied by the multivariate statistical analysis of forty-five samples using elemental composition data obtained by LA-ICP-MS. The influence of surface roughness (polished raw material vs. artefact) and micro-inhomogeneity on the LA-ICP-MS signal was studied under the optimised working conditions of the laser ablation device. Principal component analysis, correspondence analysis, independent component analysis, multi-dimensional scaling, Sammon mapping and fuzzy cluster analysis were applied and compared in order to reveal statistically significant compositional differences between particular geological sites and to disclose the provenance of the raw materials used in manufacture of the artefacts. Twenty-seven artefacts and eighteen raw material samples from natural resources in the Czech Republic, Slovakia, Italy, Greece, Syria, Iraq, Turkey, Mexico and Nicaragua were examined with special attention focused on samples from Moravia (Czech Republic) and some Near East sites (Tell Arbid, Tell Asmar). The Carpathian origin of the obsidian artefacts was investigated in the Moravian samples using the Pb, Rb and U contents. The Near East samples were classified according to their Sr, Ba, Zr and REE contents as per-alkaline obsidians (Bingöl A/Nemrut Dağ) originating from Southeast Anatolia.

Přichystal, A., Škrdla, P.: Searching for the principal source of obsidian used in prehistoric times of Slovakia and Central Europe. In: *19. Kvartér - Sborník abstract*. 29th November 2013.

Concerning the principal source of obsidian for Slovakia and Central Europe, all recent authors locate it to the primary occurrence at the village of Viničky (Szőllőske). This obsidian is evidently different comparing with this one used mostly for prehistoric artefacts. That is why we suppose the main source of prehistoric obsidian in fluvial sediments (secondary deposit) in the western surroundings of the Brehov village.

Přichystal, A., Škrdla, P.: Kde ležel hlavní zdroj obsidiánu v pravěku Střední Evropy? / Where was situated the principal source of obsidian in prehistory of Central Europe? *Slovenská Archeológia* 62/2 (2014), 215–226.

Carpathian obsidian represented one of the most important raw materials in prehistoric times of Central Europe. According to the distribution maps, the Slovakian source (Carpathian 1) played the decisive role not only in Slovakia but in the whole Central Europe as well. The provenance of this obsidian was supposed near the village Viničky at the southern margin of the Zemplínske vrchy Mts. But the natural obsidian from the surroundings of Viničky (no sculpture, polyhedral shape, almost non-translucent glassy mass, dimensions of pieces usually up to 3–4 cm) has absolutely different properties comparing the appearance of prevalent part of obsidian artefacts (conspicuous sculpture on relics of original surface, a good translucence, common dimensions of pieces above 6 cm and more). We found the occurrence of such shortly transported and sculptured natural obsidians in lenses of probably deluvio-fluvial gravels in air-borne sands situated in central to NE parts of the Zemplínske vrchy Mts., i.e. in the surroundings of Brehov. In recent time these deluvio-fluvial or fluvial rocks with obsidian are probably partly covered by younger flood loams or air-borne sands. Our finding shows the mentioned area with about 6 km^2 could be the principal source supporting by obsidian Central and SE Europe from the Middle Palaeolithic.

Rácz, B.: Закарпатські обсидіани: міфи та реальність. 1 частина: дані спеціальної літератури/Transcarpathian obsidians: myths and reality. Part 1: Data from special literature. *Acta Beregsasiensis* VIII/2 (2009), 273–278.

Trancarpathia is a populated region from the early periods of Palaeolithic. From each historical period we have got the archeological findings. The first tools have made from stone. Thanks to the variety of geological structures, Transcarpathia is very rich of raw materials. One of the most popular stone raw material for the prehistorical man was the obsidian. According to the geological and archaeological literature descriptions, the obsidian can be find in several places: Vihorlat-Gutin Mountain Range, the Oas (Avas) Mountains and Beregovo Hills. The obsidian is described in the form of bombs, seeds, debris and the block, their occurring mostly happened with perlite. The obsidians of the Rokosovo – Maliy Rakovets region are mentioned in the geological and in the archeological literature too. This is a Carpathian 3 type of the obsidians from the Carpathian Basin. The aim of the first part of the article was to collect the descriptions of the obsidians from the literature. In the future we would like to present the results of the field-work from the mentioned places.

Rácz B.: Kárpátaljai obszidiánok: szakirodalmi adatok és terepi tapasztalatok/Transcarpathian obsidians: literature data and field experience. In: Kreiter A. – Pető Á. – Tugya B. (szerk.): *Környezet-Ember-Kultúra. A természettudományok és a régészet párbeszéde*. Magyar Nemzeti Múzeum Örökségvédelmi Központ, Budapest, 2012, 353–362.

People of the Palaeolithic knew the environment and stone raw materials very well. In the territory of Transcarpathia people utilized stones, which proved to be suitable for the production of chipped stone tools. One of the most important raw materials was a high-quality obsidian, three types of which are already known in the Carpathian Basin. One of them is found in Transcarpathia, in primary geological conditions. In this study I present a literature review of geological and archaeological sites that are known in Transcarpathia, from which obsidians are described. The data are complemented by my own field experiences, analysis and evaluation of these resources. The majority of the obsidians that are described by the geological literature, cannot correlate with raw materials that would be suitable for preparing chipped stone tools. Moreover, the rocks in the geological literature are often incorrectly identified as obsidians. According to the literature and field research we can conclude that the Carpathian 3 obsidian was the only local obsidian raw material that was used by prehistoric people in the area of present-day Transcarpathia.

Rácz, B., Szakmány, Gy., Biró, K. T.: Contribution to the cognizance of raw materials and raw material regions of the Transcarpathian Palaeolithic. *Acta Archaeologica Academiae Scientiarum Hungaricae* 67/2 (2016), 209–230.

On the territory Transcarpathian Ukraine, about 100 Palaeolithic localities are known up to our days. Field survey for collecting geological samples localized 19 different raw material sources all of which yielded hard rocks with conchoidal fracture that are suitable for tool making with knapping. Out of the 19 raw material types 11 were actually found in archaeological assemblages of the studied area. The most popular raw materials of Transcarpathian Ukraine are the Korolevo hyaline dacite, Rokosovo obsidian, (Carpathian 3 type) and siliceous rhyolite tuff varieties (type I and II), siliceous tuffite (type I and II), siliceous and opalised rhyolite (type I and II) from the Beregovo Hills area, as well as silicified sandstone (type II) and the siliceous argillite. On the basis of the principal raw material circulation of the Palaeolithic three territorial groups have been formulated. These are named after the most abundant and used rock types of the given region. Three raw material regions are recognized in Transcarpathia: volcanic, metasomatic, and sedimentary. Furthermore, sub-regions were also established in the volcanic region (Rokosovo-Maliy Rakovets and Korolevo-Veryatsa sub-regions) and in the metasomatic region (Beregovo, Muzhiyevo and Bene–Kvasovo sub-regions).

Renfrew, C., Cann, J. R., Dixon, J. E.: Obsidian in the Aegean. *Annual of the British School at Athens* 60 (1965), 225–247.

Obsidian to the Greeks was no more than a semi-precious stone, black and shiny, suitable for mirrors or exotic ornaments. But to their predecessors in the Aegean through five millennia it was an important raw material for the manufacture of tools and weapons. Sharper and more abundant than flint, more easily worked and cheaper than copper, it was not displaced entirely even by the use of bronze, which was always an expensive material, there being no source of tin in the Aegean. Only when knowledge of iron-working was brought to the Aegean coasts did obsidian fall from its position as an important raw material to that of a curiosity. Huge quantities of obsidian are to be found lying about the surface of most prehistoric sites in south Greece—any farmer or shepherd will tell of the 'little razors' to be found on his land. But its occurrence in nature is very unusual since it is found exclusively in regions of recent volcanic activity, and then only when certain conditions exist, such as a high silica content in the lava of the volcano. Every single piece found in mainland Greece had to be imported from overseas, a process implying competent geological knowledge, skill in sailing and navigation, and perhaps social organization, to a considerable degree. It is the earliest trade in the world for which we have concrete evidence.

Repčok, I.: Stopy delenia uránu a možnosti ich využitia pre datovanie na príklade vulkanických skiel. *Západné Karpaty* [Séria mineralógia, petrografia, geochémia, ložiská 3] (1977), 175–196.

The paper deals with the methodology of dating natural materials on the basis of fission tracks originating from the splitting of uranium nuclei. Four types of volcanic glass were dated, from Viničky (11.1 ± 0.8 Ma), Merník (13.3 ± 1.2 Ma) Szabova skala (14.3 ± 1.4 Ma) and Rudno nad Hronom (12.3 ± 1.0 Ma).

Repčok, I., Kaličiak, M., Bacsó, Z.: Vek niektorych vulkanitov vychodneho Slovenska určeny metodou stop po štiepeni uranu. *Západné Karpaty* [Séria mineralógia, petrografia, geochémia, metalogenéza 11] (1988), 75–88.

Some volcanites of eastern Slovakia have been dated by the fission track method. The Slanské vrchy Mts.: rhyolites on the periphery – Upper Badenian, andesites and diorite porphyrites of the upper structure – Middle to Upper Sarmatian, dacites-rhyodacites of the upper structure – Upper Sarmatian. The Zemplínske vrsky Mts.: rhyolite –

Upper Badenian and rhyodacite – Middle Sarmatian.

Rómer, F.: Első obsidian-eszközök Magyarországon / First obsidian implements in Hungary. *Archaeologiai Közlemények* 7 (1868), 161–166.

Report on the first obsidian tools found in Hungary (1865) from the territory of Erdőbénye. Also presenting a large obsidian core from Marosvásárhely (Târgu Mureş, Romania) and Kolozsvár (Cluj-Napoca, Romania) as well as arrowheads made of silex from Transdanubia.

Rómer, F.: Ó-kőkori eszközök Magyarországon. *Archaeológiai Értesítő* 1 (1868), 3–8.

Flóris Rómer, pioneering figure of Hungarian archaeology and founder of the periodical Archaeológiai Értesítő was specifically interested in chipped stone artefacts. Just in 1866 in his monograph on Hungarian prehistory (first of its kind), he commented with regret on the lack of chipped stone tools from the territory of Hungary. In a few years time, he could report on stone tools from the beginnings of the lithic periods including several pieces made of obsidian. It is of symbolic significance for us that the leading archaeological periodical started with a communication on stone, more specifically, obsidian tools...

Rómer, F.: Ismét néhány szó az obsidián-eszközökről. *Archaeológiai Értesítő* 1 (186), 56–59.

Continuation of the report on obsidian tools recently found; mainly the same pieces as already published in Archaeologiai Közlemények 7. Rómer emphatically encouraged potential finders of stone artefacts on reporting the finds personally to him and the periodical Archaeológiai Értesítő, e.g., in form of letters to the Editor.

Rómer, F.: Hogyan készülnek az obszidián késpengék? *Archaeológiai Értesítő* 4 (1871), 250–252.

Technological observations by F. Rómer on the production of obsidian blades on the basis of anthropological analogies.

Rómer, F.: Les silex taillés et les obsidiennes en Hongrie. In: *Compte-Rendu*, Budapest 1876, 5–17.

On the occasion of the VIIIth International Congress on Anthropology and Prehistoric Archaeology, Flóris Rómer published the first catalogue and map of obsidian and silex artefacts collected in the previous decade from the territory of Hungary. The new acquisitions were presented on the exhibition organised in honour of the Congress.

Rosania, C. N., Boulanger, M. T., Glascock, M., Biró, K. T.: Geochemical Analysis of Central and Eastern European Obsidian. In: Gliozzo, (ed.): *37th International Symposium on Archaeometry*. Program and Abstracts. Siena, 12–16 May 2008, Universitá d. Studi de Siena, 2008, 245.

Poster presented on the 37th ISA conference in Siena based on analytical results of the University of Missouri, Research Reactor, using Neutron Activation Analysis.

Rosania, C. N., Boulanger, M. T., Biró, K. T., Ryzhov, S., Trnka, G., Glascock, M. D.: Revisiting Carpathian obsidian. *Antiquity: Project Gallery* 82/318 (2008).

Archaeological interest in sourcing obsidian artefacts has increased exponentially since Renfrew's ground-breaking work with Aegean obsidian. Although Mediterranean obsidian has received the lion's share of attention, sources in Central and Eastern Europe have recently become the focus of characterisation efforts. This is timely Carpathian obsidian was first exploited during the Middle Paleolithic, and was traded widely throughout Europe during later times. Identifying Carpathian sources of obsidian artefacts may therefore provide data on human cultural interactions ranging from social boundaries to resource-procurement patterns over a considerable period of time. Despite increased international collaboration aimed at characterising Carpathian obsidians, advances in understanding of the archaeological significance of Central and Eastern European obsidian sources have been hampered by difficulties of language and access.

Roska, M.: Adatok Erdély őskori kereskedelmi, művelődési és népvándorlási útjaihoz / Data on the trade, cultural and migrational routes of prehistoric Transylvania. *Archaeológiai Értesítő* 47 (1934), 149–158.

A systematical collection of archaeological obsidian finds from the territory of Transylvania, (Romania) by geographical location and chronological period. Possible routes of trade and communication were hypothesed. The author emphasised the role of the rock-salt deposits as possible counter value for barter.

Rózsa, P., Elekes, Z., Szöőr, Gy., Simon, A., Simulák, J., Uzonyi, I., Kiss, Á. Z.: Phenocrysts in obsidian glasses. *Journal of Radioanalytical and Nuclear Chemistry* 256/2 (2003), 329–337.

The aim of the current paper is to map minerals mainly of Carpathian obsidian glasses by nuclear microprobe based on the particle induced X-ray emission (PIXE) providing analytical data on them for the first time. Some samples from Armenia, Greece are also involved to make a comparison with the Carpathian specimens. The following minerals are identified and analyzed: pyrrhotine, chalcopyrite, pyrite, zircon, pyroxene, biotite, plagioclase feldspar, and anhydrite. On the basis of rock-forming silicate minerals, some petrologic processes are outlined. With the identification of accessory minerals (anhydrite, pyrrhotine, chalcopyrite, pyrite), some geological conclusions are also drawn.

Rózsa, P., Szöőr, Gy., Elekes, Z., Gratuze, B., Uzonyi, I., Kiss, Á. Z.: Comparative geochemical studies of obsidian samples from various localities. *Acta Geologica Hungarica* 49/1 (2006), 73–87.

Obsidian samples from different localities of various geologic settings (Armenia, Hungary, Iceland, Mexico, Slovakia and Turkey) were analyzed by particle induced Gamma-ray emission (PIGE) technique and laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS). Samples from Mexico and Iceland show higher alkali and REE content as well as higher Nb and Ta abundances than the other samples. Discrimination diagrams show samples from Mexico and Iceland to belong to WPG. The position of the samples from the Tokaj Mts. is also definite, and it corresponds to the expectation (VAG or VAG+syn-COLG fields). Using a Li-B diagram the obsidian samples can be distinguished according to their geographic distribution. By means of a Ce-Ti diagram, obsidian from the Tokaj Mts. can be divided into three groups that may correspond to the archeometrical C2E, C2T and C1 groups. Phenocrysts in the obsidian samples from the Tokaj Mts., and the Aragats Mts. (Armenia) were detected and analyzed by micro-PIXE (proton induced X-ray emission) method. In this way silicate minerals (zircon, pyroxene, biotite, plagioclase feldspars), ore minerals (chalcopyrite, pyrrhotine, pyrite), and other non-silicate mineral (anhydrite) were identified.

Ryzhov, S.: Obsidian outcrops in Transcarpathia and their use during the Palaeolithic Time. In: Yamada, M., Ono, A. (eds.): *Lithic raw material exploitation and circulation in Prehistory. A comparative perspective in diverse paleoenvironments*. Series: Etudes et recherches archéologiques de l'Université de Liège No. 138., Université de Liège, Service de préhistoire & Centre de recherches archéologiques. 2014, 113–129.

In Ukraine, obsidian artifacts found in the Stone Age, and their origin is poorly understood. Soon as possible sources of supply of obsidian artifacts are volcanic mountain in the Carpathians, the Crimea and the Caucasus. At the current stage of research only volcanic region of Transcarpathia is the source outputs obsidian in Ukraine. Obsidian outcrops in the territory of Transcarpathia are known only in the vicinity of the ridge of Velykyj Sholes (next to villages Rokosovo and Malyj Rakovets). Recent collaborative studies have confirmed the presence of local obsidian. XRF and NAA data indicate that Ukrainian obsidian is chemically different from other Carpathian obsidians, and suggest that the Ukrainian material is internally homogenous and belongs to so called Carpathian 3 source. The site of Malyj Rakovets IV is located in area of the extinct volcanoes of the Neogene period. Paleolithic inhabitants intensively used the obsidian rocks that were formed on the surface during eruptions. Artifacts of the Lower, Middle, and Upper Paleolithic cultural horizons of the site were discovered in stratigraphical context. On the site Malyj Rakovets IV natural obsidian blocks are virtually absent. The nearest outcrops are known at the distance of two kilometers of where and still can be found on eroded slopes. The local Paleolithic inhabitants in different times used other available raw materials. This is particularly clearly visible in the Upper Palaeolithic time.

Sobkowiak-Tabaka, I., Kasztovszky, Zs., Kabaciński, J., Biró, K. T., Maróti, B., Gméling, K.: Transcarpathian contacts of the Late Glacial Societies of the Polish Lowlands. *Przegląd Archeologiczny* 63 (2015), 5–28.

Identification of exotic raw materials discovered within the context of Late Glacial societies of the North European Plain is a crucial factor in discussion about far-reaching exchange systems of goods and ideas. The present paper considers the occurrence of obsidian finds on the Polish Lowlands, hundreds of kilometers away from its sources located south of the Carpathians. The focus is on chemical recognition and identification of a large and unique assemblage of obsidian artefacts from two Polish localities based on non-invasive Prompt Gamma Activation Analysis (PGAA). As a result, a clear connection of northern Polish obsidians with its outcrops located on the northern (Slovakian) fringe of the Tokaj Mountains was established that is the first detailed identification of obsidian finds from the territory of Poland ever. A review of Polish and Slovakian obsidian assemblages from the Late Glacial times and the importance of obsidian exchange and mobility for Late Palaeolithic societies of Central Europe are discussed supported by analytical results of PGAA.

Soják, M.: Analýza kamennej industrie zo Zemplínskych Kopčian a Brehova (Slovensko) / Analyse der Steinindustrie aus Zemplínske Kopčany und Brehov (Slowakei). *Přehled výzkumů* 54/1 (2013), 99–109.

Analysis of chipped stone industry from Kopčany and Brehov (Slovakia). The flake stone assemblages which were discovered during the excavation of two archaeological sites in Eastern Slovakia – Zemplínske Kopčany and Brehov were analysed. Obsidian stone, which is a local raw material, occurs at a higher frequency than imported raw materials – Jurassic flint "G" and basalt. Local raw materials were used at Brehov. The local obsidian dominates and other stone materials are present in small proportions. The typological character of the flake industries is also different. Flakes account for 68 % of the artefacts and blades 25 %. Specific artefacts are the „łuszcznie" ("Splitter" in German) though to have been used as chisels or cutting tools. The analyzed assemblages are compared with assemblages from other Baden culture sites in Slovakia and in particular to those from the Malopolskie Voivodship. The analyzed artefacts from Zemplínske Kopčany and Brehov correspond to two phases in the development of the Baden Culture. The older phase has stronger affinities to the Funnel Beaker culture, and in the case of the Brehov site, to a younger phase, which is parallel with the Pleszow-Zesławice group in the Malopolskie Voivodship.

Suda, Y., Yamada, M., Ryzhov, S., Stepanchuk, V.: Preliminary report on obsidian petrography from the Transcarpathian region in Ukraine. *Natural Resource Environment and Humans* 4 (2014), 21–37.

This paper reports the field occurrence, mineralogy, and whole-rock chemistry of the obsidian from the Neogene Carpathian volcanic arc area. The study area encompasses the Transcarpathian (Zakarpatia) region in Ukraine. A mafic xenolith comprising of a plagioclase, amphibole, and olivine mineral assemblage was found from the obsidian in this area. SEM-EDS analysis indicates that the olivine has high magnesium content. The forsterite (Mg_2SiO_4) content varies from 77% to 80%. The chemical composition of plagioclase remains constant, and is enriched in calcium. The anorthite ($CaAl_2Si_2O_8$) content varies from 89% to 94%. The amphibole is classified into the tschermakite following the nomenclature of Leake et al. (1997). Based on the compositions of the amphibole and the plagioclase, pressure and temperature conditions of the mafic xenolith were estimated to be 4.5–7.9kbar and 1185–1358°C respectively. These results indicate that this mineral aggregate is not genetically associated with the rhyolitic magma from which the obsidian was derived, but is considered to be of an exotic xenolith originated from the gabbroic rocks of the lower crustal level of the Carpathian volcanic arc. The finding of mafic xenolith will help in characterizing the obsidian from this area, and is a key in understanding the tectonic and evolutionary history of the Carpathian volcanic arc.

Suda, Y., Grebennikov, A. V., Kuzmin, Y. V., Glascock, M. D., Wada, K., Ferguson, J. R., Kim, J. C., Popov, V. K., Rasskazov, S. V., Yasnygina, T. A., Saito, N., Takehara, H., Carter, T., Kasztovszky, Zs., Biró, K. T., Ono, A.: Inter-laboratory validation of the WDXRF, EDXRF, ICP–MS, NAA and PGAA T analytical techniques and geochemical characterisation of obsidian sources in northeast Hokkaido Island, Japan. *Journal of Archaeological Science: Reports* 17 (2018), 379–392.

Obsidian provenance studies, based on geochemical signatures, are important for determining the source regions of obsidian artefacts. Such research depends on the availability of reproducible geochemical data. An inter-laboratory study was conducted to validate analytical methods applied to samples from four obsidian sources in northeast Hokkaido Island (Shirataki, Rubeshibe, and Oketo regions). The methods applied were WDXRF, EDXRF, ICP–MS, NAA and PGAA. Eight laboratories in Japan, the Russian Federation, Republic Korea, Hungary, Canada, and the USA took part in the trials. Results indicate discrepancies between laboratories, but compositional data for 53 elements were successfully compiled, and reference compositions for 16 elements in each sample defined. Based on these data, a new chemical discrimination scheme is proposed for obsidian sources in the Shirataki, Rubeshibe, and Oketo regions. This scheme is applicable to the discrimination of obsidian sources using semi-quantitative EDXRF analysis, with this being important in non-destructive provenance studies of artefacts. This study fosters the further establishment of reference materials for obsidian sources in the Hokkaido region, and the sharing of such materials.

Szabó, J.: A Tokaj-Hegyalja obsidiánjai (Obsidians of the Tokaj mts.). *A Magyarhoni Földtani Társulat Munkálatai* 3 (1867), 147–172.

Detailed geographical and geological description of the obsidian sources in the Tokaj region.

Szabó, J.: L'obsidienne prehistorique en Hongrie et en Grece. In: *Congr. Int. d'Anthr. et d'Arch. Prehist VIII.* Compte-Rendu 2 (1876), 96–100.

On the occasion of the VIIIth International Congress on Anthropology and Prehistoric Archaeology, József Szabó summarised geological information on obsidians of the Tokaj region and the Melian sources.

Szádeczky, Gy.: A magyarországi obsidiánok, különös tekintettel geológiai viszonyaikra [Hungarian obsidians, with special regard to their geological relations]. *Értekezések a természettudományok köréből* 16 (1886), 1–64.

Detailed geographical and geological description of the obsidian sources in the Tokaj region.

Szeliga, M.: Der Zufluss und die Bedeutung des Karpatenobsidians in der Rohstoffwirtschaft der Postlinearen Donaugemeinschaften auf den Polnischen Gebieten. In: Kozłowski, J. K., Raczky, P. (eds.): *The Lengyel, Polgár and related cultures in the Middle/Late Neolithic in Central Europe*. The Polish Academy of Arts and Sciences Kraków – Eötvös Loránd University Institute of Archaeological Sciences Budapest, Kraków, 2007, 295–307.

The inflow of Carpathian obsidian to the territory of Poland in the period of the development of post-linear communities constitutes a continuation of the phenomenon, which had been begun by the people of the Linear Pottery Culture. Archaeological data point to an undisrupted continuity of this process throughout the 5th and 4th millennia BC. The leading role in its distribution was played by the Rzeszów settlement concentration of the Malice culture. This is reflected in the local incidence of obsidian, which is decidedly higher in comparison to the more distant settlement enclaves of this culture, as well as of the Lengyel communities. This type of territorial differentiation does not point to a higher variability in time, retaining similar proportions throughout the entire 5th millennium BC. The conclusions following from a thorough analysis of the percentage-based shares of this raw material necessitate a search for justification of its inflow into the foothills of the Carpathians and the Sudets, which would be other than purely utilitarian. Obsidian is postulated to have the function of a symbol of prestige. It is not connected directly with the sphere of economic demand, but whose import resulted from the necessity to satisfy quite different needs and had other aims than obtaining good quality raw material.

Tripković, B.: Obsidian deposits in the Central Balkans? Tested against archaeological evidence. *Starinar* 53–54 (2003–2004), 163–179.

Finds of obsidian artefacts on sites distant from the presumed primary source have often received a romantic note in the history of archaeology, manifested in the idea about local exploitation as a form of procurement and archaeologists' search for as yet undetected deposits of this raw material. In due course, such concepts have found their way into Serbian archaeology as well. The main objective of this contribution, therefore, is to reconsider the current knowledge about obsidian in the central and north Balkans, to test how well founded the idea about the use of local sources is, as well as to indicate some possible directions for future research.

Tripković, B.: The quality and value in neolithic Europe: an alternative view on obsidian artifacts. In: Tsonev, T., Montagnari-Kokelj, E. (eds.): *The Humanized Mineral World: Towards social and symbolic evaluation of prehistoric technologies in South Eastern Europe.* Proceedings of the ESF Workshop, Sofia, 3–6 September 2003. ERAUL 103 (2004), 119–123.

In current studies, obsidian is considered both as a highly valuable commodity, of exotic origin, and in other cases as a raw material with practical use only. The answer to the problem is not an easy one, since the basic qualities of obsidian are also found in many other raw materials, often easily accessible from prehistoric settlements. In this assessment of the subject of distribution and the chronology of obsidian finds I have tried to view obsidian exclusively on the basis of its chronological and cultural context. Such methodological premise leads to a conclusion that the role, importance and value of obsidian in the life of prehistoric communities can be best understood during the period of neolithization of the European continent and later on, when obsidian becomes an integral part of the complex changes in the perception and the use of the environment.

Tripković, B., Milić, M.: The origin and exchange of obsidian from Vinča–Belo Brdo. *Starinar* 58 (2008), 71–86.

Since the time of the revolutionary characterisation of obsidian in the 1960's only a small number of artefacts from the Serbian sites have been analysed, of which at least seven samples come from the site of Vinča. These results showed that obsidian was coming from Carpathian sources, disproving old romantic ideas of the existence of local obsidian sources in the central Balkans. These results allowed for the development of ideas about exchange networks of interregional importance during the Late Neolithic in which obsidian was an integral component. In this paper we will be discussing the results of the characterisation of 60 obsidian samples, representing ca. 4% of the entire obsidian assemblage from the site. The samples

were taken from the whole Neolithic sequence at Vinča selecting macroscopically different obsidian types.

Tsonev, T., Montagnari-Kokelj, E. (eds.): *The Humanized Mineral World: towards social and symbolic interpretation of prehistoric technologies in South Eastern Europe*. Proceedings of ESF Exploratory Workshop, 3-6 September, Sofia, ERAUL 103 (2003), 71–76.

There are very few obsidian artefacts from prehistoric settlements in Bulgaria – sensu lato Neolithic till Bronze Age (Eneolithic). On the contrary, such artefacts are numerous in the countries surrounding (European Turkey, Romania, Greece, Hungary). we have tried explain this general absence of such artefacts in Bulgarian settlements. In seemed interesting to compare two generally divergent approaches, the geological and the archaeological. We decided to look for the existence of obsidian in the territory of Bulgaria, and organized a study trip to the main paleovolcanic regions located in the south and south-eastern parts of the country: the Dambalak (Eastern Rhodopes), as well as the Bulgarovo and Rossen paleovolcanoes (the latter actually under the Black Sea). According to geologists obsidian exists as nodules in these areas, as the paleovolcanoes produced acid conditions favourable for the production of obsidian or glassy rocks.

Tykot, R. H.: Obsidian procurement and distribution in the central and western mediterranean. *Journal of Mediterranean Archaeology* 9/1 (1996), 39–82.

Obsidian has long been recognized as an indicator of long-distance, maritime-based exchange networks in the Neolithic central and western Mediterranean. Earlier studies have identified and chemically characterized the major island sources, but few subsequent efforts have been directed at determining the provenance of significant numbers of artefacts from secure archaeological contexts. This paper presents new interpretations of obsidian procurement and distribution based on the chemical and visual sourcing of more than 2700 artefacts from island and mainland sites in France and Italy, and discusses the spatially and temporally dynamic economic and social role of obsidian. Finally, it is suggested that long-distance prestige exchange of obsidian and other materials was an important way of maintaining ethnic or kin connections in increasingly sedentary Neolithic societies.

Tykot, R. H., Ammerman, A. J.: New directions in central Mediterranean obsidian studies. *Antiquity* 71 (1997), 1000–1006.

Mediterranean obsidian-provenance studies are changing in direction and focus of modern research, with characterisation of the Sardinian sources, application of minimally destructive and inexpensive analytical techniques, analysis of complete or large parts of assemblages, and the integration of provenance data with reduction technology and use-wear traces.

Warren, S., Williams, O., Nandris, J.: The sources and distribution of obsidian in Central Europe. In: *International Symposium on Archaeometry and Archaeological Prospection*. 1977

Fieldwork and first source characterisation of the Carpathian obsidians by NAA, presented ob the ISA symposium, 1977

Wilczyński, J.: Obsidian products from Targowisko 10 site (Wieliczka distr.). In: Gancarski, J. (ed.): *Transkarpackie kontakty kulturowe w epoce kamienia, brązu i wczesnej epoce żelaza*. Wydawnictwo: Muzeum Podkarpackie w Krośnie, Krosno, 2010, 109–131.

The multicultural open-air site "Targowisko 10", located in the Kłaj commune, Małopolska province, Poland, was discovered during the surface research conducted on the planned route of the A-4 motorway between Krakówand Tarnów. The research was funded by the state, and the issues connected with the archaeological work were handled by the Institute of Archaeology and Ethnology of the Polish Academy of Sciences, the Archaeological Museum in Cracow and the Jagiellonian University: The Cracow Team for Motorway Survey, Registered Partnership. The systematic archaeological rescue research on the site started in 2000 under direction of W. Machowski. In 2001–2005 it was continued by B. Koniecznyand B. Grabowska. The result of the research was the discovery of a rich inventory consisting of the very interesting and diverse stone material (e.g. a group of obsidian items), hearth remains and, what is unusual for this part of Poland, some remains of fauna. This site, being one of the very few located east of the Vistula, is a perfect supplement to the image of Palaeolithic settlement of southern Poland.

Wilczyński, J.: The techniques of obsidian treatment on the Malice culture settlement of Targowisko 11, Lesser Poland. *Przegląd Archeologiczny* 58 (2010), 23–37.

This article is devoted to the obsidian inventory from Targowisko 11 site associated with the Malice settlement. The years of research on this site resulted in the discovery of a very rich complex of obsidian debitage, consisting of several dozen examples of cores and several hundred blade and flake fragments. Such a large number of artifacts made it possible to reconstruct the process of obsidian treatment carried out on this site.

Wilczyński, J., Czekaj-Zastawny, A., Zastawny, A.: Flint and Obsidian Malice Culture Artefacts from Brzezie, Site 17, Wieliczka District, Małopolska. *Fontes Archaeologici Posnanienses* 51 (2015), 245–262.

This article shall discuss the lithic inventory described at the Malice culture settlement discovered at the multicultural Brzezie 17 site. During rescue excavations at this site some 8,526 lithic artefacts were documented, diverse in terms of the raw material, technology of production, typology and chronology. The largest corpus of materials could be linked with settlements relating to the Linear Pottery culture (LPC; 4,123 specimens) and the remainder to the Malice culture (MLC; 677 specimens), the Neolithic (233 specimens) and general prehistory (3,503 specimens).

Williams, O., Nandris, J.: The Hungarian and Slovak sources of archaeological obsidian: an interim report on further fieldwork. *Journal of Archaeological Science* 4/3 (1977), 207–219.

This report describes the results of fieldwork carried out in the Zemplén Mountain area of north-eastern Hungary in 1975. The aim of this work was to locate and sample geological sources of obsidian which may have been used by prehistoric man. These sources are of increased importance since the work of Nandris (1975) showed that the Romanian "sources" do not produce workable obsidian. During the fieldwork three sources in Hungary were visited and sampled; one of these was the previously unlocated source of Csepegő Forrás. A number of other possible localities for geological obsidian are mentioned in 19th and 20th century geological and archaeological literature, and the present state of knowledge with regard to these is summarized. Further sources exist in central and in south-eastern Slovakia. These sources were not visited but material has been obtained from both areas. The central Slovak sources do not produce workable obsidian and are not therefore relevant to archaeological studies. Obsidian from three localities in south-eastern Slovakia is of good glassy quality and further fieldwork is now needed to check the validity of these localities as geological sources. Reference is made to obsidian sources in the western U.S.S.R., and the problem of the use of tektites in archaeological sites is discussed. The obsidian samples obtained during this work are currently being analyzed using neutron activation, in order to characterize the sources on the basis of their trace element analysis and thus to relate them to archaeological obsidian from central and eastern Europe.

Williams-Thorpe, O.: Obsidian in the Mediterranean and the Near East: A provenancing success story. *Archaeometry* 37/2 (1995), 217–248.

Obsidian provenancing studies comprise one of the most productive and successful research programmes of archaeological science. Obsidian characterization has been successful because workable obsidian is homogeneous on a small scale, analysable by a large number of methods, and is restricted to a small number of mainly readily distinguishable geological sources. Analytical, dating, source, and trade studies within the western Mediterranean, central and eastern Europe, the Aegean, and Anatolia and the Near East during the last 30 years or so are reviewed. Research has shown that distributions are mainly separate in the four regions examined, and that obsidian was traded up to 900km in the prehistoric period. Publications on obsidian in the areas under review reached a peak of frequency in the later 1970's and 1980's, but have now decreased in number. This may reflect changing fashions in archaeometric studies, and a current lack of routine application of the provenancing methods developed.

Williams-Thorpe, O., Warren, S. E., Nandris, J.: The Distribution and Provenance of Archaeological Obsidian in Central and Eastern Europe. *Journal of Archaeological Science* 11/3 (1984), 183–212.

The sources of archaeological obsidian in central and eastern Europe are briefly described and analyses in northeast Hungary and southeast Slovakia are reported. Instrumental Neutron Activation Analysis was used to determine 16 trace elements and two major elements. Principal Components Analysis supported by Discriminant Analysis showed seven analytical groups in these data. The archaeological obsidian were assigned by Discriminant Analysis to three of the Carpathian source groups defined, the remaining four source groups not being represented in the archaeological record. Carpathian obsidian was used most widely in Hungary, Slovakia and Romania, and also reached south to the Danube in Yugoslavia, west to Moravia, Austria and to the Adriatic near Trieste, and north to Poland. There is no evidence at present for any overlap between the Carpathian

obsidian distribution and the distributions of the Near Eastern or Aegean sources, but there is an overlap with Mediterranean obsidian at the Neolithic site of Grotta Tartaruga in northeast Italy where Liparian and Carpathian 1 material were identified. The distribution of obsidian from the Carpathian sources is considered in terms of linear supply routes. Based on limited available evidence the supply zone is significantly smaller and the rate of fall-off with distance slightly lower than that reported for Near Eastern obsidians.

Yamada, M., Ryzhov, S. (eds.): *Archaeology and Geology of Ukraine in Regional Context*. Center for Obsidian and Lithic Studies – Meiji University, Tokyo, 2015.

The Center for Obsidian and Lithic Studies (COLS), Meiji University, founded in April 2001, is unique because it is the only institute in Japan with research facilities for all fields of obsidian studies, both from the Natural and the Social Sciences. In 2010 the COLS was reorganized to further promote obsidian studies and to enhance international research collaborations networks, such as the Organization for the Strategic Coordination of Research and Intellectual Properties at Meiji University. In 2013 we embarked on an international joint research project with the Department of Archaeology and Museology of the Taras Shevchenko National University of Kiev, which led to archaeological and geological expeditions in Ukraine during August of the same year. In 2014 after the conclusion of the bilateral agreement on research, education, and cultural cooperation between Meiji University and Taras Shaevchenko National University of Kiev, we published the proceedings of our joint research projects titled "Archaeological and Geological Researches in Ukraine", edited by Masayoshi Yamada. The collected papers in this second volume present an update on the results of our ongoing research endeavors.

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