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Abstracts

Semitransparent obsidian of dark gray color from Artheni deposit (Armenia)

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Session III - Analytical aspects of obsidian studies
Form of communication: poster
Day 1 (27 May) 15:50-17:00

Obsidian is a natural glass produced when volcanic lava rapidly cools through the glass transition temperature and freezes not permitting sufficient time for crystal growth. Armenia has one of the most obsidian-rich natural landscapes in the world and accordingly has considerable reserves of obsidian. Obsidians are natural alumosilicate glasses composed of M_2O–Al_2O_3–SiO_2, (M = Na, K, Ca), and contain different elements present in major (>1 wt%), minor (0.1–1.0 wt%) and trace (<0.1 wt%) amounts incorporated into the silicate network during glass formation. They can contain also significant amounts of water (up to 10–12 wt%) both in the form of OH groups and as molecular water, which affect strongly their physical and chemical properties, and as well as the crystalline inclusions (so-called microlites, up to 1–5 wt%) in the glassy matrix. The color of the glass depends upon the presence of various metals together with the circumstances of its formation, but obsidian is typically black or grey and is sometimes banded. Analysis of obsidian samples were carried out by different methods (scanning electron microscopy–energy dispersive spectroscopy (SEM-EDS), XRD analysis, the absorption, reflection and Raman spectroscopy in the UV, visible and IR ranges, as well as thermo-gravimetric analysis (TGA) measurements for characterization of semitransparent obsidian of gray color from Arteni deposits.

Keywords: obsidian, physical and chemical properties

The provenance of Kul Tepe obsidian artifacts; Syunik and the Highlands of Armenia as possible seasonal pastureland

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Session I - Obsidian sources and their characterisation
Form of communication: oral
Day 1 (27 May) 10:30-10:50

Excavations at the site of Kul Tepe in the Jolfa region in north-western Iran have unearthed various archaeological materials from Late Neolithic/Early Chalcolithic to Achaemenids periods (end of 6th millennium to 3rd century BC). During the Chalcolithic and the Bronze Age most lithic tools used in Kul Tepe were made of obsidian. From the first and second excavation seasons, 53 and 32 obsidian samples were selected and analyzed by pXRF. According to the results, the main source of obsidian for the workshops in Kul Tepe was Syunik, but other sources in the Lake Sevan Basin like Ghegam, Bazenk, Choraphor and Gutansar and the Lake Van region (Nemrut Dağ and Meydan Dağ) were utilized also

Keywords: Kul Tepe, obsidian, provenance, pXRF, Syunik, Prehistoric trade

Occurrences of the volcanic glass related to Neogene volcanism in the Eastern Slovakia

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Session I - Obsidian sources and their characterisation
Form of communication: poster
Day 1 (27 May) 15:50-17:00

Occurrences of volcanic glass in the Eastern Slovakia are mainly associated with products of acidic volcanism. It is a part of bimodal andesite-rhyolite volcanism of the Late Badenian to Early Pannonian age. Rhyolite and rhyodacite volcanism is characterized by pyroclastic rocks in the form of tuffs and pumice tuffs. Massive forms of volcanic glass – perlites, pitchstones and obsidians – are related principally with intrusive and extrusive forms of rhyolite volcanism. Perlitized volcanic glasses of marginal parts of rhyolite extrusive bodies are known from the surroundings of Byšta, Brezina, Viničky and Malá Bara localities. Small grains of obsidians are part of pyroclastic rocks from the region of Hermanovce, Skároš, Veľká Tŕňa a Veľká Bara. Glasses, sometimes referred to as pitchstones, form marginal parts of different intrusive forms (necks, dykes) of rhyolites in the area of Merník cinnabar deposit. In the northwest part of Lipová hora hill, they reach directly the surface, where they form the marginal parts of a larger body, as well as separate, pure glassy dykes. Significantly extended are rhyolite glasses - obsidians with autochthonous occurrences in the Zemplínske vrchy Mts. These occurrences are related mainly to the Borsuk extrusive body near Viničky and rhyolite body in pure glassy development covered by the Borsuk sequences. Allochthonous occurrences of obsidians in the form of marekanite are known from the area of Šibeničný vrch hill near the Streda nad Bodrogom. Marekanite is a part of redeposited rhyolite tuffs and polymict epiclastic breccias. Primary source of these obsidians is not known yet. In the area of Brehov, under eolian sands there were found, applying technical works, the interbeds with sculptured fragments – nodules of obsidians. Obsidians at the similar position are known from the surroundings of Cejkov. Glassy facies to pure volcanic glass were verified by drilling works at the base of the Velký vrch hill extrusive body north of Brehov.

Keywords: rhyolite volcanites, volcanic glass, Eastern Slovakia

Building a data base of the Mesoamerican obsidian outcrops

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Session I - Obsidian sources and their characterisation
Form of communication: oral
Day 1 (27 May) 9:30-9:50

As an important part of the projects that support the CAICPC network (Applied Sciences to the Research and Conservation of Cultural Heritage Network), in the frame of the SICOM 2015 (Symposium on Research and Characterization of Obsidian in Mexico) it was proposed the creation of a shared data base of the obsidian outcrops registered in Mexico and neighbor countries. The main goal of this project is to promote research on this important archaeological material providing free access to data base to members of the network.
In order to carry on this work, every research institute that have had performed obsidian elemental analysis in México was invited to share their results to build up a joint data base. At this stage we included three analytical techniques (XRF, NAA and ICP-MS), using the same reference material (obsidian rock No. 286 del NIST) to obtain reliable and comparable results. Currently, our data base includes 29 outcrops in 8 Mexican states and 4 outcrops in Central America. As a result of the first round of analysis we reach 477 geological samples analyzed mainly by XRF.
To display and share the data base we published a web page that includes the basic information concerning the geological obsidian outcrops and their analytical results, in addition to the references and documents related with them.
Taking into consideration the cost of the international reference material for all the involved laboratories, we developed a strategy to establish a set of 6 cubes of internal obsidian references shared with all laboratories to analyze them in the same conditions and calibrate equipment in the same way.

Keywords: obsidian, Mesoamerica, data base, reference material

New-old obsidian nucleus depot find from Besenyőd, NE Hungary

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Session VI - Contemporary approaches to reconstructing exchange
Form of communication: poster
Day 1 (27 May) 15:50-17:00

From the archaeological depository of the Jósa András Museum, Nyíregyháza, a new obsidian core nucleus depot came to light recently. The finds were spotted by A. Mester when selecting material for the exhibition *Obsidian in the Tokaj Mountains: an industrial centre in Stone Age Europe*, organised on the occasion of the International Obsidian Conference (IOC 2019, Sárospatak). They were found by a local farmer, Miklós Laskai in course of digging a storage pit for potatoes. The find assemblage was transferred to the Museum in 1947 by Lajos Tar, teacher from the village. It was reported among the new acquisitions of the Museum by Lajos Kiss, curator of the collection, but unfortunately it did not get wider attention.
The finds comprise four medium-to-large obsidian conical blade cores, very similar in form and finish to the famous Nyírlugos core finds, though obviously more modest in size as well as number. We can justly suppose that the similarities with the Nyírlugos depot find are not incidental: Besnyőd is located along the same “Eastern route” leading towards the Transylvanian salt regions as pointed out by M. Roska in 1934.
In our poster we intend to present the cores to the wider public and present provenance data by Prompt Gamma Activation Analysis.

Keywords: obsidian, core, depot, Besenyőd

Geochemical characterization of obsidian artefacts from Mesolithic and Neolithic sites in the Iron Gates, Southeast Europe

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Session IV - Use of obsidian by chronological periods
Form of communication: oral
Day 2 (28 May) 12:40-13:00

Artefacts made from obsidian were recovered from Mesolithic and Early Neolithic sites in the Iron Gates section of the Lower Danube Valley during excavations in the 1960s. Archaeologists of the time disagreed over the likely provenance of the obsidian, variously attributing it to Carpathian, Aegean, or even 'local' sources. We present the results of non-destructive pXRF analyses of museum-curated obsidian from sites on the Romanian bank of the Danube. The obsidian is shown to originate from at least three distinct sources. Comparisons are made with geological obsidian samples from sources in the Aegean, Anatolia, Carpathians and Central Mediterranean.

Keywords: obsidian provenancing, Iron Gates, Mesolithic, Neolithic

Reflection of the *magus*: The provenance of an obsidian mirror associated with the sixteenth century polymath, John Dee

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Session VIII - Exploring the allure of obsidian: Symbolic, social, and practical values for obsidian
Form of communication: oral
Day 3 (29 May) 12:10-12:30

John Dee (1527–1609) was a mathematician and astronomer and advisor to Queen Elizabeth I of England. He was also interested in optics and mirrors, and along with his medium, Edward Kelly, he also became involved in the occult. The instruments that he and Kelly used are on display in the Enlightenment Gallery in the British Museum and include an obsidian mirror.
Such mirrors are usually associated with the Aztecs (as described by Sahagun in the *Codex Florentinus*), although they are also known in other central American contexts (obsidian mirrors of a different type are also documented in the Neolithic Near East and from Rome). It is thought that some were brought to Europe after the conquest of Mexico by Hernando Cortés between 1527 and 1530 or perhaps later, as the *Kingsborough Codex* (a native legal document dating to 1554) suggests. It is not known where John Dee obtained his mirror from, but it may be no coincidence, given Dee's reputation in his later days, that in the Post Classic period in Central Mexico obsidian mirrors are associated with the god/deity Tezcatlipoca, Lord of the Smoking Mirror, the supreme deity and trickster.
Our paper will not only describe the recent portable XRF analysis of John Dee's mirror but will also compare its geologic source to two similar mirrors and other obsidian objects in the British Museum and elsewhere.

Keywords: obsidian mirror, John Dee, British Museum, sourcing

“And even one warrior is in the field”: an importance of Yabrud II (Syria) obsidian artifact for understanding of EUP human dispersal events beyond the East Mediterranean Levant

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Session VII - Super-long distance movement of obsidian in prehistory: why, how and what for?
Form of communication: oral
Day 1 (27 May) 17:00-17:20

Along with a few more Levantine sites having long Early Upper Paleolithic (EUP) sequences, Yabrud II rock-shelter in Syria received many controversial industrial-chronological interpretations. Matching together our new site’s archaeological interpretations and data on the site’s single obsidian artifact found at layer 4, the following observations are proposed now.
Yabrud II, layer 4 with materials from layers 5, 3–2 belongs to Levantine Aurignacian A / Ksar Akil Phase 3 representing a mixture of Early Ahmarian and Aurignacian features. The EUP industry is an “industrial bridge” between Southern Levantine Early Ahmarian with some carinated burins and Levantine Aurignacian B / Ksar Akil Phase 4. The latter industry is also suggested to be a “proto-type” in local Levantine origin for Western Eurasia Proto-Aurignacian. Accordingly, Yabrud II Levantine Aurignacian A / Ksar Akil Phase 3 materials are important for Aurignacian origin considerations and its sites are not restricted to the East Mediterranean Levant. The artifact data allow comparisons with Shanidar cave, layer C (Zagros Mountains) and Kamennomostskaya cave, lower layer (north-western Caucasus). Accordingly, human dispersal events are proposed from the Levant into Middle East and south of Eastern Europe.
The Yabrud II obsidian was chemically analyzed and it matches Kömürcü obsidian outcrops of the Göllü Dağ volcanic complex (central Turkey) being separated from Yabrud II by > 700 km. A few obsidian artifacts at Shanidar cave, layer C assemblage connected to also distant (no less than ca. 450 km) but different obsidian sources allow us to discuss a possibility for a EUP network for human dispersal events in the Near and Middle East, additionally keeping in mind the S. Kuhn’s data on actual absence of proper UP sites around Göllü Dağ volcanic complex.

Keywords: Levant, Early Upper Paleolithic, Komürcü outcrops at Göllü Dağ volcano in central Turkey, human dispersal events

Microtomography of the vesiculated obsidians of Sierra Las Navajas (Hidalgo, Mexico)

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Session III - Analytical aspects of obsidian studies
Form of communication: oral
Day 1 (27 May) 14:20-14:40

Sierra de las Navajas obsidian, highly exploited by the pre-colonial Mesoamerican people, is unique throughout the world for its green color and gold/silver shine. The surface of these obsidian often shows small vesicles. A study of the three-dimensional morphology and distribution of vesicles, performed by high-resolution X-ray micro-CT on the SYRMEP beamline of the Elettra synchrotron light source (Trieste), allowed to calculate a vesicularity in the order of 2 vol.%, and to verify that vesicles are isolated, elongated and iso-oriented.
A higher number of samples was analyzed by X-rays microtomography at the STAR lab of University of Calabria in order to investigate the influence of vesicularity on the macroscopic aspect. All the selected obsidians are green, but they show different hue: some are homogeneously shining, some have no hue at all and a very smooth surface and some others show bands with variable hue and roughness. The 3D reconstruction of vesicles showed that the opaque samples and the bands with no hue of inhomogeneous obsidians are poorly or not vesiculated. The stronger is the hue, the higher is the number of vesicles. Moreover, the vesicles are always elongated and iso-oriented. This accounts for the different aspect shown by different cuts of the same sample: the highest hue is on the surfaces on which the major axes of the vesicles lay, which generally coincides with the surface of natural fracture, while the orthogonal cuts are opaque.
The preliminary results of this study suggest that microvesiculation strongly influences the hue and the fracture of the obsidians, which in turn are among the main factors determining the use of obsidians as weapons, tools or ritual objects. It was observed, for example, that the pre-hispanic blades were produced with obsidian showing no hue (and no vesicularity), because this allows to produce sharper artifacts.
Keywords: X-ray micro-CT, obsidian fracture, vesiculation

Sub-sourcing of Sierra de las Navajas obsidians (Hidalgo, Mexico)

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Session I - Obsidian sources and their characterisation
Form of communication: poster
Day 1 (27 May) 15:50-17:00

Sierra de Las Navajas (State of Hidalgo, Mexico) was among the most important sources for obsidian trade in Mesoamerica during the pre-colonial and early colonial times.
Chemical composition has been used to distinguish between the different volcanic sources within Sierra de las Navajas. In particular, according to previous studies very high contents of HFSE distinguish the obsidians from Las Minas complex (the most exploited sub-source) from those of other sub-sources. In this work a geochemical study by XRF and ICP-MS was carried out on the obsidian of Sierra de las Navajas. Our data demonstrate that the composition of the Las Minas green obsidians is not constant in terms of many major and trace elements: a group of samples have high Nb, Zr, Y, Rb, poorly fractionated Heavy Rare Earth Elements (HREE) patterns and low TiO_2 and Ba, but other obsidians from the same area have lower Nb, Zr, Y, Rb, higher Ba and TiO_2 and more fractionated HREE. This geochemical variation is also observed within the same stratigraphic sequence and can be explained with the empting of a zoned magma chamber in which dominated the process of fractional crystallization of K-feldspar and Ti-rich phases. The chemical variation found in the Las Minas samples encompasses those of the three subsources previously identified (Las Minas, El Horcón and Ixatla volcanic complexes). The macroscopic aspect of the samples with different composition is identical and they cannot be distinguished on the basis of their color, microvesicularity or microcrystallinity. Therefore, caution must be taken when attributing artifacts to one of the sub-sources of Sierra de las Navajas on the basis of chemical composition since compositional variations, internal to each sub-source, must be taken into account.

Keywords: Chemical composition, trace elements, obsidian sources

Exploitation of the Zayukovo (Baksan) obsidian in the Paleolithic of the Northern Caucasus: new discoveries and new sites

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Session IV - Use of obsidian by chronological periods
Form of communication: oral
Day 2 (28 May) 10:00-10:20

The Elbrus region, dividing the Greater Caucasus Mountains into the Western (Black Sea basin) and Eastern (Caspian Sea basin) parts, also contains the main mountain passes between the Southern and Northern Caucasus and is the location of the Zayukovo (Baksan) obsidian source. In 2016-2018 we made special field surveys in the Zayukovo (Baksan) source region between the modern towns of Zayukovo and Atazhukino in the Baksan River valley in order to get new information about geology and accumulation of obsidians in the region. Several outcrops of obsidian within the Zayukovo (Baksan) area were discovered, sampled, and studied. They were named Zayukovo-1-4. Obsidian samples were analysed using the ThermoScientific *Quant'X* EDXRF spectrometer in the Geoarchaeological XRF Laboratory, Albuquerque (USA; http://www.swxrflab.net/).
Our research show, that Zayukovo (Baksan) obsidian was actively used in the Paleolithic of the Northern Caucasus.During the Middle Palaeolithic, this obsidian was transported almost 250 km away from the source to several sites in the Northwestern Caucasus, and was intensively exploited in Saradj-Chuko grotto, located 5-7 km from the source. The Zayukovo (Baksan) obsidian is concentrated in the Upper Paleolithic layers 1A-1C in Mezmaiskaya cave, dated from 38 to 24 ka, and in the Epipalaeolithic (16 – 12/11.5 ka) layers in Mezmaiskaya, Kasojskaya caves, and also in the Gubs VII Rockshelter in the Northwestern Caucasus. Also, in the Epipalaeolithic layers in Sosruko Rockshelter, located about 25-30 km from the Zayukovo (Baksan) obsidian source, and in discovered by our team in 2018 Psytuaje Rockshelter, located 5-7 km far, this obsidian was one of the main raw materials.

This research was supported by the Russian Scientific Foundation grant No. 17-78-20082, "Human-nature interaction in ancient in the Central Caucasus: dynamics of environmental change and technological innovations, and adaptations of subsistence strategies".

Keywords: Obsidian industry, lithic technology, obsidian transport, Paleolithic, Northern Caucasus

Obsidian Exploitation and Shifting Cultural Identities on Sardinia and Corsica

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Session VI - Contemporary approaches to reconstructing exchange
Form of communication: oral
Day 3 (29 May) 9:40-10:00

Exchange is a central focus of a large portion of modern obsidian studies, and the reconstruction of various exchange mechanisms using provenance data has a long history in the discipline. While modeling the movement of objects across space is revealing, it is also critical to flesh out the implications of exchange relationships and their capacity to create, reify, and reflect distinct cultural groups. Archaeologists often assume that people who share the same material culture also share similar cultural practices, kin relations, or ethnic identities, which in the context of obsidian sourcing has been applied through the analysis of similarities and differences in procurement and exploitation.
Using obsidian as a proxy, this paper takes a long-term perspective on prehistoric group interaction and social identity on the Mediterranean islands of Sardinia and Corsica, where obsidian sources on Monte Arci were exploited from the Neolithic through Bronze Ages. Social network analysis (SNA) is employed to identify the strengths of inter-site relationships through time based on the relative proportions of raw materials from the four main subsources at Monte Arci. We in turn argue that prehistoric social networks in Sardinia and Corsica are complex and reflect a long history of mutable cultural boundaries that were mediated by the flow of goods and information.

Keywords: Central Mediterranean, Network Analysis, Social Identity, Group Interaction, Early Farming Societies

The development of obsidian procurement in the cave of Getahovit (NE Armenia)

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Session VI - Contemporary approaches to reconstructing exchange
Form of communication: poster
Day 1 (27 May) 15:50-17:00

The cave of Getahovit-2 is situated in north-eastern Armenia, in the foothills of the Lesser Caucasus which dominate the valley of the Kura. The excavations (2011-2018) have revealed several phases of occupation – Upper Palaeolithic (ca. 22,000 cal BC), Chalcolithic (ca. 4700-4000 cal BC), and early Middle Ages (ca. 900-1200 AD). Although the cave is near outcroppings of flint (lower valley of the Aghstev river), the artefacts found there are mainly in obsidian, whatever the period of occupation.
During the Chalcolithic period, the cave served as a shelter for herds, as seen in the succession of coprolite deposits, the remains of animal excrement that was regularly burned to clean the floor of the cave. The origin of the populations that sheltered their herds in this cave is difficult to determine: did they come from the nearby Kura basin, like the many transhumant groups mentioned in the ethnographic sources? Or did they come from the basin of the Araxes, farther south, where a Chalcolithic culture is well-attested? The study of the provenance of obsidian in the early Chalcolithic provides us with some indications and suggests links with the south.
The procurement of obsidian evolved in the middle Chalcolithic, and the techno-typological study of the material shows in particular that the flakes –a large majority of the assemblage– come only from sources situated in Armenian territory (Geghasar, Gutansar, Tsaghkunyats), whereas a few blades knapped by pressure were imported from more distant sources, Chikiani in Georgia or Sarikamis in eastern Turkey. Among the sources in Armenian territory, the choice of the deposits evolved gradually and in the latest phase of occupation the Tsaghkunyats outcrops represent about two-thirds of the pieces analysed.
A study of the environmental and cultural contexts in the Chalcolithic period enables a better understanding of how procurement developed.

Keywords: obsidian procurement, Northeastern Armenia, Chalcolithic

Chikiani obsidian source and transportation routes in Neolithic-Chalcolithic period cultures of Lesser Caucasus of Georgia

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Session VII - Super-long distance movement of obsidian in prehistory: why, how and what for?
Form of communication: oral
Day 1 (27 May) 18:00-18:20

Obsidian is one of the most long distance trade materials in archaeological science. After prehistoric humans found out benefits of obsidian, he had permanent connection with obsidian sources. One of the richest regions is considered to be South Caucasus, where at the very north of many sources, is located Chikiani obsidian dome. The Chikiani volcano is located in Southern Georgia, some 85 km west-southwest of Tbilisi.
At Chikiani, obsidian is abundant and easy to access from the North - passing through Tsalka Lake and from the South - through the river Paravani. Chikiani obsidian has a high-grade quality. It can be presented with black, brown, reddish or mixed colors.
Khrami river, as a second source, receives many obsidian blocks from its tributaries running down from the Chikiani slopes and carries many obsidian pebbles as far as its lower course.
According to palynological analysis of Paravani lake sediment, we can see that after Holocene in Southern Caucasus, concretely on Javakheti Plateau warm climate appears, it's thinkable that after VIII millennium in Neolithic – Chalcolithic times this territory would not be hardly reachable for the population (nowadays in winter a snow cover lasts more than six month). On lesser Caucasus between VI-IV millennium very interesting Neolithic Sulaveri-Shomu and Chalcolithic Sioni culture sites are examined (Also Tsopi, Dmanisi, Javakhi, Tsiteligorebi sites) in which the leading part in its' lithic industry takes obsidian (more than 90%). It's undoubted that population of mentioned cultures' and sites would have permanent connection with Chikiani source.
Exactly through which way/direction was obsidian distributed?
There are clearly developed river flows In Javakheti and Kvemo Kartli regions. With this point, we think that river Khrami's two tributaries and the whole river-bed of Mashavera should be considered as the obsidian's main distribution routes in Neolithic-Chalcolithic times**.**

Keywords: obsidian, distribution, source

Technology of obsidian assemblage from the Late Neolithic site of Potporanj (Serbia)

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Session V - Lithic technology and use-wear
Form of communication: oral
Day 2 (28 May) 13:00-13:20

Studies of obsidian artefacts found within the territory of modern-day Serbia have focused on their identification and provenance, considering them as an indicator of prestige and trade. However, no technological analysis of these artefacts has been done. Several large assemblages are available (*e.g.*, the sites of Vinča Belo Brdo, Potporanj, and Selevac) and, although recent studies have indicated their origin from Carpathian 1 sources, the corresponding reduction sequences, knapping methods and techniques remain unknown.
In order to fill in this gap, we focus on the assemblage from the site of Potporanj. Morpho-technological analysis of this material demonstrates the presence of all phases of the reduction sequence. Combining this evidence with provenance studies, it becomes possible to address questions regarding models of acquisition, trade, exchange, and technological interaction networks.

Keywords: obsidian, technology, reduction sequence, Late Neolithic, Potporanj, Serbia

The distribution of obsidian in the Middle Danube area in the Neolithic

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Session IV - Use of obsidian by chronological periods
Form of communication: oral
Day 2 (28 May) 12:00-12:20

In the Middle Danube area, Carpathian obsidian has been used in the Starčevo-Körös-Criş period as well as in the late Neolithic (Vinča, Alföld Linear Pottery culture, Bükk). During the early Neolithic, it is the most common raw material in Northern Hungary and the Upper Tisza region, but is quite rare further South. We have mapped the presence and percentage of obsidian for Bosnia and Hercegovina, Hungary, Slovakia, Serbia, Montenegro, Romania, and the Transcarpathian Ukraine as well as Poland, mainly using published sources. The available data are often not very detailed, so this can only present a very sketchy overview, which will hopefully lead the way to a more detailed discussion the mechanisms of raw material transport and distribution, which will help to pit exceptional sites like Potporanj in the South Banat (paper by Jovanović and Bogosavljević Petrović) into context. The limited scientific analysis points to the use of mainly the Carpathian 1 and 2 sources.
We are very aware of the shortcomings of this approach. Data on size, weight and the stages of reduction sequence are needed to understand the organisation of production.
In the southern part of the study area, Jovanović has analysed a number of unpublished assemblages in detail, and information about the technological aspects of obsidian working will be presented. This is complemented by a case study from NW-Romania.

Keywords: Starcevo-Körös culture, obsidian

Use of obsidian from the Palaeolithic to the Bronze Age in Slovakia

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Session IV - Use of obsidian by chronological periods
Form of communication: oral
Day 2 (28 May) 10:40-11:00

Near the Zemplínske vrchy hills, autochthonous sources of obsidian are known in Viničky and secondary ones between Cejkov and Brehov. Most artefacts on archaeological sites were made of obsidians with sculpturing suggesting the utilisation of secondary sources. In Aurignacian culture obsidian was only marginally used, however, it dominated in the Gravettian and Epigravettian. It sporadically occurred in western Slovakia as well. It is documented in the Świderian in the Spiš region (Eastern Slovakia) in the Late Palaeolithic and at other Epipalaeolithic to Mesolithic sites in Spiš, Orava and in southern Slovakia. The Mesolithic industry from Košice-Barca I was exclusively made of obsidian.
Obsidian prevailed in all stages of the Eastern Linear Pottery culture at sites in the Východoslovenská nížina lowland. On the other hand, it was less frequent in the Košická kotlina basin. In the Bükk culture, it prevailed at the sites situated closer to the sources; on the rest of the territory, it was a minor raw material. In the west of Slovakia, obsidian first appeared as early as the later stage of the Linear Pottery Culture. There is higher frequency of occurrence at sites of the Želiezovce group – Lengyel I culture, when it arrived to Moravia and Austria. The occurrence of obsidian decreased in the subsequent periods.
By the end of the Neolithic (Csőszhalom-Čičarovce group) and in the Early Eneolithic (Tiszapolgár culture), obsidian artefacts were more frequent at settlements than burial grounds. Use of obsidian survived until the Early Bronze Age (the Košťany and Otomani cultures).

Keywords: obsidian, use, archaeological cultures, Slovakia

Neutron studies in the obsidian research - performed at the Budapest Neutron Centre

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Session III - Analytical aspects of obsidian studies
Form of communication: oral
Day 1 (27 May) 14:00-14:20

One important task in the archaeometry of obsidian objects is to determine the provenance of the raw materials. For this task, several analytical methods are used to measure the elemental or isotopic composition of the objects. At the Budapest Neutron Centre, already in the early 2000's we have demonstrated that Prompt Gamma Activation Analysis (PGAA) is able to quantify, non-destructively, the major components and some fingerprinting trace elements of the bulk material. When using an external neutron beam, the analysis of large objects is possible without the need for sampling. In the last few years, we were able to utilize PGAA and NAA methods in a complementary mode, to obtain a wider set of analytical data for provenance studies.
Over the years, we have performed successful case studies on archaeological objects with Hungarian, Croatian, Polish and Romanian places of origin. We have demonstrated that PGAA can be used as effectively in provenance research as other widely used methods.
In one study, we used the combination of PGAA, Mössbauer Spectroscopy, Electron Microscopy and Small Angle Neutron Scattering (SANS) to explain the geochemistry of mahogany obsidian. The possibility to apply SANS for provenancing obsidian is currently being further studied.

During our work we have been co-operating with numerous Hungarian and other European Museums, often with national (OTKA) and European (CHARISMA and IPERION-CH) financial support.

Keywords: neutrons, PGAA, NAA, SANS, non-destructive study, provenance

Physical methods of the Carpathian obsidians study

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Session III - Analytical aspects of obsidian studies
Form of communication: poster
Day 1 (27 May) 15:50-17:00

Recent study of the Carpathian obsidians have been focused on the origin of obsidians by means of Electron Probe Micro-Analysis (EPMA) of glass + minerals, LA ICP MS from glass spots and WR, fission track dating (FT) of glass, K/Ar dating of WR, Ar/Ar dating of glass + biotite, radiogenic isotopes (Sr, Nd, Pb, Hf) and stable isotopes (O, H, Li, B) see Kohút et al. (2019 – this volume). However, important results in geological and archeological study were obtained by means of the μCT, X-ray spectroscopy, Raman spectroscopy, Mössbauer spectroscopy, Positron annihilation lifetime spectroscopy (PALS), DTA (thermogravimetric analysis), Fourier-transform infrared spectroscopy (FTIR), Magnetic susceptibility + thermomagnetic curves, and Electron (spin) paramagnetic resonance (ESR/EPR) methods as well as. The comprehensive research was realized on the Carpathian obsidians samples from the localities Viničky, Cejkov, Brehov and Hraň. Generally, complex study based on their chemical composition does not support an exact discrimination between samples from studied localities, and it is recommended to classify these obsidians by common label "*Carpathian 1*" only. Naturally, there exist some small mutual differences among samples from these localities; indeed these variations are often statistically overlapped. Noteworthy, there exist peculiar physical differences within some hand specimens in the micro-domains due to presence or absence of oriented flow fabric, presence of various microlites, dominance of the Fe-Ti oxides and/or pyroxenes trichites in nanoscale, their specific gravity etc., albeit glass composition of these obsidians is generally comparable. The trichites magnified up to 500x look like continuous linear alignments (5 - 10 μm in diameter) are actually discontinuous, triaxial, hieroglyphic formations, documenting the rapid quenching of the flowing melt in nano dimension. Besides scarce miarolitic cavities representing *macro-voids* (≥2 mm in size) there were observed *meso-voids* (100 ~ 300 μm), *micro-voids* (10 ~ 30 μm) and *nano-voids* (0.2 ~ 1.6 nm) by means of μCT and PALS.

Keywords: Carpathian obsidians, physical methods, micro- & nanoscale, voids & pores

Progress in geological understanding of the Carpathian obsidians

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Session II - Formation and geology of obsidian
Form of communication: oral
Day 1 (27 May) 11:40-12:00

The Carpathian obsidians from the Zemplín – Tokaj area (SE Slovakia and NE Hungary), the only natural volcanic glass region in Central Europe, have been studied by geological and archaeological methods for long time (see review: Biró, 2006). However, modern geological investigation was missing. Chemical analyses of obsidians performed by archaeological survey often contain only eclectic set of elements that cannot be used for geological purposes (e.g., rock typology, and/or genesis determination). Therefore, comprehensive and systematic study including Electron Probe Micro-Analysis of glass and minerals, bulk analysis of the major and trace elements, determination of radiogenic (Sr, Nd, Pb, Hf) and stable (O, H, B, Li) isotope compositions, Ar/Ar dating of glass and biotite, fission track dating of glass, U–Pb zircon and (U–Th)/He zircon has been undertaken. Although the obsidians are dominated by amorphous volcanic glass with high silica content (up to 76–77 wt.% SiO_2) strictly suggesting their crustal affiliation, the presence of accessory minerals like olivine, pyroxene, amphibole and/or bytownite feldspar indicate their partial mantle-derived origin. Some isotopic characteristics of these obsidians with more radiogenic Sr–Nd isotopic composition, and elevated values of the stable isotopic O, H and Li signatures attest to crustal-dominated source; in contrast their Pb, Hf and B isotopic systematics points to a lower crustal metabasic source slightly influenced by sub-continental lithospheric mantle. Collectively, isotopic compositions of the Carpathian obsidians resemble arc igneous products derived by multi-stage processes with the primary basaltic magma formed due to melting of the lower crustal source at the mantle/crust boundary. Subsequent formation of a melt reservoir in the middle

crust, accompanied by secondary melting of the surrounding rocks, and/or repeated process of assimilation and fractionation produced a suite of chemically variable lithology from basalt to rhyolites and/or obsidians before 12.1–11.4 Ma in the Carpathians.

Keywords: Carpathian obsidians, geology, isotopic composition, dating

Super-long-distance exchange of obsidian in the prehistoric Arctic: current evidence from Northeast Siberia and Alaska

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Session VII - Super-long distance movement of obsidian in prehistory: why, how and what for?
Form of communication: oral
Day 1 (27 May) 17:20-17:40

The long-distance movement of obsidian from sources to utilisation sites is well-known in different parts of the world, including Oceania, North America, and the Near East. In the Eurasian Arctic, only after accumulation of data in 2009–2019 did it become possible to reconstruct major obsidian trade/exchange networks.
The study of obsidian distribution from the source at Lake Krasnoe [*Red Lake*] in the Chukotka region of the Siberian Arctic has allowed us to establish the extremely wide-ranging circulation of this raw material in prehistory, beginning at least at ca. 9000 years ago. At this time, obsidian from Lake Krasnoe was brought (most probably, by exchange rather than direct travel) to the Zhokhov site in the High Arctic, at a distance of ca. 1500 km in a straight line. This is an example of super-long-distance movement of obsidian in the Arctic, established by us for the first time (data by V. Pitulko, Y. Kuzmin, M. Glascock, and others). In later times (Neolithic–Bronze Age, ca. 7000–2000 years ago), the Lake Krasnoe obsidian was transported to the Kolyma River basin and beyond it, with distances often exceeding 1000 km as the crow flies. At ca. 1000–600 years ago, this obsidian was brought to Alaska across the Bering Strait, ca. 1000 km away from the source.
The phenomenon of super-long-distance trade/exchange of obsidian in the Arctic, now securely established by our informal team, deserves more research in the near future.

Keywords: obsidian exchange, prehistory, Arctic, Siberia, Alaska

Circulation and origin of the obsidian in the Tyrrhenian zone: the example of prehistoric Corsica

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Session IV - Use of obsidian by chronological periods
Form of communication: poster
Day 1 (27 May) 15:50-17:00

In the western Mediterranean, the obsidian sources are only located on four Italian islands: Lipari (Aeolian archipelago), Palmarola (Pontine archipelago), Pantelleria (between Sicily and Tunisia), and Sardinia. For over 15 years, our team has been striving to try and understand how this raw material was acquired, especially in prehistoric Corsica.
The flexible multi-method analytical strategy deployed has made it possible to characterise more than 2,300 artefacts originating from about twenty Corsican Neolithic sites. The results obtained offer a renewed diachronic vision of obsidian procurements in this specific part of the Tyrrhenian zone, from the Early Neolithic to the Late Neolithic. These results notably point to the close links that existed between Corsica and Sardinia during these periods but also reveal epiphenomena that remain to be explained, such as the occasional presence of obsidians from the Pontines or the Aeolian archipelago.

Keywords: Obsidian, provenance, Corsica, Neolithic

Viničky rhyolite volcano: one of the sources of obsidian in Eastern Slovakia

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Session II - Formation and geology of obsidian
Form of communication: oral
Day 1 (27 May) 12:20-12:40

Four essential volcanic units have been recognized in the late Middle Miocene rhyolite complex at the southern side of the Zemplín horst next to the village Viničky, well exposed in galleries of a wine cellar: distal facies tuffs and paleosoil, proximal facies of phreatomagmatic pyroclastic ring, roots of a rhyolite dome and a thick rhyolite flow at the top of the succession. Obsidians associate with the last two units. Roots of the extrusive dome, exposed in the eastern side of the wine cellar, are formed of almost fully perlitized glass of a rhyolite composition. Perlite is of grey to dark grey colour with typical perlitic bulbous jointing. The cross section shows a lateral development of the glass and its subsequent perlitization. At the margin, in thickness up to 10-15 m, perlite shows a fluidal structure parallel to the body margin. In the central part perlitized glass is massive, including marekanite with obsidian cores of black colour. Their size ranges from a few mm to 10 cm, very rarely larger. In fragments of dimensions up to 0.5 cm obsidian is variably translucent or opaque. Weathered out obsidians from this primary source occur on the recent surface in eluvial and deluvial deposits at the southern slope of the Borsuk hill, having the local name Zajačí skok (Hare Jump).
The second obsidian occurrence in the Viničky area is related to the southern marginal and basal parts of a thick rhyolite lava flow covering older volcanic units. Its source is at the Borsuk hill extrusive dome 1.5 km northeastward. The basal part of the flow with obsidian crops out in galleries in the northern part of the wine cellar. It is formed of strongly perlitized glass breccia with distinctly fluidal texture. Breccia is formed of angular fragments to blocks of dimensions up to 3 m with matrix of grey-pinkish disintegrated perlitic matter. Obsidians, similarly as in the first case, are a part of perlite blocks, showing a marekanite character. Black obsidian cores are usually smaller, up to 5 cm in diameter. A possibility that obsidians from this primary source occur at the current surface is less likely.

Keywords: obsidian, perlite, marekanite, rhyolite dome, rhyolite dome-flow

A 19th century pseudo-obsidian reference: the glassy andesite of Buják, Hungary as possible chipped stone raw material

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Session I - Obsidian sources and their characterisation
Form of communication: poster
Day 1 (27 May) 15:50-17:00

Ferenc Schafarzik, Hungarian geographer and geologist, in his monography on the Cserhát, part of the Northern Hungarian Range, gave a detailed description of a volcanic rock outcrop near the village of Buják. He described the rock glassy, colourless, of isotropic matrix, with some parts strongly resembling obsidian.
Our aim was to rediscover that small outcrop, to study the rock with modern petrographical and geochemical methods, and to determine whether it can be regarded as chipped stone raw material.
Our work was initiated by archaeological inquires searching for possible raw material sources of knapped stone objects made of neutral magmatic rocks in the Cserhát.
We georeferenced both the geological and the 1:10000 topographic map of the area and by that tool we started with the systematic field work. The location described by Schafarzik could then be identified on the SW slopes of Bársony Hill, Buják. The collected rock samples were described from petrological point of view (macroscopic observations, stereo- and polarized light microscopy, SEM, chemical analysis: both mineral- and whole rock chemistry) and we performed knapping experiments, too.
The rock proved to be basaltic andesite (SiO_2 56 wt%). Its main and trace element composition is fairly similar to other samples from the region's basaltic andesites.
Its texture is microholocrystalline-porphyric, sometimes pilotaxitic porphyric. The euhedral or subhedral plagioclase, pyroxene and amphibole phenocrysts either stand alone or form groups. Plagioclase is labradoritic in the matrix, while bytownitic as phenocrysts. Two pyroxenes are present: augite and orthopyroxene with some Ca-content.
Knapping experiments demonstrated that the macroscopically "most glassy" rock variant is suitable for making knapped stone.
The locality studied could be regarded potential raw material source for the knapped tools made of neutral magmatic rocks in the Cserhát region, Hungary.

Keywords: andesite, Schafarzik, Cserhát, Buják, knapping, petrography

The use of the Slovakian and Hungarian obsidian: the earliest data

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Session IV - Use of obsidian by chronological periods
Form of communication: oral
Day 2 (28 May) 9:00-9:20

The occurrence of obsidian in geological outcrops in the north-eastern part of the present-day Hungary and the eastern part of Slovakia as well as in the archaeological assemblages has been known for more than 150 years ago.
The occurrence of the raw material on the Lower Palaeolithic site of Rusko (MIS 11 or 9) or the Early Middle Palaeolithic locality of Rybnik (MIS 6), both in Poland should be verified by analytical methods. Similarly, the isolated artefacts collected in the vicinity of the outcrops of the obsidian and placed to the Lower Palaeolithic only after typological considerations should also According to the present-day information first use of this volcanic glass is securely dated to the last Interglacial and the Early Würm (MIS 5 and 4) in the cave localities of the Bükk Mountains. At the same time, obsidian artefacts were found in the Taubachian and Charentian assemblages of the Obłazowa cave in the Polish Carpathians, dated to the same period and to the Interpleniglacial, respectively. These data clearly show that the raw material was transported over 160 km even during the Middle Palaeolithic period.
The Micoquian or Keilmessergruppe is characterised by the use of bifacial working. In Hungary a series of surface collected assemblages (including Sajóbábony in the Bükk Mountains and Legénd in the Cserhát area) yielded obsidian artefacts and the use of the raw material was also reported from the Ciemna cave, Poland.
Finally, during the surface collections and a single excavation of the Middle Palaeolithic sites with leaf points (erroneously named as 'Szeletian') yielded also some obsidian artefacts. The occurrence of the obsidian published from the assemblage of Zeitlarn (near Regensburg, Bavaria) and the „amorphous volcanic glass" from the Remete Upper cave (Budapest, Hungary) should be removed from the technical literature. Finally, the revision of the available evidences from the excavations of the Pilisszántó II rockshelter, the rather atypical lithics (including a piece of obsidian) cannot be placed to the Middle Palaeolithic period.

Keywords: obsidian, Middle Palaeolithic, Micoquian, leaf point industry, distance of raw material transport

Linking WD-XRF and ED-XRF for obsidian sourcing: a case study for the Paleolithic Omegura sites at Nagawa town, Nagano prefecture, Japan

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Session III - Analytical aspects of obsidian studies
Form of communication: oral
Day 1 (27 May) 14:40-15:00

Non-destructive compositional analyses with an energy dispersive X-ray fluorescence spectrometer (ED-XRF) were carried out for 1,069 pieces of obsidian artifacts excavated from the Paleolithic Omegra sites at Nagawa town in Nagano prefecture, Japan. Eight pieces of obsidian slabs, whose compositions were determined using a flux fuse method with wave dispersive X-ray fluorescence spectrometer (WD-XRF), were used as standards for ED-XRF analyses. Analytical results of the standards using ED-XRF showed good correlations with those using WD-XRF for elements heavier than phosphorus (P). Determinations using bulk fundamental parameter (FP) method, however, did not show a good correlation for Mn which is one of the elements used for the sourcing of law materials of obsidian artifacts in Japan, it is because of the overlap between the high energy-side slop of Mn K-α and the low energy side slop of Fe K-α. Instead, determinations using the empirical calibration curve method, which corrects interference from Fe, showed a good correlation for Mn. The Omegra artifacts were compared with law stones on compositional diagrams. Compositional features indicate that the law materials of the Omegra artifacts would have been collected not only from the Omegra area and the Wada-Takayama area at the Omegura side of the dividing mountain, but from the Hoshigato area the other side of the divide. In addition, chemical compositions of a few artifacts indicate that their law materials would have been collected from the northern Yatsugatake area at the south of Omegura, which means that the prehistoric humans might have migrated in the High land area.

Keywords: WD-XRF, ED-XRF, obsidian, sourcing, non-destructive analysis

Least Cost Pathway Analysis of obsidian circulation and social communication in Early Holocene Cyprus

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Session VI - Contemporary approaches to reconstructing exchange
Form of communication: oral
Day 3 (29 May) 9:00-9:20

Obsidian artefacts appear in the archaeological record of Cyprus at the same time when the first human populations establish communities across the island. Geological sources of obsidian do not exist on Cyprus so the material had to be procured elsewhere and then introduced to the eastern Mediterranean island. Recent geochemical analyses using portable-X-ray Fluorescence Spectrometry identified that the Cypriot obsidian derives from multiple geological sources. However, once on the island the material is consumed with no clear preference for specific sources in specific sites. There is, however, a clear distinction between sites that use obsidian and sites that do not. In order to address this distinction, a geospatial model (Least Cost Pathway Analysis, LCPA) was developed to investigate (a) the optimal routes for obsidian circulation in Early Holocene Cyprus and (b) whether the routes delineated in the archaeological record reflect functional or social criteria. This paper discusses the results of the LCPA on obsidian circulation on Cyprus and uses these outcomes to address the paths these first communities used to build their social networks and exchange their goods.

Keywords: obsidian, Cyprus, Early Holocene, geochemistry, Least Cost Paths Analysis, social territories

Unique grinded obsidian finds from Eneolithic site at Nitra-Selenec

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Session V - Lithic technology and use-wear
Form of communication: oral
Day 2 (28 May) 13:20-13:40

The Nitra-Chrenová, Selenec site, dated to Eneolithic, Bronze and Middle Age was discovered during the rescue excavation in 2009-2010. A total number of 137 pits and cemetery were found at the site. Most of the pits are dated to the Eneolithic period - Ludanice group.
The assemblage of lithic industry from Eneolithic pits consists of a total of 161 chipped stone artefacts. As regards raw materials, limnosilicite prevailing, followed by radiolarite, Jurassic flint from Cracow-Czestochowa upland, obsidian, burnt and unidentified raw material. The most common lithics are unretouched blades, bladelets and their fragments. Other unretouched flakes, small flakes and their fragments, tools and cores were also registered.
In the collection there are two unique finds of obsidian. The first represents a single-platform miniature prismatic core with maximum precise and standardized rectilinear regularly parallel scars. The flaking angle is 90°. The pressure was used most probably for knapping of this core. There were three various surfaces recognized from three sequences. The oldest part is a natural cortical surface. The core was knapped during the next phase. At the final stage, the piece was grinded at two areas. Besides, there was a fragment of flake with grinded dorsal face in the assemblage too.
There are two possible interpretations of grinding obsidian artefacts: (1) repairing of the core during debitage to smooth out the irregularities or (2) to make personal adornment.

The study was supported by project APVV-14-0742: “The dynamics of use of raw material sources in the Paleolithic and Neolithic in Western Slovakia” and project VEGA 2/0101/19: „Technology and economics of raw materials in the context of the development of Postpaleolithic lithic stone industries in Slovakia“.

Keywords: Slovakia, lithic industry, obsidian, grinded artifacts

Acquisition patterns of obsidian at the Upper Palaeolithic Mattobara site in north-central Japan

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Session IV - Use of obsidian by chronological periods
Form of communication: oral
Day 2 (28 May) 9:40-10:00

The presentation focuses on the combination between acquisition patterns and migration range of an Upper Palaeolithic social group, with particular emphasis on the Mattobara site case study. The site is located on the left bank of the latest Pleistocene river terrace in the middle course of the Shinano River in Niigata Prefecture, north-central Japan. Among three locations at the Mattobara site – A, B, and C – very small amounts of obsidian have been found at Locations A and C, and no obsidian was found at Location B. According to the results of obsidian provenance analysis by Energy Dispersive X-ray Fluorescence analysis, obsidian from Location C was brought from Kirigaine and West Kirigamine sources in Nagano Prefecture of the Central Highlands (Honshu Island) with a migration range of ca. 170 km; and, in the case of Location A, from Fukaura and Oga sources, ca. 400 and 310 km north of the site, respectively. From the beginning of the 1970s up to the present, obsidian provenance analyses in the central Japanese Islands have reached 86,523 samples, and many empirical results regarding maximum obsidian transportation or migration ranges fit into area with a radius of ca. 200 km. The range roughly corresponds to the morpho-typological distribution of diagnostic lithic artifacts. It is highly possible to predict the appearance of common morpho-typological features of diagnostic tool types that might have originated in these repeated communicative processes of lithic acquisition activities. At Mattobara Location A, this is not the case, and obsidian from the distant Fukaura and Oga sources has been brought to Location A by a certain exchange network system.

Keywords: Upper Palaeolithic, Mattobara site, Japan, obsidian, migration range

Humans and materials in motion in the Southern Caucasus: exploring the role of mobile pastoralists in the exploitation and diffusion of obsidian

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Session VIII - Exploring the allure of obsidian: Symbolic, social, and practical values for obsidian
Form of communication: oral
Day 3 (29 May) 10:30-10:50

Recent research on the Chalcolithic period and the Bronze Age in the Southern Caucasus has highlighted the seasonal movement of mobile pastoralists groups from north-western Iran towards the rich pasturelands of the Azerbaijani and Armenian highlands, where obsidian sources abound. Such links between Iran and the Caucasus are for example suggested by the excavations of Godedzor (Armenia) and Uçan Agil (Nakhchivan), both seasonal campsites presenting similarities with the sites of the Urmia region, and corroborated by the presence of Armenian obsidian material (mostly from the Syunik outcrops) at numerous north-western Iranian sites, such as Kultepe-Jolfa or Dava Göz.
While different routes between these two regions have been suggested, i.e. through the Araxes valley and the Vorotan valley, none of these hypotheses has so far been substantiated by sufficient data to confirm either possibility. This is especially the case for the Araxes valley alternative, which involves the crossing of Nakhchivan, a region where only a handful of obsidian artefacts had been analysed until recently. However, new data from two recent research programs has brought key information regarding the role of mobile pastoralists in the exploitation and diffusion patterns of obsidian in the Southern Caucasus from the Neolithic to the Bronze Age (6200–1500 BC). By investigating the obsidian industries found on numerous mobile pastoral campsites located in the mountainous areas of Nakhchivan, these projects offer crucial new insights into the complex socio-economic systems in place in the Southern Caucasus during the Chalcolithic.

Keywords: Southern Caucasus, Iran, Prehistory, obsidian, pastoralism

Upper Palaeolithic obsidian exploitation and human behavior in the Oki Islands and Chūgoku Mountains of the Southwestern part of the Japanese archipelago

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Session IV - Use of obsidian by chronological periods
Form of communication: poster
Day 1 (27 May) 15:50-17:00

Our main research objective is to develop a model of Upper Palaeolithic (ca. 30–40 ka) exploitation of Oki Islands' obsidian sources that correlates with the consumption patterns observed at sites distant from the sources. This exploitation is considered one of the first cases of sea transport of obsidian by *Homo sapiens* in East Asia, and it is possible to draw from it some social characteristics of early *Homo sapiens*.
We will explain the chronological transition and regional variation of the consumption of Oki obsidian during the late Palaeolithic up to the Jomon period in the Chūgoku Mountains. Next, we will clarify behavioral territories and the production sites of trapezoid tools by the assemblage and lithic reduction sequence of each site.
Results so far are as follows. Oki obsidian was used more in the period 30–40 ka (trapezoid tool industry) than during the last glacial maximum (land bridge period). Referring to studies of global climate and sea level fluctuations, the Oki landscape in 30–40 ka consisted of separate at the Sea of Japan or was unstable. The behavior territories of Homo sapiens, as analyzed from the lithic reduction sequences, are assumed to be about 100–150 km in extent, depending on the embedded strategy.
Most of the Oki obsidian produced in the late Palaeolithic to the Jomon period was consumed in the Mt. Daisen area. We evaluated this area as the center of the hunting and gathering territory, also containing the landing sites for seaborne obsidian. In addition, the top of Mt. Daisen (altitude 1,729 m) is interpreted as a terminal that recognizes the landscape up to the Chūgoku Mountains area and the Oki Islands. Because we can visually recognize the range of about 100 km radius from the Oki Islands to the Chūgoku Mountains area, it can be discussed that this particular *Homo sapiens* group specialized in obsidian procurement by sea transfer with this place as a terminal.

Keywords: obsidian sources, obsidian procurement, Upper Paleolithic, trapezoid tool industry

Non-destructive ED-XRF provenance analysis of Palaeolithic obsidian artifacts from the Czech Republic and Slovakia

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Session III - Analytical aspects of obsidian studies
Form of communication: poster
Day 1 (27 May) 15:50-17:00

Technological characteristics and surely attractive appearance made volcanic glass obsidian rare but prominent raw material of the Stone Age in East-Central Europe. There is only one source area in continental Europe connected with the acid Tertiary volcanism at the border of Western and Eastern Carpathians. The important point is that individual natural sources of obsidian have slightly different chemical composition which enables to determine provenance of the artifacts based on concentrations of certain elements. However, in the Czech Republic obsidian artifacts are rare among Palaeolithic assemblages, thus it is important to apply non-destructive methods. We have used both portable and bench-top ED-XRF devices for non-destructive provenance analysis of obsidian tools. Calibration based on international reference materials and NAA/ICP MS analyzed natural obsidians were employed to make analyses reliable. Artifacts were analyzed together with samples from natural occurrences from Eastern Carpathians. It is possible to distinguish the main sources known as the Carpathian I, Carpathian II and Carpathian III and even some specific locations within them. The most striking result of analyses is that obsidians used as raw materials for Palaeolithic and Mesolithic artifacts were made of both Carpathian I and Carpathian II sources. Preliminary conclusion shows that while the Carpathian II sources were used during the Szeletian and Aurignacian, the Carpathian I sources prevail since the Gravettian.

Keywords: obsidian artefacts, Paleolithic, provenience, ED-XRF

Provenance of the Stroked Pottery culture obsidian from Dzielnica (Opole province, Upper Silesia, Poland)

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Session I - Obsidian sources and their characterisation
Form of communication: oral
Day 1 (27 May) 10:50-11:10

During archaeological excavations at Dzielnica (Opole province, southern Poland) in 2006 there were found obsidian flakes connected with the Stroked Pottery culture (Stichbandkeramik, SBK). Two pieces of well translucent obsidian with inventory numbers 45/06 and 56/06 have been analysed using neutron activation analysis in the Nuclear Physics Institute of the Czech Academy of Sciences, Husinec-Řež near Prague. Both samples were analysed for 8 major elements (Si, Ti, Al, Fe, Mg, Ca, Na, K), 18 trace elements (As, Ba, Co, Cr, Cs, Hf, Mn, Mo, Ni, Rb, Sb, Sr, Ta, Th, U, V, W, Zn and 13 elements from the group of rare earth elements.
For determination of obsidian provenance we used various diagrams based on trace element ratios and comparison of the Polish artefacts with natural obsidian sources in Slovakia or in Hungary and also with Neolithic tools from Moravian Painted Ware I (Lengyel I) settlements Těšetice-Kyjovice and Brno-Žebětín. The Lengyel obsidian tools from Těšetice-Kyjovice form a homogenous collection and O. Williams-Thorpe with her colleagues already studied them with conclusion on their provenance from the Slovakian source Carpathian 1. In our discriminating diagrams the Polish SBK obsidians from Dzielnica have the same position as the Lengyel samples from southern Moravia. We also confirmed the Th/U ratio as excellent marker to distinguish the Slovakian (Carpathian 1) and Hungarian sources (Carpathian 2). Th/U ratios of Dzielnica obsidians with values 1,75 and 1,78 (it is under 2) together with relatively lower contents of Ba, La, Th and usually also Na, Rb, Sc, Fe, Cs, Hf, Ce, Sm and Eu testify undoubtedly for the Slovakian source Carpathian 1. It seems the geochemical differences between the Slovakian source in the northern part of Zemplín Hills (Carpathians 1a, probably the principal source for prehistoric obsidian in Central Europe) and the well-known source at Viničky in the southern part of Zemplín Hills (Carpathians 1b) are very inconspicuous. Macroscopic appearance of obsidians from Dzielnica is characteristic for the source Carpathians 1a. Using of obsidian from the Slovakian source at Paleolithic (from the Epigravettian onwards) and Mesolithic sites in Poland has been described by R. E. Hughes and D. H. Werra.

Keywords: Stroked Pottery culture, Dzielnica, southern Poland, obsidian, Slovakian source

Obsidian exchange in Early Neolithic Eastern Hungary

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Session VI - Contemporary approaches to reconstructing exchange
Form of communication: poster
Day 1 (27 May) 15:50-17:00

In the autumn 2017, during preventive excavations along the M4 motorway, a unique deposition of obsidian nodules was discovered at the site of Váncsod, Szénás-dűlő. The find contained 13 large nodules and belongs to the Early Neolithic Körös period. According to PGAA results, the source of the raw material can be determined as the Slovakian sites of the Tokaj-Eperjes Mountains (Carpathian C1). Taking the Váncsod assemblage and other finds from Hajdú-Bihar County as our starting point, we analyse access to obsidian raw material, the character of obsidian exchange and interaction networks in the period in Eastern Hungary.

Keywords: Obsidian nodules, Early Neolithic, exchange

The Carpathian 3 obsidian - the geoarchaeological review

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Session I - Obsidian sources and their characterisation
Form of communication: poster
Day 1 (27 May) 15:50-17:00

The territory of the westernmost part of present-day Ukraine (Transcarpathia) has been a densely inhabited area in almost all periods of human history. In the region of Transcarpathia, currently more than 100 Palaeolithic sites are known, most of them known from surface collections. Early petroarchaeological studies commenced in Transcarpathia with the activity of V. Petrun' and by the discovery of Middle Palaeolithic settlements and workshops around Rokosovo and Maliy Rakovets and the description of the local obsidian sources. Obsidian was one of the most important raw materials for prehistoric stone tools. In the Carpathian Basin we know three separate sources of Carpathian obsidian (C1 – from Slovakia, C2 – from Hungary and C3 – from Ukraine), the aim of the present work is to introduce the Carpathian 3 obsidian from Transcarpathia.
Palaeolithic communities in the recent territory of Transcarpathia were primarily using local raw materials for the production of their tools. In the volcanic raw material regions of the Transcarpathian Palaeolithic two raw material types of volcanic origin played a dominant part in the production of stone artefacts: glassy dacite from Korolevo and Carpathian 3 type obsidian from Rokosovo.

Keywords: obsidian, Palaeolithic, Transcarpathia, raw material, Rokosovo

An update on the South Wallacean obsidian interaction sphere

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Session I - Obsidian sources and their characterisation
Form of communication: oral
Day 1 (27 May) 9:50-10:10

This paper will present an update on the South Indonesia obsidian interaction sphere, first discussed at the International Obsidian Conference in 2016. Preliminary results showed the utilisation of three unknown obsidian sources with additional three subsources suggested. Since then three new sites have been excavated, two new islands investigated and the location of one of the unknown obsidian sources has been identified. The previous source 3a, b, c originate all from the same lava flow, close to the village of Kulutan on Alor. We were able to detect obsidian transportation to small islands in the network, which might align chronologically with the emergence of this interaction zone. Dates for the start of the network have been pushed back to 15,000 years ago. Density distribution of the two unknown sources in excavated sites show that we might be able to triangulate the location of these unknown sources which will guide future fieldwork.

Keywords: Obsidian, Wallacea, Terminal Pleistocene, maritime transportation

A local behavior system for obsidian acquisition in a source area: Integrative lithic analyses focused on the Early Upper Palaeolithic industry of Hiroppara II in the Central Highlands, Japan

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Session IV - Use of obsidian by chronological periods
Form of communication: oral
Day 2 (28 May) 9:20-9:40

This paper focuses on local activities for obsidian acquisition in the Early Upper Palaeolithic (EUP) in a large obsidian source area of the Central Highlands, central Japan. A catchment area used for obsidian acquisition around the EUP site of Hiroppara II is determined. The site is located in the east bank of the Wada River, 1,400 m. The obsidian lithic industry from Hiroppara II assigned to 35-34 ka cal BP indicates the site was a lithic workshop for obsidian-blade manufacturing. To reconstruct the catchment area in detail, geochemical and geographic analyses of obsidian were integrated into the debitage analysis. 1) As multiple outcrops geochemically characterized are dispersed around the site, WD- and ED-XRF analyses of 2,401 obsidian tools and debitage from the site were performed to determine the provenances. 2) A distribution map based on roundness and cortex patterns of obsidian sampled along the bed of the Wada River illustrated five geographical areas divided by deferent appearances of cortex. Comparing cortex remained on the artifacts with the index map enables to specify obsidian-gathering spots extending from the outcrops. Results of the integrative analysis of the Hiroppara II industry indicate that 1) the outcrops of Higashi-Mochiya (58.5%: a chemical group “MT”), Wada pass (18.0%: “W”), and Hoshigadai-Hoshigato (16.6%: “HH”) were dominantly exploited; 2) Obsidian acquisition around Hiroppara II depended not only on those outcrops but also on the gathering spots yielding MT obsidian along the basin of the Wada River. Thus, the catchment area reaches a distance of ca. 15 km and a relative elevation deference of ca. 450 m; and 3) the obsidian processing at Hiroppara II represents a component of a behavior system repeatedly exploiting the catchment area. This implies a number of the EUP obsidian-blade workshops similar to the site still remain buried along the area.

Keywords: Early Upper Palaeolithic, provenance analysis, catchment area, Central Highlands

Obsidian in context

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Session VIII - Exploring the allure of obsidian: Symbolic, social, and practical values for obsidian
Form of communication: oral
Day 3 (29 May) 11:10-11:30

Obsidian sourcing, using and distributing studies have been conducted in various parts of the globe for over a century. This product of volcanic activity, due to its outstanding physical properties and aesthetic quality, was widely used by prehistoric populations. Even today obsidian fascinates people. It is commonly viewed as "magic" mineral, affecting spiritual and emotional human sphere or is a significant prop in one of the most popular video game. But how was it seen by communities of the remote past and what factors influenced on its long-distance or even super-long distance movement? In the archaeological literature one can meet two contradictory hypotheses. On the one hand, assuming the results of use-wear analyses, obsidian items are considered as common raw material for making similar items and using in an identically way as tools made of any kind of raw material. On the other hand, implements made of obsidian in spite of sharp edges, were less resistant and effective at work and therefore might have born non-utilitarian meaning.
In this paper I would like to discuss occurrence of obsidian items within Neolithic assemblages distributed in present-day Poland, changing intensity of its inflow and the potential role which obsidian items might have played in particular cultural context. Was the changeable share of obsidian artefacts in total amount of assemblages result of further location from the outcrops, or weaker intensity of exchange and trade, or maybe weaker participation in network system? Maybe obsidian, among other items, i.e. Spondylus shells, certain type of vessels or their decoration, applications of black wood-tar pigments was just an element of cultural set? Yet another possibility for presence obsidian artefacts is relation to the areas from which originated the Neolithic societies, settled areas of present-day Poland.
Ideas from various scientific fields, i.e. archaeology, ethnology and sociology will be applied to explore this striking issue.

Keywords: Neolithic, obsidian, network system, cultural set

Fashion is tradition. Obsidian on Northern Balkans Copper Age sites

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Session VIII - Exploring the allure of obsidian: Symbolic, social, and practical values for obsidian
Form of communication: oral
Day 3 (29 May) 11:50-12:10

It is common in archaeological studies that cultural changes in prehistory were significant markers of past reality, representing changes in other aspects of social or economic life of prehistoric communities. In the Northern Balkans the transition from Neolithic to Copper Age had strong and manifold cultural manifestation. These include: change in settlement organization; change in the pottery style and technology of production; introduction and use of copper objects; smaller quantity of decorated items; different types of stone tools and materials used etc. All of these point to a complex social dynamics at prehistoric settlements. Yet, one aspect of material culture remained the same for over 1500 years: the appearance of obsidian. During Late Neolithic to Copper Age timeframe it was common thing to have obsidian artifacts in some quantity at any settlement of the region.
Compositional data obtained by PGAA of obsidian from four Copper Age sites showed that they are all of Carpathian origin, from Carpathian I sources in Slovakia. Still, there were different practices observed during Neolithic (more abundant obsidian assemblages, more intensive use of obsidian, both Hungarian and Slovakian sources), while on Copper Age sites there is a reduction in the use of obsidian, but it remains constantly present. Obsidian presence on sites more than 400 km from the source in a form and quantity that is most certainly not utilitarian is an indication of social relationships on a scale we have yet to determine. In this paper, therefore, characterization and distribution of Croatian obsidian was put in its cultural and geographic settings to create new perspective on obsidian at territorial margins of its distribution. We will try to observe this obsidian occurrence as a possible example of *longue durée* and start a discussion about the significance of this practice as a source of information on prehistoric population in the Northern Balkans.

Keywords: obsidian, Copper Age, Northern Balkans, PGAA

New results from sourcing the early Neolithic obsidian artefacts from Pollera Cave (Liguria, NW Italy)

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Session III - Analytical aspects of obsidian studies
Form of communication: poster
Day 1 (27 May) 15:50-17:00

The results of a new chemical characterization conducted on early Neolithic obsidian artefacts from the excavations campaign 1971-73 at Pollera Cave are presented. We analysed four artefacts from the Impresso-Cardial deposit (layer III, level XXII), already analysed by means of neutron activation (INAA) at the end of the '70s during Lawrence H. Barfield's pioneering obsidian circulation research in northern Italy.
The new investigations have been undertaken with the aim of resolving some inconsistencies found in previous publications (i.e. 3 artefacts, one of which generically attributed to the Impressed Ware Culture, the second from the XXII level and the last from XVII, published in 1979, whilst another article in 1991 reports 4 artefacts, all from level XXII). This contradictory information did not allow us to identify the individual analysed artefacts and to attribute them to their respective sources identified at that time (Lipari and Sardinia). Moreover, the evidence of imports of Lipari obsidian in upper Tyrrhenian area during the early Neolithic does not agree with the data from the neighbouring Arene Candide Cave. Therefore, the four artefacts have been re-analysed in France using non-destructive methodologies: PIXE at CENBG (AIFIRA platform) and EDXRF at IRAMAT-CRP2A.
The new analyses established that all the four obsidian artefacts found in the Early Neolithic Pollera's horizon (all marked as from level XXII) can be actually ascribed to only two different chemical-compositional groups (SB2, SC) of the Sardinian source of Monte Arci. These new results are in better agreement with the data obtained from Arene Candide and offer new ideas for discussing the dynamics of circulation of this volcanic glass in the Tyrrhenian area during the Neolithization process (VI millennium BCE).
The difference with previous results can be explained considering the pioneering stage of the research during the '70s, when only little comparative data were available for the obsidian source identification, thus possibly biasing the attribution. The occurrence of typing mistakes reporting the information can be another explanation for the aporia. However, this research reveals the importance of checking back with more modern and sensitive analytical methods old determinations, especially when they appear in contradiction with new evidence.

Keywords: obsidian sourcing, PIXE, EDXRF, Early Neolithic, Pollera Cave (Liguria, Italy)

A molecular model for water diffusion in obsidian

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Session III - Analytical aspects of obsidian studies
Form of communication: oral
Day 1 (27 May) 15:00-15:20

The obsidian hydration dating of manufactured obsidian tools and debitage converts the amount of surface diffused molecular water into a calendar age using diffusion coefficients derived from experiments conducted at elevated temperature (140–180^{o}C). The procedures for these accelerated hydration experiments are well developed, but an understanding of water diffusion at the molecular level is not well articulated. We propose that the rate of water diffusion in obsidian is controlled by the number of hydroxyls (OH) in the glass structure that are linked to non-bridging oxygen that form in the glass during the molten phase, and then, structurally frozen in during the cooling. The linked hydroxyls create pathways for the diffusion of molecular water. Larger numbers of bound hydroxyls create more diffusion pathways and faster hydration rates. We quantify this relationship by the correlation of hydroxyl concentration with activation energy values.

Keywords: obsidian, hydration rates, non-bridging oxygen, diffusion

Geochemical classification and characterization of obsidian sources in Oki-Dogo island: application to the provenance study of archaeological obsidian artifacts

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Session I - Obsidian sources and their characterisation
Form of communication: oral
Day 1 (27 May) 10:10-10:30

Obsidian sources and its related archaeological sites are distributed in the Oki-Dogo island on the southern margin of the Japan Sea. Archaeological studies had revealed that the obsidian in this island was widely provided as the lithic row material during the prehistoric age at the Chugoku and Shikoku regions. Therefore, detail geochemical characterization of obsidian in this island is quite significant to perform the provenance analysis of obsidian artifact in the western Japan. Suda et al. (2016) reported that the number of obsidian sources in this island reaches 17, which are geochemically divided into 9 groups. Based on these results, we established a system of provenance analysis of obsidian artifacts related to the Oki-Dogo source. In this system, we applied the semi-quantitative non-destructive analysis by ED-XRF, in which tow obsidian specimens (SE1-295, N7-403) were used as the standard materials for the calculation of semi-quantitative data by FP method. The 31 obsidians from the sources, had already been geochemically classified by quantitative data, were analyzed by this method to determine the compositional fields for the 9 groups in the variation diagrams. The measurements were repeated 10 times for each specimen. The compositional fields were defied as the ellipses of equal probability calculated from the plots in diagrams. Then, we designed a program using the Microsoft Excel to perform all calculations, in which the results can be yielded only to input the semi-quantitative data in an Excel Sheet. Using this system, we performed the analysis of several hundreds of obsidian artifacts from the Miyabi prehistoric site in Oki-Dogo. We can assign 60% of obsidian, while the remaining 40% did not have an affinity with known source. Although further investigation to make clear the 40% obsidian is necessary, we succeeded the improvement of provenance analysis of obsidian artifacts related to the Oki-Dogo source.

Keywords: obsidian, west Japan, Oki-Dogo island, WD-XRF, ED-XRF

The inflow of obsidian north of the Carpathians during the Neolithic: chrono-cultural variability of distribution

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Session IV - Use of obsidian by chronological periods
Form of communication: poster
Day 1 (27 May) 15:50-17:00

The Neolithic inflow of obsidian north of the Carpathians closes between the end of 6th and the middle of 4th millennia BC, and is closely related to the Danubian communities. This phenomenon is documented by over 220 sites with diverse cultural affiliations, clustered mainly on the areas in the upper Vistula basin. The analysis of findings reveals the existence of certain clear differences regarding the form, intensity as well as directions and extent of obsidian distribution during this period. In the early stage of this period, through the entire 5th millennium BC, obsidian was imported to settlement centres in the upper Vistula basin only in the form of concretions and subjected to processing on the spot, and then its products were redistributed to more distant areas. This system, as well as the range of processing and tool production do not reveal any significant changes until the end of 5th millennium BC. Its breakdown took place in the first half of 4th millennium BC and is recorded at the stage of the Wyciąże-Złotniki group and the late Lublin-Volhynian culture development. Among such dated findings, there is currently no evidence unambiguously confirming the local treatment of obsidian, as well as its inflow in the form of concretions. In the inventories of these cultural groups only triangular arrowheads are known, which were imported from the Bodrogkeresztúr cultural environment. They are clustered on a relatively small area on the left bank of the upper Vistula, and their presence indicates a completely different role of this material and the nature of its distribution in this period.

The research was financed from the funds of the National Science Centre (DEC-2015/19/B/HS3/01720).

Keywords: obsidian, distribution systems, Upper Vistula Basin, Early and Middle Neolithic

New PGAA data on the origin of Early Neolithic (LPC) obsidian in the upper Vistula Basin

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Session IV - Use of obsidian by chronological periods
Form of communication: poster
Day 1 (27 May) 15:50-17:00

According to the current state of research, the artefacts made of obsidian are known form more than 100 LPC sites from Poland. They confirm the inflow of this raw material into the areas on the Northern side of the Carpathians, starting from the classical phase of LPC development, accumulating mainly on the settlement centres located in the loess uplands in the Upper Vistula Basin. One of the most numerous (118 pieces) collections of LPC obsidian products from this area was discovered at site No. 6 in Tominy, located on the Northern foreland of the loess Sandomierz Upland (central Poland). In order to determine the origin of the raw material from which these artefacts were made, 12 macroscopically different pieces were selected for detailed research. Their non-destructive analysis was done at the Prompt-Gamma Activation Analysis (PGAA) facility at the Budapest Neutron Centre (BNC), operated by the Centre for Energy Research, Hungarian Academy of Sciences. The aim of the analysis was to determine concentrations of characteristic fingerprinting chemical elements, without destruction of the objects. The results confirmed the exclusive existence of *Carpathian 1* type products, allowing the identification of its origin with outcrops located in the area between Kašov and Cejkov in Eastern Slovakia. They correspond also very well with results of previous PGAA measurements conducted for the series of obsidian artefacts, originating from a few other LPC sites from Poland, indicating the location of main obsidian outcrop during the LPC development in this relatively small area in Eastern Slovakia.

The PGAA measurement was supported by National Science Centre in Poland (grant number: 2015/19/B/HS3/01720).

Keywords: LPC, Provenance, PGAA, Upper Vistula Basin, Eastern Slovakia

Cooling and hydration of the Carpathian obsidian, a differential scanning calorimetry (DSC), thermogravimetry (DTA) and infrared spectroscopy (FTIR) study

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Session II - Formation and geology of obsidian
Form of communication: oral
Day 1 (27 May) 12:00-12:20

The low temperature water diffusion is very common in the rhyolitic glasses but the interpretation of the cooling and hydration process on a relative effusion timescale is very controversial in the literature. The primary occurrences of the calc-alkaline Miocene (13-11.2Ma) Carpathian obsidian frequently associated with perlite deposits in variable eroded lava dome and flow edifices. The samples have been obtained from Lebuj, Erdőbénye outcrops (Tokaj Mountains) and Viničky (Zemplín Hills). Differential scanning calorimetry (DSC) measurements performed in order to evaluate the glass transition temperature (T_g) related to cooling history.
The controlled cooling/heating cycle behavior has been determined at 5, 10 and 25K/min. Thermogravimetric analysis (TGA, 25-1000°C, heating rate: 10°C min^{-1}) was used to quantify the total volatile content (TVC). The textural heterogeneity in the water concentration evaluated by Fourier transform infrared spectroscopy (FTIR) on double polished thin sections (MCT detector, range 400-6000 cm^{-1}).
The peak glass transition temperatures lie in the range of 670-780°C, which slightly shifts with controlled cooling/heating rates. The estimated natural cooling rates are generally <25K/min.
The measured TVC of the obsidian varied between 0,1-0,5% and elevated above 3% in the perlites. The FTIR revealed a very heterogenous water concentration profile. The hydration rinds (2-3% H_2O) transition rapidly (30-50 μm) to non-hydrated obsidian cores. The results confirmed that rhyolitic lava have been quenched from temperatures of 850-760°C (based on original water content). Using a mean T_g (760 °C) the first 90°C of cooling of these lavas occurred above the glass transition in a plastic state, which followed by a longer period in solid-state (glassy) to ambient temperature. The TVC analysis confirm that majority of the magmatic water was lost during the effusive degassing. The textural water diffusion happened

below the glass transition. The glassy shells of the perlitic cracking formed in the response to hydration induced stress. The relict obsidian grains support the theory that the fast but incomplete, temperature dependent hydration process could possibly occur during the post eruptive cooling or later at ambient temperature.

This study belongs to the Hungarian–Italian MTA-CNR bilateral research project 2019–2021. János Szepesi work is supported by the European Union and the State of Hungary, co-financed by the European Regional Development Fund in the project of GINOP-2.3.2-15-2016-00009 ‘ICER’.

Keywords: obsidian, perlite, hydration, glass transition temperature

Some thoughts about the cultural traditions and raw material selection strategies connected to obsidian in the Neolithic Carpathian basin

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Session IV - Use of obsidian by chronological periods
Form of communication: oral
Day 2 (28 May) 11:40-12:00

This presentation focuses on a number of lithic assemblages of several LBK and Lengyel communities in Transdanubia. These assemblages are of special interest as they are located at the periphery of these two cultural areas? In this area we can study different patterns of change which involve in some cases a change of raw materials, in other instances a switch to a new technological tradition.
The main questions are: 1. How can we interpret the raw material selection criteria and use in different regions and periods? 2. What was the value of the obsidian in the Middle and the Late Neolithic periods? 3. What did the obsidian and raw material choices depend on in different regions and in the context of different cultural traditions?

Keywords: Middle and Late Neolithic, Carpathian basin, LBK, Lengyel culture, cultural tradition

Nuclear analytical investigations on prehistoric obsidian artefacts from Romania

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Session IV - Use of obsidian by chronological periods
Form of communication: oral
Day 2 (28 May) 12:20-12:40

We briefly review the results of the nuclear analytical investigations carried out on a series of obsidian artefacts from Romania, during the past years in the Centre of Energy Research, Hungarian Academy of Sciences. Several Romanian and Hungarian museums and academic centers provided a total of 72 samples, found in different parts of the country. The samples show great dispersion not only geographically but also in cultural and chronological sense: most of them belong to the Early Neolithic Starčevo-Criş culture, but more samples come also from the Upper Paleolithic, Middle and Late Neolithic, Copper Age and Late Bronze Age. Their archaeological contexts are also varied. Although most of the studied artefacts come from excavations, the exact provenance and find-circumstances of some samples are unknown or at least uncertain.
The obsidian samples were subjected to non-destructive Prompt Gamma Activation Analysis (PGAA) at the Budapest Neutron Centre. The main goal of the research was to determine the origin of raw materials through the geochemical composition of the samples. Therefore, the chemical compositions of the artefacts have been compared to those of reference samples collected from different European and Western Asian sources, measured by PGAA. Based on characteristic major and trace element concentrations, most of the studied Romanian obsidian artefacts can be characterized as Carpathian 1 type obsidians, whose outcrops can be found in the Slovakian side of the Tokaj-Eperjes Mountains. However, some samples from Banat and Muntenia have been identified as Carpathian 2 type. Meanwhile, the origin of distant regions can be completely excluded. Apart from the cultural and territorial dispersion of the samples, the information obtained and compared to the results of other previous studies can expand our knowledge about the prehistoric use of the obsidian in the Carpathian Basin and major surrounding areas.

Keywords: Obsidian, Romania, prehistory, nuclear analytical investigations

Producing value: obsidian stemmed tools from West New Britain, Papua New Guinea

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Session VIII - Exploring the allure of obsidian: Symbolic, social, and practical values for obsidian
Form of communication: oral
Day 3 (29 May) 10:50-11:10

Obsidian has many inherent physical characteristics that might explain why this raw material has frequently been valued by societies around the world: e.g. shiny, reflective physical appearance, translucence, black colour, consistent conchoidal fracturing, spatially constrained location of outcrops, etc. All of these traits probably contributed to the appeal of large obsidian retouched tools that circulated over long distances in Papua New Guinea during the mid-Holocene. Within this specific cultural context, however, the physical characteristics of the artefacts were not sufficient to establish their worth as prestigious objects. A key component in the creation of social value for stemmed tools was a production system that operated through networks of craft specialists. Using a combination of raw material characterisation, replication, lithic analysis, and use-wear analysis, we reconstruct a complex manufacturing process distributed across space, possibly involving several sets of knappers, and at times conducted in secret. We argue that in addition to its attractive physical characteristics, the social networks created during the production of stemmed tools were central to their role as ceremonial items.

Keywords: valuables, exchange, production, Papua New Guinea, Holocene

Changes in Obsidian Island Source Usage in Northern Italy during the Neolithic: Selection or Availability?

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Session VI - Contemporary approaches to reconstructing exchange
Form of communication: oral
Day 3 (29 May) 9:20-9:40

Obsidian was widely used for stone tools in northern Italy during the Neolithic period (ca. 6000-3000 BC), coming from the far-away island sources of Lipari, Palmarola, and Sardinia. The large-scale, continuous inhabitation of Sardinia and Lipari, which was made possible by the introduction of domesticated animals in the Early Neolithic, strongly infers regular maritime travel capabilities, and obsidian was distributed from these island sources throughout the Italian peninsula and beyond to France and Croatia.
For the northern part of the Italian peninsula, the nearest obsidian source is the tiny island of Palmarola, nearly 500 km to the south, while Lipari and Monte Arci (Sardinia) are much further away. The sites tested include Case Catena, Pontetaro, Guidorossi, and Gaione, all near Parma and Early-Middle Neolithic, and Pescale (Prignano) which is Middle-Late Neolithic, and add to previous studies in northern Italy. Obsidian cores have been found at some of these sites, confirming the local production of the final tools.
Analyses were conducted using a portable X-ray fluorescence spectrometer, a non-destructive analytical method that provides calibrated major and trace element data sufficient to attribute artifacts to specific subsources on Lipari (Gabellotto Gorge, Canneto Dentro) and Sardinia (Monte Arci SA, SB, SC) whose usage has been shown to vary over time. The results obtained in this study show striking differences between the sites, with 71% Lipari, and 27% Palmarola at the Parma sites vs. about 87% from Sardinia and 12% from Lipari at Pescale.
These results are compared to address whether the differences observed may be related to chronological change, and if so what that infers about socioeconomic and other changes between the earlier and later Neolithic. The obsidian distribution patterns will also be used to propose potential transportation routes and how and why they may have changed over the course of the Neolithic.

Keywords: obsidian sourcing, northern Italy, Neolithic trade, western Mediterranean

Obsidian production and consumption in Yellowstone National Park, USA

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Session VII - Super-long distance movement of obsidian in prehistory: why, how and what for?
Form of communication: oral
Day 1 (27 May) 17:40-18:00

A new study of nearly 700 obsidian artifacts from Yellowstone National Park using a pXRF and encompassing several Native American prehistoric sites (ca. 10,000 BP to 1,000 BP) is revealing new patterns of source acquisition and trade of obsidian. In particular, the use of raw material from Obsidian Cliff is mapped across the park. The use of the park area in antiquity was mostly seasonal or periodic, largely due to the coldness of winters and abundance of snow, and it was shared among several tribes, as it is today. As a result, specific patterns of consumption are highly variable, but it is possible to track local procurement of obsidian vs. access to more distant sources.
Obsidian Cliff was undoubtedly the major source for obsidian, and it was traded significant distances, including to Ohio and Maine. Yellowstone Park was inserted in existing trade networks as demonstrated by the presence of different sources, and it was a place for different tribes to meet, given the periodic occupation of the land and the vast spaces available. Tracking and mapping the movement of obsidian in different areas is of great value to identify the major routes in ancient exchange systems and identify areas possibly used by different tribes, such as the Shoshone and Black Feet that are known to have frequented the area before European contact. It is also an area of great significance for insights on craft specialization among mobile Native Americans and the development of very long distance trade networks.

Keywords: Yellowstone, Obsidian Cliff, trade, exchange, sourcing, consumption

Investigation of the sources and uses of obsidian during the Neolithic in Poland – preliminary review

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Session VIII - Exploring the allure of obsidian: Symbolic, social, and practical values for obsidian
Form of communication: oral
Day 3 (29 May) 11:30-11:50

One of the more important problems related to studies of the Stone Age is determining the social mechanisms responsible for long-distance distribution of siliceous rocks. Obsidian is an excellent raw material for implementing such investigations.
There are no natural outcrops of obsidian in Poland, so all of the artifacts and nodules recovered from archaeological sites must have been conveyed there by some means (exchange, direct access, mobility, etc.) at different times in the past. Since 'exotic' (i.e. non-local) raw materials are marked as special by humans cross-culturally, we imagine that prehistoric peoples may have made analogous distinctions.
The oldest traces of using obsidian by prehistoric societies in Poland are dated to the Middle Palaeolithic. In Palaeolithic and Mesolithic we find single specimens as very rare examples of a more numerous presence of obsidian artefacts (ex. Rydno, ochre mine). A dramatic increase in using obsidian begins with the arrival of first Neolithic societies to Polish lands.
The oldest Neolithic materials are connected with the first phase of the Linear Pottery Culture, with an increase in the second (Music note style), and in the end stage (especially in Želiezovce style). The dramatic increase of the use of obsidian is noticed in inventories related to Malice Culture and the Lengyel-Polgár Complex. But obsidians are also observed in younger material connected with the activity of communities from the end of Neolithic and the beginning of Eneolithic – Wyciąże-Złotniki group or Baden Culture.
In Poland we have obsidian recovered from more than several dozen Neolithic sites, in addition to those with single finds. In the presentation we would like to present preliminary review concerning the sources and uses of obsidian during the Neolithic in Poland.

Investigations financed by National Science Centre, Poland (OPUS 15 2018/29/B/HS3/01540).

Keywords: obsidian, long-distance distribution, Neolithic, Poland

Obsidian as a determinant of the migration routes of Gravettian and Epigravettian hunter-gatherers

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Session IV - Use of obsidian by chronological periods
Form of communication: oral
Day 2 (28 May) 10:20-10:40

The Western Carpathians covers approximately 90,000 square kilometers and include territories of Austria, Czechia, Hungary, Slovakia and Poland. Due to the mapping of distances between lithic raw material sources and archaeological site, it can be stated that this vast geographic area was the foraging territory of hunter-gatherers in the Upper Palaeolithic. One of the lithic raw materials involved in the technological organization of hunter-gatherers was the obsidian. Although the obsidian is a high quality knapping raw material, it hardly travelled over the arch of the Carpathians during Gravettian, where we can find just a single piece of that raw material. But general, obsidian is rarely found at Gravettian sites located even closer to the outcrops of this raw material, except for sites located directly on its outcrops from eastern Slovakia. The first largest quantity of obsidian in the northern territory of the Western Carpathians was dated to 18 ka calBP at Targowisko 10 in Lesser Poland, but still on Epigravettian sites obsidian material is discovered rarely, which makes us think that the raw material has not been used so frequently, like for example, Jurassic or Cretaceous erratic flint, numerously found in Czech locations. Perhaps this indicates the lack of convenient passages through the Slovak Carpathians, what forced the Gravettian and Epigravettian hunter-gatherers to use mainly the Moravian Gate as a kind of corridor for flint raw materials transportation.

Keywords: Upper Palaeolithic, raw materials