IOC 2019

International Obsidian Conference 2019

27–29 May 2019,

Sárospatak (Hungary)

Venue:

Rákóczi Museum of the HNM,

Sárospatak

Organised by:

Hungarian National Museum,

Budapest

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Program Abstracts Field Guide

HUNGARIAN NATIONAL MUSEUM

International Obsidian Conference 2019

27–29 May 2019,
Sárospatak (Hungary)

- Eötvös Loránd University, Budapest, Hungary
- Centre for Energy Research, Hungarian Academy of Sciences, Budapest, Hungary
- Mining and Geological Survey of Hungary, Budapest, Hungary
- Hungarian Natural History Museum, Budapest, Hungary
- Herman Ottó Museum, Miskolc, Hungary
- State Geological Institute of Dionýz Štúr, Bratislava, Slovakia
- Institute of Archaeology, Slovak Academy of Sciences, Nitra, Slovakia
- Masaryk University, Brno, Czech Republic
- Taras Shevchenko National University, Kyiv, Ukraine
- Ferenc Rákóczi II. Transcarpathian Hungarian Institute, Beregovo, Ukraine

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HUNGARIAN NATIONAL MUSEUM

MAGYAR NEMZETI MÚZEUM
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Edited by
András MARKÓ, Kata SZILÁGYI & Katalin T. BIRÓ

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IOC 2019 International Obsidian Conference

27–29 May 2019 Sárospatak Hungary

Conference program

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Day 1 (27 May)

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12:50-13:00
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13:00-14:00: lunch break

14:00-19:00 Excursion Slovakian obsidian localities: Viničky, Streda nad Bodrogom, Cejkov

20:00-22:00 Conference dinner

<u>Day + (30 May)</u>

Post-Conference tours

Tour 1: 8:00-19:00 Sárospatak – Beregsurány – Rokosovo – Beregovo – Sárospatak
consider for departure and accommodation

Tour 2: 9:00-17:00 Sárospatak – Miskolc, Herman Ottó Museum – Budapest

Tour 3: 9:00-17:00 Sárospatak – Budapest, Budapest Neutron Centre – Budapest City Centre

IOC 2019

International Obsidian Conference

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Sárospatak
Hungary

Abstracts

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

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Smbatyan, H.A. (ARTVAN, Yerevan, Armenia)

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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Glascock, Michael D. (Research Reactor Center, University of Missouri, 1513 Research Park Drive, Columbia, MO 65211, United States)

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 6^{th} millennium to 3^{rd} 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

Authors:
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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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Kasztovszky, Zsolt (Centre for Energy Research, Hungarian Academy of Sciences Budapest, Hungary)
Mester, Andrea (Jósa András Museum, Nyíregyháza, Hungary)

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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Bonsall, Clive (Archaeology, University of Edinburgh, United Kingdom - C.Bonsall@ed.ac.uk)

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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Glascock, Michael D. (Research Reactor Center, University of Missouri, Columbia, MO, USA)

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

IOC 2019

International Obsidian Conference

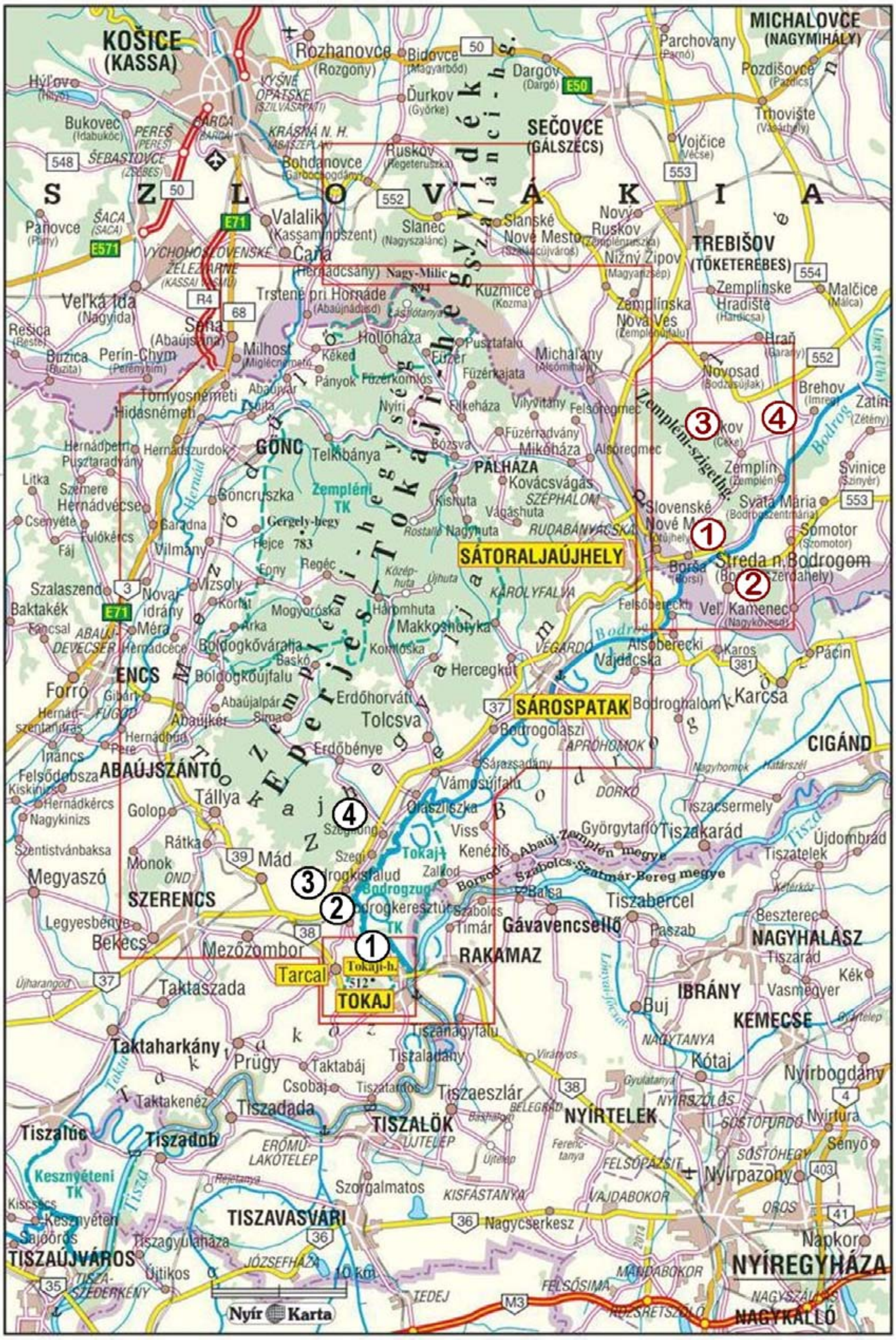
27–29 May 2019 Sárospatak Hungary

Field Guide

IOC-2019

International Obsidian Conference

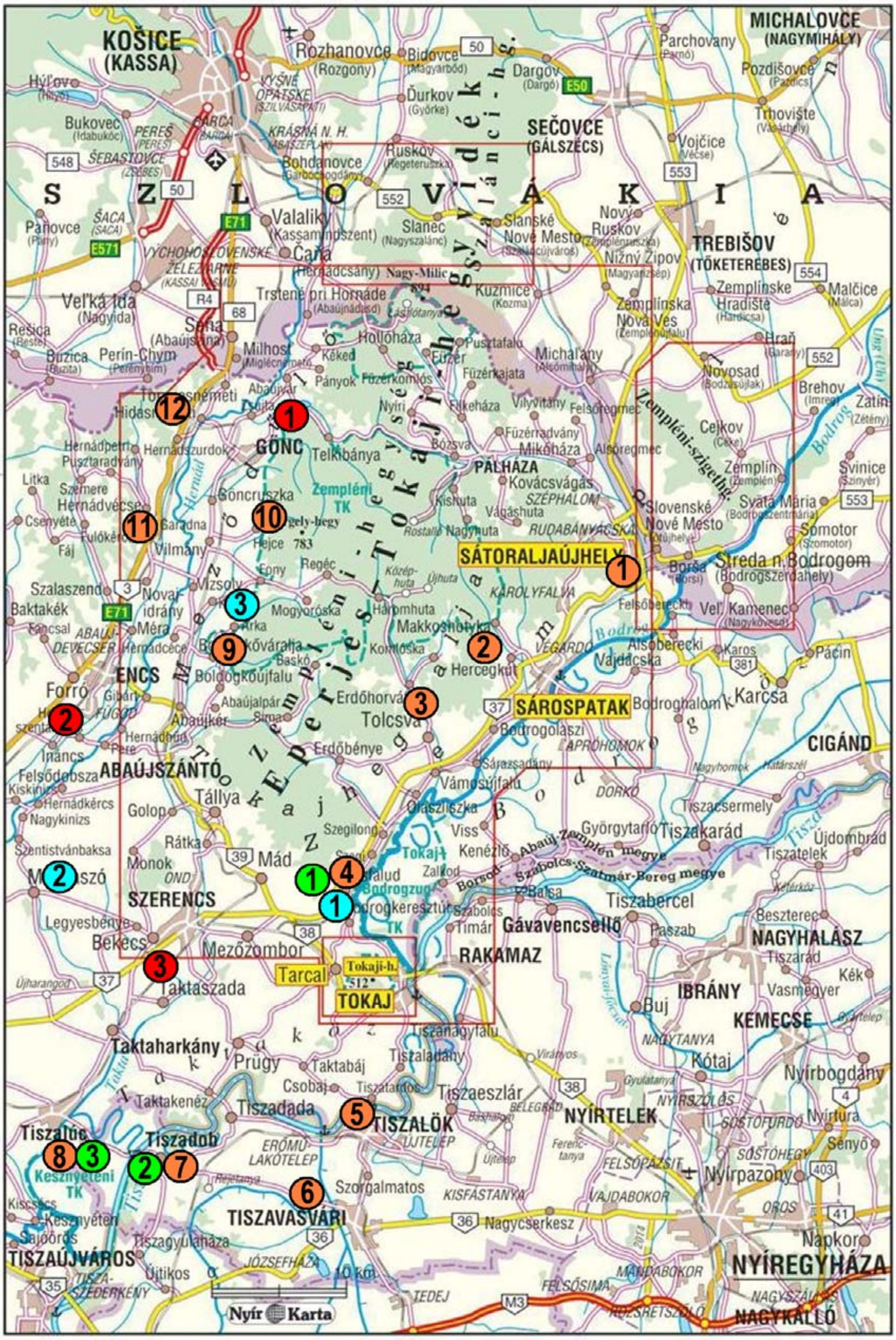
28 May 2019: Excursion to Hungarian obsidian localities
29 May 2019: Excursion to Slovakian obsidian localities.
30 May 2019: Excursion to Ukrainian obsidian localities.



Route overview

Hungarian localities: 1. Lebuj-kanyar; 2. Bodrogkeresztúr, viewpoint; 3. Mád-Nyerges; 4. Erdőbénye-Meszes

Slovakian localities: 1. Viničky; 2. Streda-nad-Bodrogom,; 3. Kašov; 4. Cejkov.



Selection of important archaeological sites in the Tokaj (Zemlén) area

UP: 1. Bodrogkeresztúr-Henye; 2. Megyaszó-Szelestető; 3. Arka-Herzsarét; MN: 1. Sátoraljaújhely-Ronyva part; 2. Hercegkút; 3. between Tolcsva and Erdőhorváti; 4. Bodrogkeresztúr; 5. Tiszalök; 6. Tiszavasvári; 7. Tiszadob; 8. Tiszalúc; 9. Boldogkőújfalu; 10. Garadna; 11. Hejce; 12. Hidasnémeti; LN: 1. Gönc; 2. Ináncs; 3. Szerencs; CA: 1. Bodrogkeresztúr; 2. Tiszadob; 3. Tiszalúc. The eponym LN, ECA site (Tisza)polgár is located a few kms south from the cut-out.

Excursion to Hungarian obsidian localities

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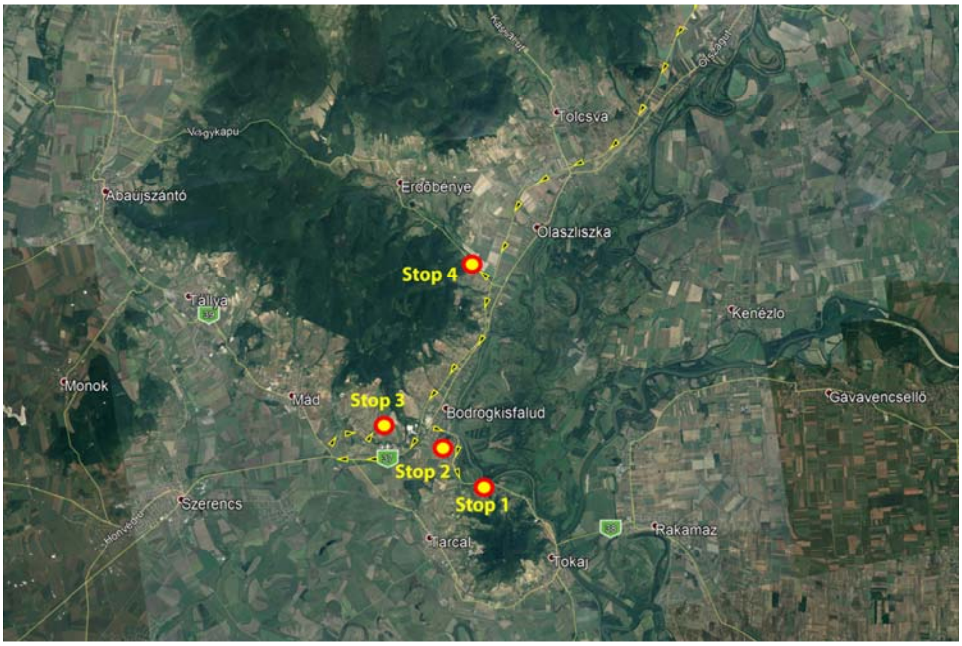

Fig. 1. Map of the IOC2019 Field Trip, Hungary

Stop 1 – Lebuj Bend

The outcrop is located at eastern edge of the Tokaj Nagy Hill dacite composite volcano. (**Fig. 2.**). Its name is connected to the famous, centuries-old Lebuj pub in Bodrogkeresztúr.

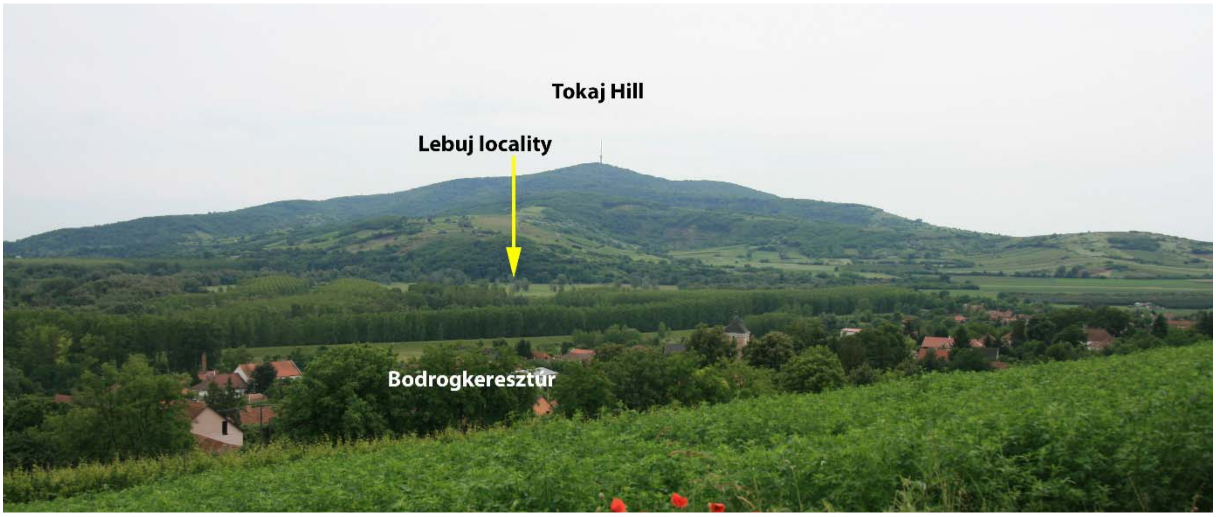

Fig. 2. Panorama of the northern side of the Tokaj-Nagy Hill dacite composite volcano. The perlite outcrop is located at eastern base of the hill (Photo by J. Szepesi, 2018)

The outcrop wall (**Fig. 3.**) was created during a road construction in the 18th century. The significance of this outcrop is demonstrated by historical perspectives (Townson 1793, Beudant 1822, Ricthofen 1860). Esmark (1798) applied the perlite geological term at the first time in Hungary referring the Lebuj locality. Szabó (1866) recognized the genetic relationship between obsidian and perlite. The 100 meter long, 15 meter high wall (Figure 8) contains obsidian grains nested in perlite which is called traditionally as “marekanite”. The name came from Pallas, who described almost the same formation from Okhotsk, Russia (Pallas 1771).
From a volcanological point of view the Lebuj represents an older lava dome occurrence at the eastern margin of the Szerencs Caldera. The field survey identified 6 major lithofacies zones (**Fig. 3.**) which follow each other upwards: rhyolite, welded lapilli tuff, red and black perlite breccia, obsidian rich perlite, reddish perlite, lithophysae rich perlite.

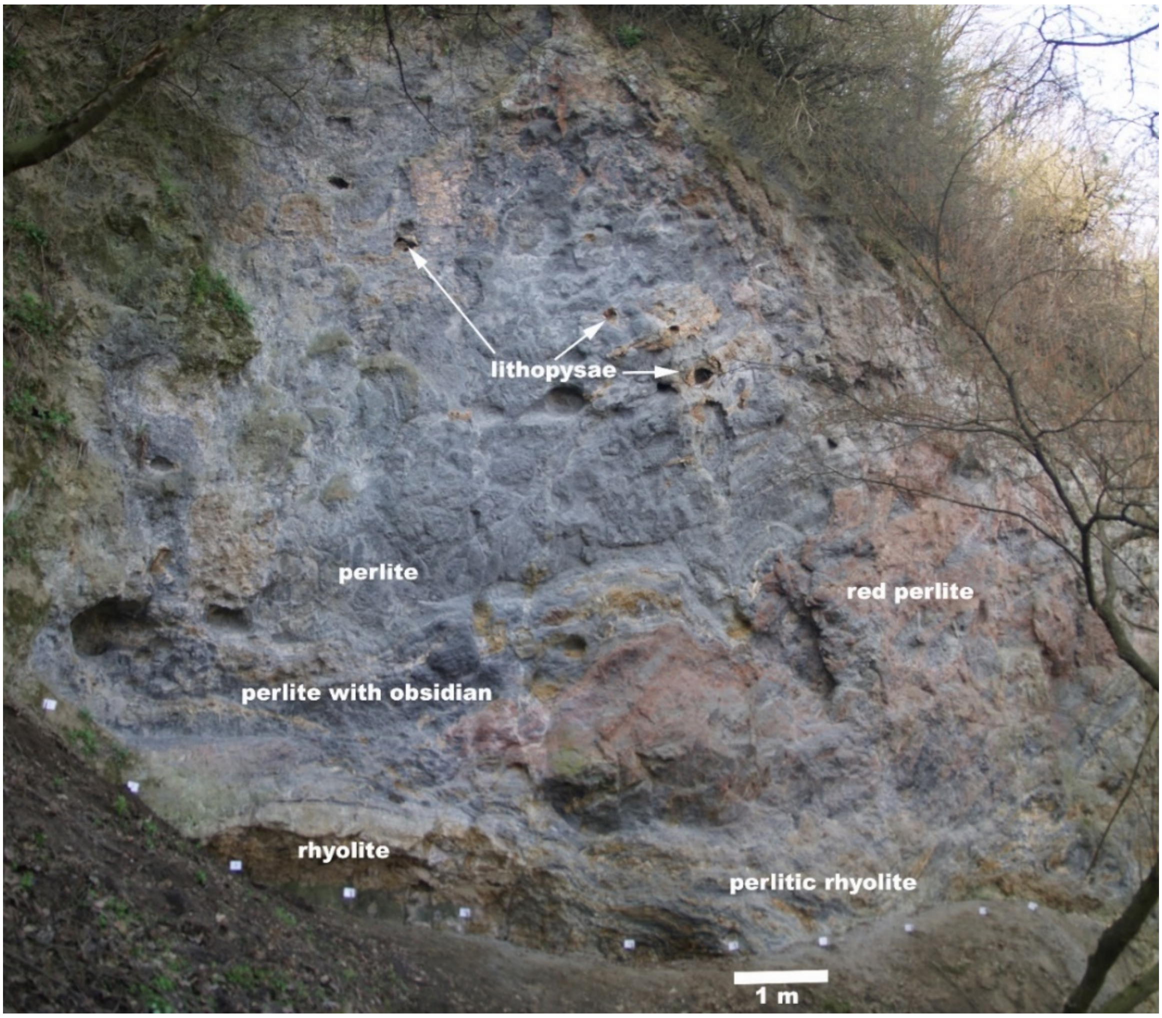

Fig. 3. Lithofacies zonation of western wall of Lebuj outcrop (Photo by J. Szepesi, 2009)

The obsidian rich zone is identified only at the central-lower perlitic part of the outcrop (**Fig. 3**.) in a thickness of 2-4 meters. The small (<1cm), rounded to subangular grains are nested in gray perlite. The perlitic lava texture is generally flow banded, which is defined by strong fluidal alignment of white-gray bands (**Fig. 4a, b**).

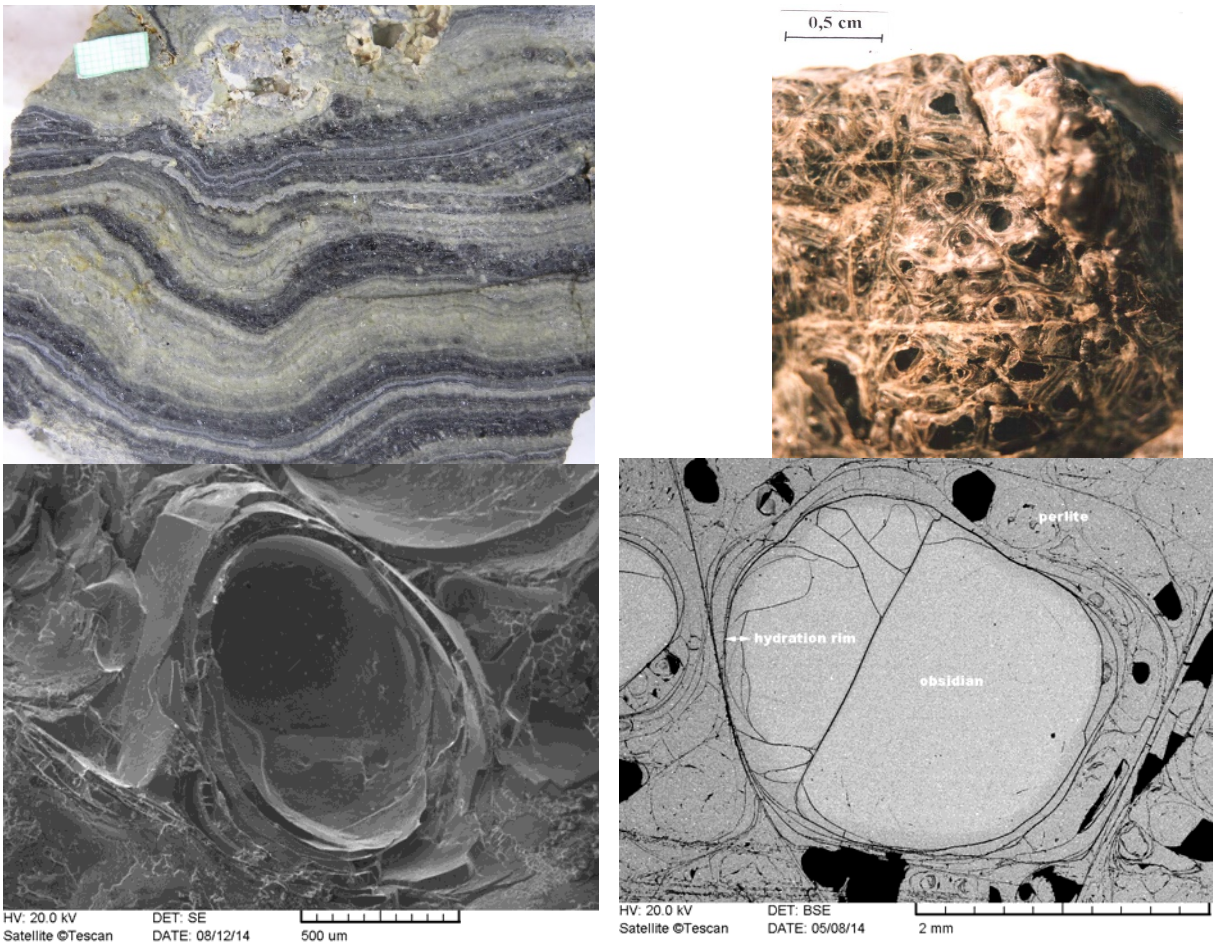

Fig. 4. Close-up and SEM imaging of the Lebuj samples, a, banded perlite with obsidians (scale=1cm), b, close up view of the textures with rounded to subangular obsidian grains, c, rounded surface of the obsidian grain bounded by dense perlitic cracking (SEM image), d, Backscattered image of an obsidian grain in thin section, a darker hydration rim can be clearly identified at the grain boundary

Two feldspars (sanidine and plagioclase), quartz, biotite and rare ilmenite are observed as phenocrysts. The perlitic texture is defined by an onion skin like foliation around the obsidian cores (**Fig. 4c**). The density of perlitic fracturing is varied between 50-250 μm, rare fractures cut through the obsidian cores (**Fig. 4d**). The macroscopically black obsidian shows light-gray color on backscattered images, while the perlitic matrix is dark gray. A hydration rim can be seen at the margin of obsidian cores (**Fig. 4d**). The surrounding glass is variably felsitic in certain bands and sometimes contains small spherulites. Under the glassy zone a devitrified rhyolite lithofacies is identified with a thickness of 1-2 m (**Fig. 3.**) which disappear from the central part of the outcrop wall and occurs in the eastern edge. Common hollow cavities (lithopysae, 1-10 cm) developed with concentric crystallized rims most frequently in the upper part of central wall (**Fig. 3.**). Occasionally, a reddish colored perlite breccia zone crops out at the partly soil covered western part. A welded lapilli tuff and the lowermost rhyolite at the base of the succession make the volcanological interpretation even more complicated.

Stop 2 – Bodrogkeresztúr, viewpoint

Fig. 5. View from the lookput towards the North in the Bodrog valley. (Photo by B. Hegyi, 2019).

The lookout built on the 152 m high eroded surface of the Dereszla perlitic lava dome at the eastern margin of Szerencs caldera. Looking around, the eastern part of the Tokaj Mountains is clearly visible extending through the Hungarian-Slovakian border (**Figs. 5-6.**). The volcanic area is bounded by the tectonic line of Bodrog river. This part of mountain designated as UNESCO World Heritage. The Tokaj Wine Region (TWR) historic cultural landscape was the World's first delimited wine region (since 1737) and demonstrates the long tradition of wine production.

The calc-alkaline volcanic activity occurred between the Late Badenian and Early Pannonian period in the TM (15-9.4 Ma Pécskay et al., 1987, 2006, Pécskay & Molnár, 2002; Lexa et al., 2010).

Fig. 6. Erosional butte of Szegi, Castle Hill from the lookout. The ignimbrites of the beackground range is covered by pyroxene-dacite flows

The Tokaj Mountains and the neighboring Zemplín Hills (Bačo et al., 2017, 2019) represent coeval intermediate to silicic volcanic activity. The typical landscape elements from south in clockwise direction are the following. The largest pyroxene-dacite cone of the Tokaj Nagy-hill represents latest volcanic activity of the mountain, radial sloping ridges are individual flows and domes. The dacite flow covers the silicic lava domes, especially the Lebuj obsidian locality. Looking forward in northwestern a large quarry is facing to the main road excavated in the widespread Sarmatian ignimbrites. The hydrothermally altered rock has been utilized as a natural building stone for several centuries. In northern direction the smaller individual cone of Szegi, Castle Hill is an erosional butte, where the ignimbrite covered by harder pyroxene dacite. Going forward, andesitic composite volcanoes can be seen near the horizon. The riverplain from east is the Bodrogköz, where the volcanic formations continue towards western under the sedimentary cover.

Fig..7. The flooded river plain of Bodrogköz in 2010. The volcanic formations continue towards western direction under the sedimentary cover.

Stop 3 – Mád-Nyerges (Kakas Hill)

The obsidian bearing layer below Nyerges top that represents the topmost rhyolite flow units of the Szerencs caldera (**Fig. 8.**) succession. The dense debris of the black angular fragments (1-3 cm) was found in between 229-250 m. a.s.l).

Fig. 8. Gentle slopes of the Nyerges Hill, The peak region represents the topmost rhyolite flows of the Szerencs caldera

The obsidian mixed with slightly larger fragments of hydrothermally altered rhyolite and lapilli tuff. The unusual abundance of the obsidian is nearly equal with other clast types. The angular shape of glass fragments indicates nearby source with shorter deluvial transport distance. This layer is assumed as the potential source for the slope material (**Fig. 9.**). In this case, the altitude difference is about 180 meter and suggest long (~km) erosional transport on the slope.

Fig. 9. Allochtonous obsidian sources of Nyerges (229 m a.s.l.) Dense obsidian debris (black) with rhyolite tuff (white) and rhyolite (light brown-pink) fragments in forest soil.

Stop 4 – Erdőbénye- Meszes locality

Fig. 10. Meszes locality, Accumulations of rounded obsidian grains are observed at the foots of the Meszes hill (110 m a.s.l.).

The Meszes Hill (254 m a.s.l., **Fig. 10.**) is located at northeastern part of the Szerencs Caldera revealing primary and secondary obsidian sources. A 200 meter deep borehole (Eb-163) revealed the complete stratigraphy of the hill. The lithostratigraphic section is consistent with the upper part of caldera succession (Szepesi et al. 2018). The unaltered, pumice enriched massive lapilli tuff (80m) at the bottom represents the 4th major, explosive event of the caldera. In the middle part, a 40 meter thick andesite flow sequence is embedded in layers of mixed (andesitic-rhyolitic) lapilli tuff (50m). At the top, the sequence terminates with rhyolitic lavas (10 metre) in which a perlitic layer developed at the base. The obsidian was identified in two primary sources. First one was revealed by drilling and found at basal part of the rhyolite flow (5-9 m), where the obsidian forms marekanite in perlitic rhyolite and pumiceous perlite. Unfortunately, the borehole documentary did not provide data on its grain size.

Accumulations of rounded obsidian grains are observed at Meszes on the gentle slopes (150 m a.s.l) and foots of the Meszes hill (110 m a.s.l.). Here, the largest size was about 5-8 cm in diameter, and the average around 3 cm (**Fig. 12b**). The obsidian surface is smooth and curvy and has brown-gray crust while the fresh fracture surface is black.

The other primary source is the pumice rich lapilli tuff (**Fig. 11.**) which is available in outcrops, too.

Fig- 11. Meszes locality, a, Pumice rich, obsidian bearing lapilli tuff (147 m a.s.l.)

The logged outcrops were in a small quarry around the vineyards, 2 large gorges and smaller ditches. The lithofacies lacks internal stratification and comprises high amount of rounded pumice (<cm) and subordinate angular obsidian and rhyolite lapilli (~cm, Figure 6a) in a fine ash size matrix (Figure 6a). The matrix (30-45%) consists of glass shards and crystal fragments (5-10%), mainly feldspars (sanidine and plagioclase), quartz and biotite.

Fig. 12. Meszes locality, a, Pumice rich, obsidian bearing lapilli tuff (147 m a.s.l.) b Larger obsidian grains around the tuff locality from the ditch (150-135 m a.s.l.)

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Excursion to Slovakian obsidian localities

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Autochthonous (primary) occurrences of volcanic glass

Stop 1 (1a-1,2, 1b, 1c) (please see the "Map of the IOC 2019 field trip Slovakia")

Marginal parts of the extrusive dome/flow Borsuk, located close to the Malá Bara village, but especially in the surroundings of the Viničky village (**Fig. 1**) host the most important primary obsidian occurrences in Slovakia. Dominantly they crop out at the south eastern side of the dome/flow at localities marked as 1, 2 and 3 in **Fig. 2**. Obsidians always occur along with perlite, usually as obsidian cores in the perlite environment.

The form of obsidian occurrence in the perlite environment can be observed in newly driven (years 2006–2007) underground galleries of the Tokaj Viničky Ltd. wine cellars (**Fig. 3**)

1a-1 Obsidian in perlitized parts of rhyolite intrusions – Viničky – wine cellars

In Viničky locality the denudation has reached one or several small rhyolite intrusions and/or dykes affected by extensive perlitization with remnants of preserved obsidian. Intrusions with perlite and obsidian are covered by thin eluvial deposits, reaching sometimes up to 0.5 m – e.g. in localities 2 and 3 (**Fig. 2**), or by a thicker layer of polymict eluvial/deluvial deposits with thickness up to 5 m – e.g. in locality 1 (Fig. 2) and the area of the Tokaj Viničky Ltd. wine cellars (**Figs. 2 and 4**; Bačo et al. 2011).

Gradual weathering of perlite deliberates enclosed obsidian cores into these eluvial/deluvial deposits. Size of individual obsidian pieces varies in the range 2 mm–14 cm, with the average size 3–5 cm. Not often, however, more frequently as generally assumed, there are present cores 10 cm or more in diameter (**Fig. 5a, b**). The form of obsidian pieces is irregular. Their surface is mostly smooth, patinated, sometimes with rare remnants of perlite. Sculpture of the type known from the obsidians surface at archeological sites, is absent (it has not been observed). Apparently, the residence time of obsidians in eluvial/deluvial deposits is too short to develop full scale sculpturing.

It is proved by observation of initial stages of obsidian sculpturing in a section of eluvial deposits directly above the primary source (**Fig. 6a, b, c**). Extent of sculpturing depends on the position of obsidian pieces in the section (**Fig. 4**). Obsidian in **Fig. 6a** from the top of weathered perlite shows the same type of surface attributes as obsidian cores in fresh perlite – remnants of perlite can be seen in the upper right corner of the figure. The obsidian nodule in **Fig. 6b** from a higher position shows patinated surface with a minimal rounding of edges and planes that are characteristic for bigger obsidians in perlite. Obsidian nodule in Fig. 6c from the highest position of the section (having the longest expected residence time) shows an initial stage of sculpturing in the form of roughness and small pits.

1a-2 Obsidian in perlitic breccias – Viničky – wine cellars

Most of the obsidian cores observed in the Tokaj Viničky Ltd. wine cellars occurs in perlitic breccias (**Fig. 7a, b**) that represent a base of thick and extensive rhyolite lava flow with a source at the extrusive dome of Borsuk hill NE of the village Viničky (Bačo in Kobulský et al. 2014; Lexa et al. 2014). Perlitic breccias are formed of angular blocks of dark to pale perlites up to 3 m in diameter, often with pronounced flow banding, in pinkish matrix of grounded perlitic material. They rarely include fragments of underlying pyroclastic rocks. In these breccias obsidian occurs as fragments up to 10–15 cm in diameter, but much smaller on the average. Planes of obsidian fragments are mainly concave, smooth and glossy (**Fig. 8b**). At freshly broken surface they are black or pitch black with a pronounced conchoidal fracture (**Fig. 9a**). Using a microscope one can observe in obsidian rare microphenocrysts of biotite, plagioclase, rare Fe-orthopyroxene (ferrosilite) and ilmenite (**Fig. 9a, c**). Frequently observed banded texture or alternation of dark and pale streaks is caused by flow oriented minute crystals – microlites and trichites (Fig. 9b), mostly of pyroxene composition and Fe-Ti oxides. This internal fabric of obsidian glass is a probable cause of sculpturing, if the glass is exposed to weathering.

Rare and generally small cores of obsidian enclosed in perlite fragments (marekanites) of breccias at the base of the same rhyolite lava flow occur also on its northern side, south of the Malá Bara village. However, in this case the small size of obsidian cores prevented its utilization for a production of obsidian industry.

Stop 1b - c Obsidian from perlitized parts of Viničky extrusive body / margin of Borsuk extrusive body, present in eluvial sediments – Zajačí skok locality – road cut in the vineyard - 1b and road cut under the forest - 1c

The occurrence is located on southern slopes of the Borsuk elevation point (252 m a.s.l.) – in Fig. 2 points 1 to 3, north of the Viničky village in the area of recent Tokaj vineyards (**Fig. 10**). In historical map (Janšák, 1935) it is the area defined by letters k-l (**Fig. 1**). The majority of historical findings, as well as those mentioned so far, and also in existing scientific studies of the Viničky obsidian, comes from the surface occurrences in this area.

The area of obsidian occurrence represents southern margin of the extrusive rhyolite body (Map III). The Borsuk extrusive body (**Fig. 11**) is a part of small monogenetic volcano (Lexa et al., 2014) and crops out in its central part. The underlier of this body is represented by rhyolite tuffs and pumice tuffs. These tuffs represent distal facies of Plinian / phreato-Plinian type eruptions with the centre not being identified in their close vicinity. The thickness of these tuffs is more than 15 m. Above the eroded surface of these tuffs there crop out the products of phreatic / phreatomagmatic eruptions (**Fig. 11**). They are formed of lapilli tuffs to pyroclastic breccia of distinctly polymict composition. The lithic clasts to boulders are represent prevailingly by Permian rocks - mainly micaceous sandstones and shales. The lithic fragments prevail over juvenile ones as well as the tuff matter. Contrary to underlying tuffs the dip of individual pyroclastic horizons – beds is above 15°, which together with the dimensions of clasts indicates the proximal facies of pyroclastic rocks. The centre of these eruptions is probable in the area NW of Viničky village with the presence of dacite cryptodome (**Fig. 11**).

The artificial cut (**Fig. 12a**) and wine cellars in the Zajačí skok valley have discovered the intrusive/extrusive body of strongly glassy rhyolite consisting also of the pure volcanic glass. In outcrops it is totally perlitized. From the margin with distinctly fluidal texture (**Fig. 12**) towards the distance of ca 15-20 m, the perlitized glass has preserved obsidian – marekanite – fragments (**Figs. 12c** and **13a**). Perlite is of light grey colour and has typical perlitic disintegration. Obsidian is dark grey to black. In thin flakes it is translucent.

Obsidian is formed of the pure glass, but microscopically it contains (micro) phenocrysts mainly of biotite, less plagioclases and pyroxenes (Fig. 13b, c). From the group of accessory minerals there was observed ilmenite, zircon, monazite, apatite and pyrite.

An important part of the glass – obsidian is represented by microlites. Pyroxenes represent also a main mass of microlites (**Fig. 9b, c**) and together with trichites cause macroscopically observable schliers or possible opacity. The size of pyroxene microlites is beneath 0.05 mm. Trichites (**Fig. 14a, b**) represent an important part of obsidians from the Zemplínsky ostrov area. They are formed by microcrystals probable of magnetite. They form "spider fibers" (**Fig. 14a–e**), spatially spread from common central point. The size of these bodies is usually up to 1 mm (**Fig. 14a**) and they are often arranged in parallel bands (**Fig. 14b**) and in given case it causes macroscopically observable schliers. Obsidians with their massive presence are magnetic in small grains (size around 2-3 mm) for ferromagnets and especially Nd magnets. Microscopically several structural types are distinguishable, being revealed in obsidians from individual localities. Obsidians from Viničky locality have characteristic "bead" fibers (distinct in the picture 14a, e). Obsidians from Streda nad Bodrogom contain straight trichyte fibers (Fig. of trichytes at locality Streda nad Bodrogom). Whether the trichyte form has some unambiguous discriminatory property for each site, is not known for now.

In similar position as in the wall, obsidian occurs also in the vineyard area (stop 1b, 1c – **Fig. 10**). Obsidian here is present in eluvial deposits directly on the rock underlier (**Fig. 15a, b**). Sediments are formed of perlitic sand and silt with fragments of compact perlite and "weathered" obsidians. The rhyolite fragments from the Borsuk body were transported here from the places of higher altitude. The obsidian fragments are in prevailing cases small – in average from 0.5 to 3 cm.

Exceptionally they are larger - up to 10 cm and fragments of more than 1 kg have also rarely been found (**Fig. 6a**). Their surface clearly indicates autochthonous occurrence. It is smooth, often with a perlite layer on some of the surfaces (**Fig. 16**).

Allochthonous (secondary) occurrences of volcanic glass

Stop 2 - Redeposited volcaniclastic rocks with perlite and obsidian – Streda nad Bodrogom Šibeničný vrch hill

Locality occurs in the town residential area. The quarry is located in the northern slope of the Šibeničný vrch hill (148 m a.s.l.) – **Fig. 17**. Recently in this quarry the primary wine cellars are excavated (**Fig. 18a, b, d**).

Perlite with nodules of obsidian is known also under the name "marekanite" (Šalát and Inčáková, 1964). Fragments of perlite with obsidian, as well as obsidian alone represent a part of redeposited rhyolite/rhyodacite tuffs, epiclastic volcanic sandstones and gravels, as well as epiclastic volcanic breccias laid down as a submarine landslide (**Fig. 19a, b, c, d, e, f**). So the perlite and obsidian fragments are not located at the place of their origin.

The interbed thickness of these rocks in the quarry is up to 30 m, the perpendicular thickness was not revealed by technical works. The epiclastic rocks are polymict and contain rhyolite fragments of various facial types, rhyodacites and andesites, not cropping out on recent surface. Above the interbed of these prevailingy rhyolite volcanoclastics there occurs the basaltoid pyroxenic andesite with underlying and overlying hyaloclastite breccia, indicating the elongated subaqual environment in this area. The interbeds with obsidian (marekanite) crop out mainly in eastern and southern part of the quarry with general dip to southeast, being located prevailingly in its lower part. There are documented 6 distinctly uncovered interbeds. The interbeds are irregular in vertical as well as lateral direction (**Fig. 19c**). Maximum registered thickness was up to 70 cm (**Fig. 20a**), but in a short distance the thickness changes only to 30 cm, eventually in some direction it wedges out completely.

Size of obsidian nodules varies within the range of 0.5–5 cm with the average size around 2.5 cm (**Fig. 21a, b; 22**), rarely up to 8 cm. Obsidian cores in this locality show many attributes characteristic for obsidians of the Viničky locality, as there are occurrences in the form of cores located in perlite, similar colour, luster and conchoidal fracture. The Viničky locality was generally accepted as their probable source (Baňacký et al. 1989; Bačo and Bačová 2014). However, results of K/Ar dating (Bačo et al., 2017) point to a different age and yet unknown primary source.

Planes of obsidian fragments are mainly concave, smooth and glassy (**Fig. 21b, 22**).

At freshly broken surface they are black or pitch black with a pronounced conchoidal fracture.

The obsidian is usually completely surrounded by hydrated glass – perlite and only rarely is some part of obsidian surface in direct contact with the host rock. Also in such rare cases its outer face is shiny pitchy black (**Fig. 22**). Using a microscope one can observe in obsidian from this place rare microphenocrysts of biotite and plagioclase. Frequently observed banded texture or alternation of dark and pale streaks is caused by flow oriented minute crystals – microlites, mostly of pyroxene composition and trichites mostly of magnetite (rutile?) composition (**Fig. 23a, b**). From accessory minerals there is present mainly zircon. The obsidian nodules from this locality dominantly show irisation of tumble finished pieces, an attribute that has not been observed neither in obsidians at the Viničky locality, nor in obsidians at archeological sites of Eastern Slovakia.

Could be this locality one of the sources for obsidian industry at archeological sites? The horizon of obsidian-bearing rocks is up to 30 m thick and laterally extends for 500 m in the steep northern slope of the Šibeničný vrch hill. Before opening of the horizon by the quarry it was exposed in natural outcrops or covered by a thin veneer of deluvial deposits only. Theoretically, weathered out obsidian cores could be collected and utilized by Palaeolithic/Neolithic cultures, including finds directly on the Šibeničný vrch (Janšák, 1935; Chovanec, 2004). On the other side, obsidian cores are generally too small. We lack a proper evidence and ages of dated obsidians from archeological sites, whether they are not identical with the age of volcanic glasses at this locality.

Stop 3 - Area of obsidians cropping out in Quaternary sediments east of the Cejkov village; area "Malé lúky-Žihľavník"

The area "Malé lúky-Žihľavník" of obsidian occurrence represents a part of the foothill (horst) morphostructure of the Zemplínske vrchy hills (**Fig. 24**). Relatively flat lowland terrain of the altitude around 105 m a.s.l. is bearing local elevations high up to 125 m a.s.l, forming slightly elevated mounds trending north-south.

The area with obsidian southwest of Brehov village (recently belonging to cadaster of Cejkov village) was geographically for the first time unambiguously earmarked by Janšák (1935) and designated as "one of the richest deposits in eastern Slovakia " (l.c. p. 56; **Fig. 25**). On the site he observed the great amount of raw unprocessed obsidian material from grains of small size (0.5x1.0 cm) up to 5 cm and rare pieces of the weight above 1 kg (14.5x11.0 cm) and with a relatively wide scale surface types on obsidian fragments. Even recently, it is possible to find in this locality after plowing the obsidians occurrence, as Janšák described in the 1930s. The occurrence was considered as secondary, because the obsidian pieces "were displaced by the water flowing down from the western slopes of the Zemplínsky ostrov (Zemplín Island) area" (l.c., p. 57). In his monography Janšák (l.c) did not relate this occurrence as a possible source of obsidian for other archaeological sites in the wider area.

Přichystal and Škrdla (2014) described this locality, resp. the wider area deliminated by villages Brehov, Cejkov and Zemplín, as possible source of obsidians for other archaeological occurrences in closer and wider surrounding.

Obsidian in locality "Malé lúky-Žihľavník" occurs in the area app. 400 x 300 m and plowing very likely tears it to a larger area (**Fig. 24, 25**). The area of this occurrence from the eastern and southern sides is lined with loamy (silty clay) fluvial sediments of the Holocene, with the relics of the dead arms of the surrounding streams filled with flood clays (Baňacký et al., 1989). In the central part of the area with the largest occurrence of obsidian, the Pleistocene eolic sediments crop out. They are made of Würm loess and loess loams in the form of coarse dust (granulomaximum fraction). The loess clay is brown to light brown in colour with sporadically present limonite plugs (Fe-Mn oxides). The thickness of these sediments around Cejkov village is around 10 m. Together with these sediments, the Würm fine-grained sands of (eolic sediments) also appear, alternating with loamy sands and thin beds of sandy loams, locally strongly silty. These sediments are weakly calcareous.

Obsidians occur in topsoil (**Figs. 24** and **26**), covering above described sediments. Its thickness varies between 0.3-0.5 m. The dimension of obsidian fragments (nodules) varies from centimetre dimensions and in average it is 4–6 cm. Rare fragments reach dimensions up to 10 cm, or they are even larger - having the weight above 1 kg. In the soil there commonly occur fragments free of secondary coatings when removing the clay (**Fig. 26b, 27a**). Supergene coatings by Fe a Mn oxides and hydroxides, as well as carbonates coatings (mainly calcite; **Fig. 27b**) occur in fragments, reaching the surface during the deep plowing. These fragments are derived from the underlying Pleistocene host rocks. They were probably a part of the local flood coarse-grained sediments - gravels. However, the more coherent beds of such sediments in small depths were not yet discovered in immediate vicinity of this site, neither identified by technical works. The shape of the fragments is mostly isometric, but irregularly spherical (**Fig. 27a**) or ellipsoidal (**Fig. 26b**) with different ratios of the individual axes. More rarely, it is significantly elongated in one direction or is completely irregular (e.g., **Fig. 28c**).

The surface of obsidian fragments, contrary to those of autochthonous occurrences, is mostly sculptured. However, the sculpturation rate differs. It is possible to observe obsidians with a smooth slightly pitted surface (the first two fragments in Fig. 26b). Such surface usually have small fragments. For larger, sculpturation is fully and regularly developed over the entire surface (Fig. 27a). Most often, these represent small holes of various shapes with a depth of 1 to 2 mm. Exceptionally, they are deep even 0.5 cm and in this case they have a semi-circular shape. A special type is represented by parallel sculpturation (Fig. 28b, c). The altered surface of obsidian fragments of allochthonous and mainly archeological occurrences is a consequence of supergene processes, in which glass is decomposed and microscopic particles are released possibly due to mechanical decomposition. According to until findings, the sculpturation is a reflection of the obsidian internal structure, especially the presence of microlites and their distribution in obsidian. The orientation of pyroxene microlites most often reflects fluidity - the original flow of still plastic glass (melt, high viscosity rock). Occasionally, fluidity is also demonstrated by trichites. In thin spikes, the fluidity of microlites and trichites is noticeable by banding (**Fig. 29b, d**).

The secondary association of fragments of other rock types on this site is relatively variegated. Dominating there are Neogene rocks of volcanic origin, various petrographic types of andesites, in smaller extent there occur silicified acidic rocks of extrusive and pyroclastic origin. From various areas of the "Zemplín Island" the fine-grained rhyodacites are rarely present, occurring in the Cejkov area, and superficially there were rarely found also araucarites of the "Tŕňa" type. Rocks of anthropogenic origin are also present on the surface. They represent mainly the different types of silicites, including flint, occurring mainly in the form of split industry.

The exact source area of obsidians on this site is unknown. Transport - redeposition of obsidians from the area of Viničky is impossible regarding the recent morphological situation. The paleorelief in the Pleistocene and Early Holocene was rather similar to recent one. In the older sedimentary and volcano-sedimentary formations obsidian was not found in the wider surroundings of the Cejkov locality. The source area had to be either in the north-eastern area of the Zemplínske vrchy hills. However, we do not currently know such occurrences. It is assumed that the source could be a body of perlitized glass, which was detected by a borehole under the extrusive body of andesite with the elevation point Veľký vrch hill (272 m a.s.l.) near Brehov (Bačo et al., 2003; Bačo and Bačová, 2014, Přichystal and Škrdla, 2014). Macroscopically the glass is similar to perlitized glass with obsidian (marekanite) from the area of Viničky. Regarding the stratigraphic superposition, the glassy facies of the unrecognized body is older (most probable Upper Badenian) than the facies with obsidian at Viničky area. Similar allochthonous distribution of obsidians, as in this locality, occurs west of the Veľký vrch hill, though being covered by a bed of blown wind sand with thickness above 2 m.

Translated: Zoltán Németh Ing., PhD.

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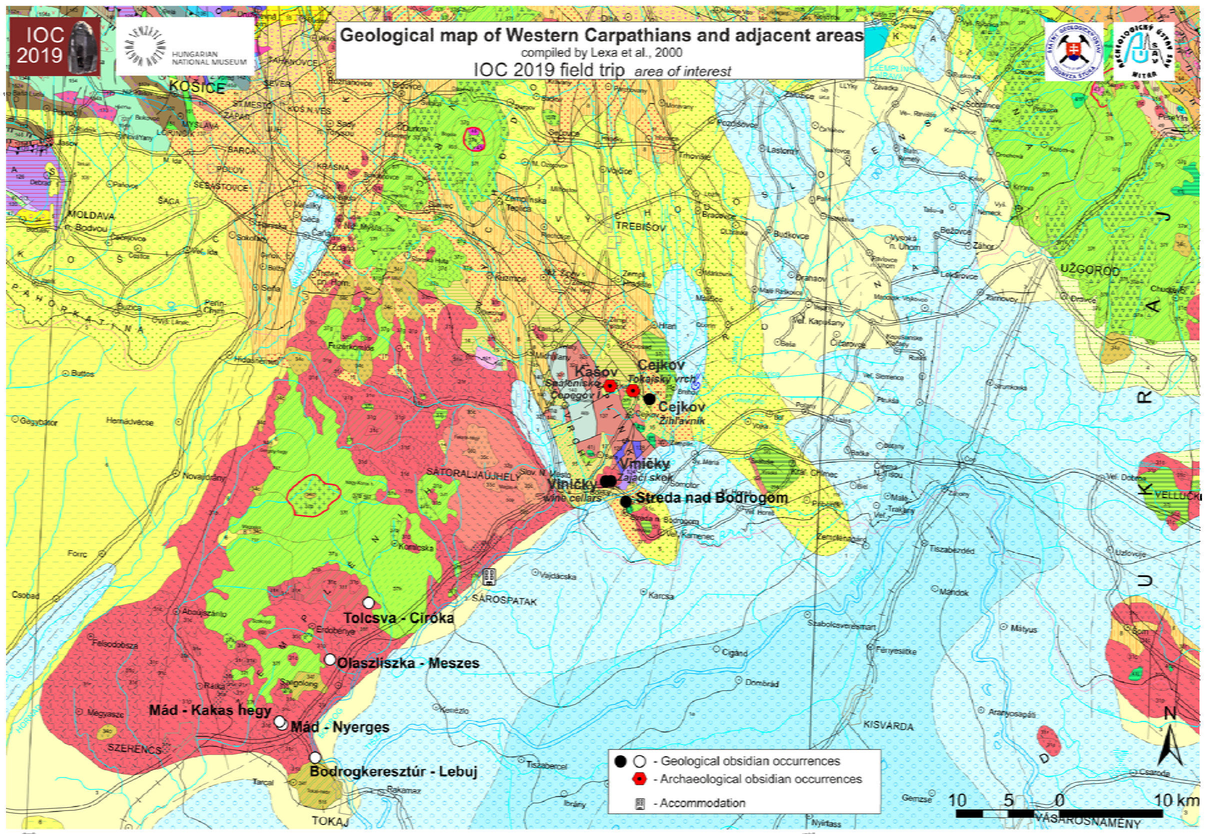


Map I. (legend 1, 2)

Neogene - Quaternary Basins

- mostly fluvial gravel and sand, subordinate lacustrine deposits (basin accumulations, a- thickness over 200m)
- gray and variegated clays, silts, sands, gravels, thin lignite seams, freshwater limestones and tuffite horizons; *Dacian-Romanian*
- clays with lignite, sands, gravels; *Late Miocene - Pliocene*
- variegated kaolinite clays, silts, sands, gravels, rare lignite seams; *Pontian*
- grey mostly calcareous clays silts, sands, gravels, lignite seams, freshwater limestone horizons; *Panonian - Pontian*
- grey and variegated clays, silts, sands, gravels/conglomerates, lignite seams, freshwater limestones, rhyolite, rhyodacite and andesite tuffs, diatomites, turbidites; *Panonian*
- grey calc. clays, variegated clays, sands/sandstones, siltstones, acid tuffs, bentonite, rare gypsum and lignite seams, freshwater silica deposits; *Sarmatian*
- gray calcareous clays/claystones, siltstones, sand/sandstones, conglomerates, acid tuffs, bentonite, limestones, diatomites and evaporites; *Sarmatian*
- grey claystones/siltstones, sandstones, conglomerates, coal seams, acid tuffs, andesite epiclastic rocks; *Late Badenian - Sarmatian*
- grey and variegated calcareous claystone siltstone, sandstone, conglomerates, thin coal seams, acid tuffs; *Late Badenian*
- grey calc. siltstones, claystones, sandstones/sands, conglomerates, intercalations of evaporites, local algal limestones and diatomic marls; *Middle Badenian*
- grey calcareous silts/siltstones, clay/claystones, sand/sandstones, subordinate gravels/conglomerates, Algal and Ostrea limestones, coal seams, tuffs/tuffites, locally anhydrites; *Early Badenian*
- grey and variegated, often calcareous claystones, siltstones, sandstones, conglomerates, gravels, breccias, evaporites, subordinate diatomites and thin coal seams; in the foredeep also lumachella limestones; *Karpatian*
- conglomerates, gravels, sands, sandstones, soltstones, clays, claystones, subordinate thin coal seams and limestones - continental facies; *Early Miocene*

Neogene - Quaternary Volcanic Formations

Rhyolites and Rhyodacites; *Sarmatian - Panonian*

- small intrusions and irregular penetration
- extrusive domes and dome flow
- lava flows, effusive complex out of volcanic cone
- effusive cones
- stratovolcanic cones
- ignimbrites, pumice tuffs, tuffs (proximal facies)
- fine, primary and redeposited tuffs (distal facies)
- epiclastic volcanic sandstones and siltstones
- limnoquartzites

Karpatian - Badenian

- extrusive domes and dome flows
- ignimbrites, pumice, tuffs, tuffs (proximal facies)
- fine, primary and redeposited tuffs (distal facies)

amf-px, px-amf and bi-amf andesites to dacites; *Sarmatian - Early Panonian*

- amf-px, px-amf and bi-amf andesites to dacites
- small intrusions and irregular penetration
- extrusive domes and dome flows
- effusive cones
- coarse to block breccias of extrusive complexes

Middle to Late Badenian

- extrusive domes and dome flows

basaltic, px and amf - px andesites; *Sarmatian - Early Panonian*

- necks, dykes
- scoria cones
- small intrusions and irregular penetration
- propilitized complex of andesite porphyries and andesites
- extrusive domes and dome flows
- lava flows, effusive complex out of volcanic cone
- effusive cones
- stratovolcanic cones
- pyroclastic cones
- effusive complexes in volcanotectonics depressions
- hyaloclastite breccias
- fine, primary and redeposited tuffs (distal facies)
- coarse to fine epiclastic volcanic breccias
- epiclastic volcanic conglomerates and sandstones

high alumina basalts to basaltic andesites; *Late Sarmatian? - Panonian*

- small intrusions and irregular penetration
- extrusive domes and dome flow
- effusive cones
- effusive complexes in volcanotectonics depressions

subvolcanic intrusions; *Middle Miocene*

granodiorites and granodiorite porphyry

granodiorites and granodiorite porphyry - small intrusions and irregular penetration

diorites and diorite porphyry

PALEOGENE OF THE INNER CARPATHIANS AND BUDA PALEOGENE

claystone, sandstone, conglomerates, coal, alginite, marly limestone, freshwater limestone; *Priabonian - Oligocene*

sandstones, calcareouse claystones, locally conglomerates: flysch, mostly claystones towards the base; *Lutetian - Oligocene*

conglomerates, sandstones, limestones, breccias, rare claystones; *Lutetian - Priabonian*

MESOZOIC AND TERTIARY OF THE OUTERALPS AND CARPATHIANS

calcareous claystones, siltstones, sandy claystones, sandstones, rare marls and slumps: flysch; *Priabonian - Oligocene*

coarse grained quartz-carbonate sandstones, fine conglomerates, subordinate claystones; *Paleogene - Eocene*

variegated and calcareous claystones, marls, sandy claystones, greywacke/arkosic and quartz-carbonate sandstones and conglomerates, subordinate pelosiderites, locally limestones; *Paleocene - Eocene*

quartz and greywacke sandstones, subordinate claystones, fine conglomerates at places: mostly thick-bedded sandy flysch; *Paleocene - Eocene*

quartz greywacke and rare arkosic sandstone, greenish/blueish/brownish grey claystones (rare calcareous), red claystones at the base: thin bedded flysch, a- grey flysch ; *Paleocene - Middle? Eocene*

MESOZOIC AND PALEOGENE OF THE KLIPPEN BELT

quartz - carbonatesandstones, polzmict conglomerates and claystones, locally red claystones: mostly thin-beddedflysch; *Maastrichtian - Early Eocene*

variegated marlstones and silty marls, rare sandstones beds; *late Albian-early Maastrichtian*

claystones, marlstones and marls, sandstones, conglomerates: flysch; *Aptian - early Senonian*

spotted, nodular and cherty limestones, radiolarites, calcarenites, rare claystones; *Hettangian - Kimmeridgian - Tithonian*

organodetritic, spotted, crinoidal and nodular limestones, subordinate dark claystones and spotted marlstones; *Sinemurian - Berriasian*

INNER CARPATHIANS AND BUDA PALEOGENE

TERTIARY

sandstones, conglomerates, marlstones: flysch with reef limestone blocks, in the Alps with Lithotamnia limestone breccias; *Maestrich ? - Paleocene - Eocene*

MESOZOIC

marls, carbonate sandstones (also flysch), limestones, conglomerates; *Senonian*

limestones, sandstones, sandy and spotted limestones, nodular and radiolarian limestones; *Rhaetian - Kimmerdgian*

variegated shales, sandstones, evaporites and dolomites (Carpathian Keuper Fm., also the Klippen Belt); *Norian*

pale, mainly organodetritic limestones and dolomites; *Carnian - Rhaetian*

metamorphosed cherty limestones of the Turna sequence and Bükk; *Late Triassic*

dolomites, recrystalized limestones with glaukophanites, phyllites and metasiltstones; *Middle to Late Triassic, Jurassic*

dark to light limestones (Gutenstein and Wetterstein Lmst.) and dolomites (Ramsau, Wetterstein and Budaörs Dol.); *Anisian - Carnian*

limestones and dolomites; *Anisian - Carnian*

quartzites, sandstones and shales; *Scythian*

sandstones, shales, calcareous shales, limestones, dolomites, locally rauwackes, gypsum, anhydrites; *Late Permian - Scythian*

LATE PALEOZOIC

conglomerates, sandstones, shales, rhyolite/dacite volcanics; *Permian*

conglomerates, sandstones, variegated shales, volcanics, b- rhyolite volcanics ; *Permian*

conglomerates, sandstones, rare rhyolite volcanics, strongly deformed; *Early Permian*

conglomerates, sandstones, shales, acid volcanics, rare coal; *Late Carboniferous*

conglomerates, sandstones, siltstones, shales, basic volcanics, rare organodetritic carbonate rocks; *Late Carboniferous (Westphalian)*

metamorfosed sandstones and conglomerates, phyllites, mafic volcanics, in the upper part dolomites and magnesites; a- metabasalts, metagabbrodiorites; *Early to Late Carboniferous (Visean - Early Namurian)*

EARLY PALEOZOIC OF THE GEMERICUM AND BÜKKICUM

metasandstones, phyllites, rera metabasalts; *Late? Devonian-Early? Carboniferous*

metamorphosed spilite-keratophyre volcanics, phyllites, rare carbonates; *Middle to Late Devonian?*

metasandstones, phyllites; *Middle to Late Devonian?*

amphibolites, gneisses, metaultramafic rocks, gabro-diorites, marbles; *Early Paleozoic?, metamorphosed in Devonian?*

metasandstones, phyllites, carbonates, cherts, rare conglomerates, basic volcanics; a- acid volcanics; *Silurian-Early Devonian?*

metasandstones, phyllites, carbonates, cherts, conglomerates, basic metavolcanics; a- acid volcanics; *Ordovician-Silurian*

CRISTALLINE BASEMENT OF THE TATRICUM, VEPORICUM AND ZEMPLINICUM

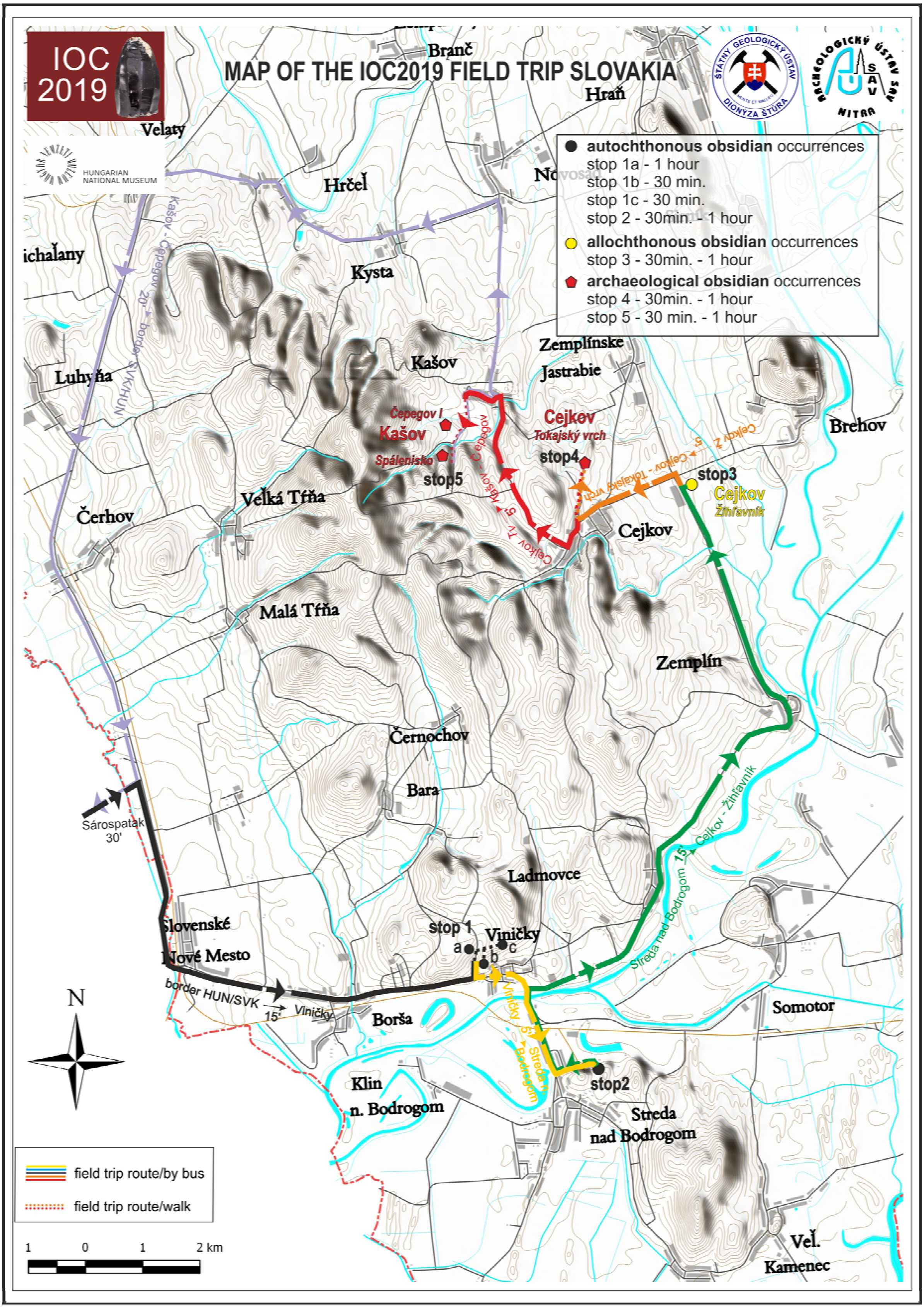
metamorphic rocks

banded gneisses and augengneisses (mostly orthognessis), migmatites

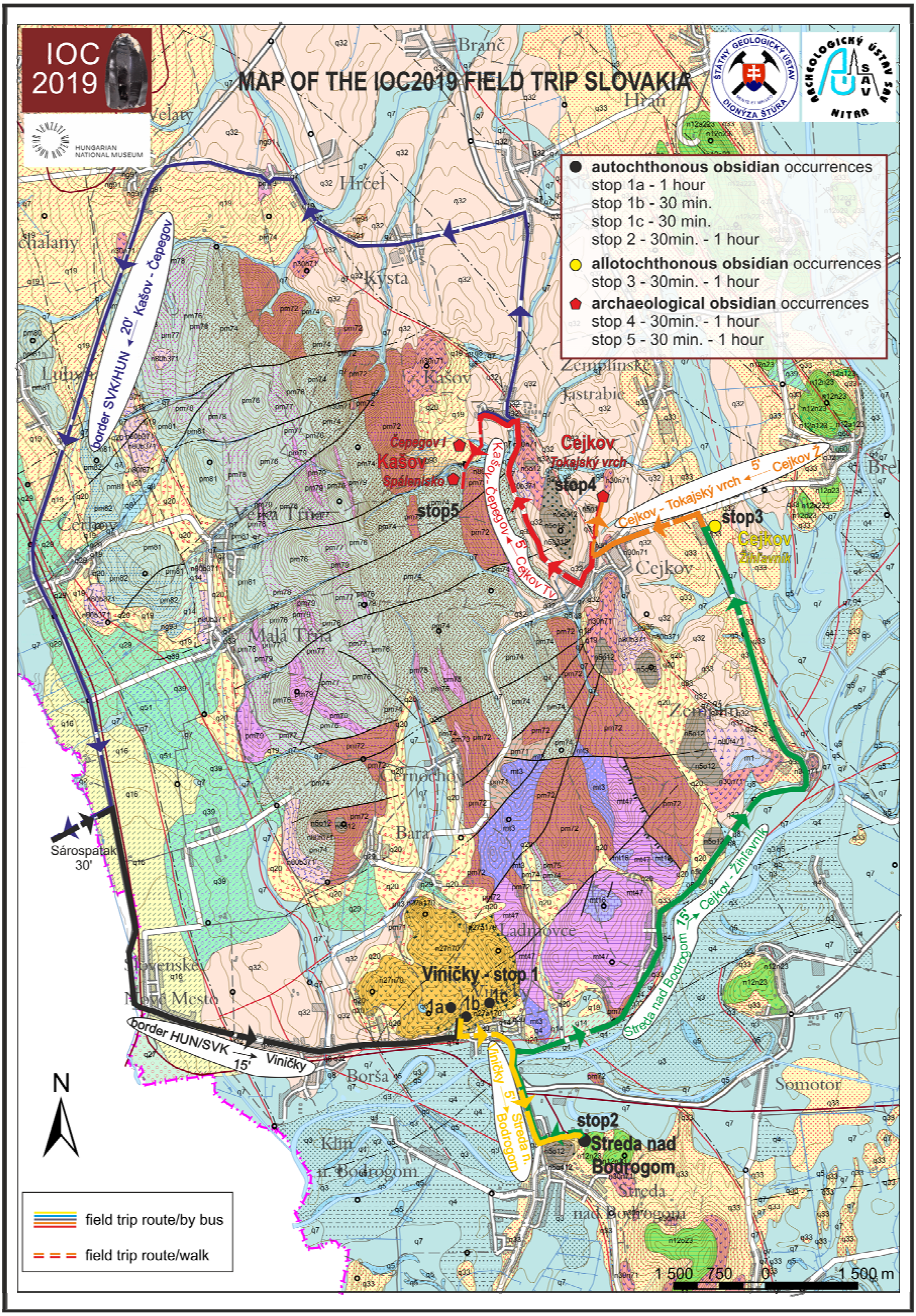
magmatic rocks

biotite tonalites to granodiorites, locally porphyric; *Hercynian*

biotite to two-mica granites; *late Hercynian*


IOC 2019
MAP OF THE IOC2019 FIELD TRIP SLOVAKIA
HUNGARIAN NATIONAL MUSEUM
ŠTÁTNY GEOLOGICKÝ ÚSTAV DIONÝZA ŠTÚRA
ARCHEOLOGICKÝ ÚSTAV SAV NITRA
autochthonous obsidian occurrences
stop 1a - 1 hour
stop 1b - 30 min.
stop 1c - 30 min.
stop 2 - 30min. - 1 hour
allochthonous obsidian occurrences
stop 3 - 30min. - 1 hour
archaeological obsidian occurrences
stop 4 - 30min. - 1 hour
stop 5 - 30 min. - 1 hour
Branč
Hraň
Velaty
Hrčeľ
Kysta
Kašov
Zemplínske Jastrabie
Brehov
Čepegov I
Kašov
Spálenisko
stop5
Cejkov
Tokajský vrch
stop4
stop3
Cejkov
Žihľavník
Cejkov
Veľká Tŕňa
Čerhov
Luhyňa
Malá Tŕňa
Zemplín
Černochov
Bara
Ladmovce
Sárospatak 30'
Slovenské Nové Mesto
stop 1
a
b
c
Viničky
border HUN/SVK
15' Viničky
Borša
Somotor
Klin n. Bodrogom
stop2
Streda nad Bodrogom
Veľ. Kamenec
Kašov - Čepegov 20' border SVK/HUN
Cejkov - Tokajský vrch
Cejkov - Žihľavník
Streda nad Bodrogom
N
field trip route/by bus
field trip route/walk
1 0 1 2 km

Map II.



Map III + Legend

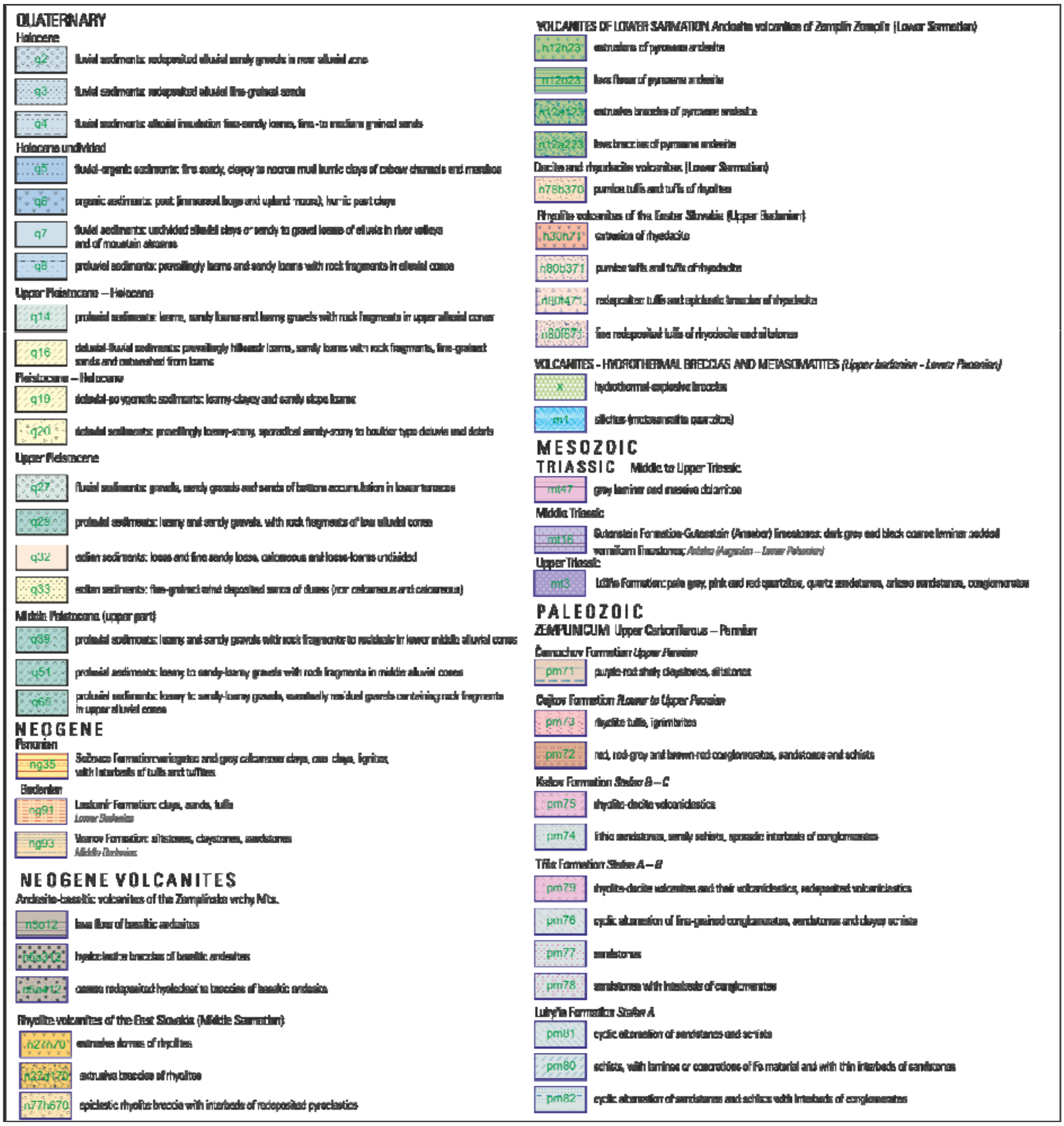

QUATERNARY
Holocene
q2
fluvial sediments: redeposited alluvial sandy gravels in river alluvial zone
q3
fluvial sediments: redeposited alluvial fine-grained sands
q4
fluvial sediments: alluvial inundation fine-sandy loams, fine- to medium grained sands
Holocene undivided
q5
q6
q7
q8
Upper Pleistocene – Holocene
q14
q16
Pleistocene – Holocene
q19
q20
Upper Pleistocene
q27
q29
q32
q33
Middle Pleistocene (upper part)
q39
q51
q60
NEOGENE
Pannonian
ng35
Badenian
ng91
Lower Badenian
ng93
Middle Badenian
NEOGENE VOLCANITES
Andesite-basaltic volcanites of the Zemplínske vrchy Mts.
n5o12
lava flow of basaltic andesites
n5a312
hyaloclastite breccias of basaltic andesites
n5a412
Rhyolite volcanites of the East Slovakia (Middle Sarmatian)
n27n70
extrusive domes of rhyolites
n27a170
extrusive breccias of rhyolites
n77h670
epiclastic rhyolite breccia with interbeds of redeposited pyroclastics
VOLCANITES OF LOWER SARMATION Andesite volcanites of Zemplín
h12n23
extrusions of pyroxene andesite
n12o23
lava flows of pyroxene andesite
n12a123
extrusive breccias of pyroxene andesite
n12a223
lava breccias of pyroxene andesite
Dacite and rhyodacite volcanites (Lower Sarmatian)
h78b370
pumice tuffs and tuffs of rhyolites
h30n71
extrusion of rhyodacite
h80b371
pumice tuffs and tuffs of rhyodacite
n80t471
n80f671
VOLCANITES - HYDROTHERMAL BRECCIAS AND METASOMATITES
x
hydrothermal-explosive breccias
mt1
MESOZOIC
TRIASSIC Middle to Upper Triassic
mt47
grey laminar and massive dolomites
Middle Triassic
mt16
Upper Triassic
mt3
PALEOZOIC
ZEMPLINICUM Upper Carboniferous – Permian
pm71
purple-red shaly claystones, siltstones
pm73
rhyolite tuffs, ignimbrites
pm72
red, red-grey and brown-red conglomerates, sandstones and schists
pm75
rhyolite-dacite volcaniclastics
pm74
lithic sandstones, sandy schists, sporadic interbeds of conglomerates
pm79
rhyolite-dacite volcanites and their volcaniclastics, redeposited volcaniclastics
pm76
cyclic alternation of fine-grained conglomerates, sandstones and clayey schists
pm77
sandstones
pm78
sandstones with interbeds of conglomerates
pm81
cyclic alternation of sandstones and schists
pm80
schists, with laminae or concretions of Fe material and with thin interbeds of sandstones
pm82
cyclic alternation of sandstones and schists with interbeds of conglomerates

Figure captions

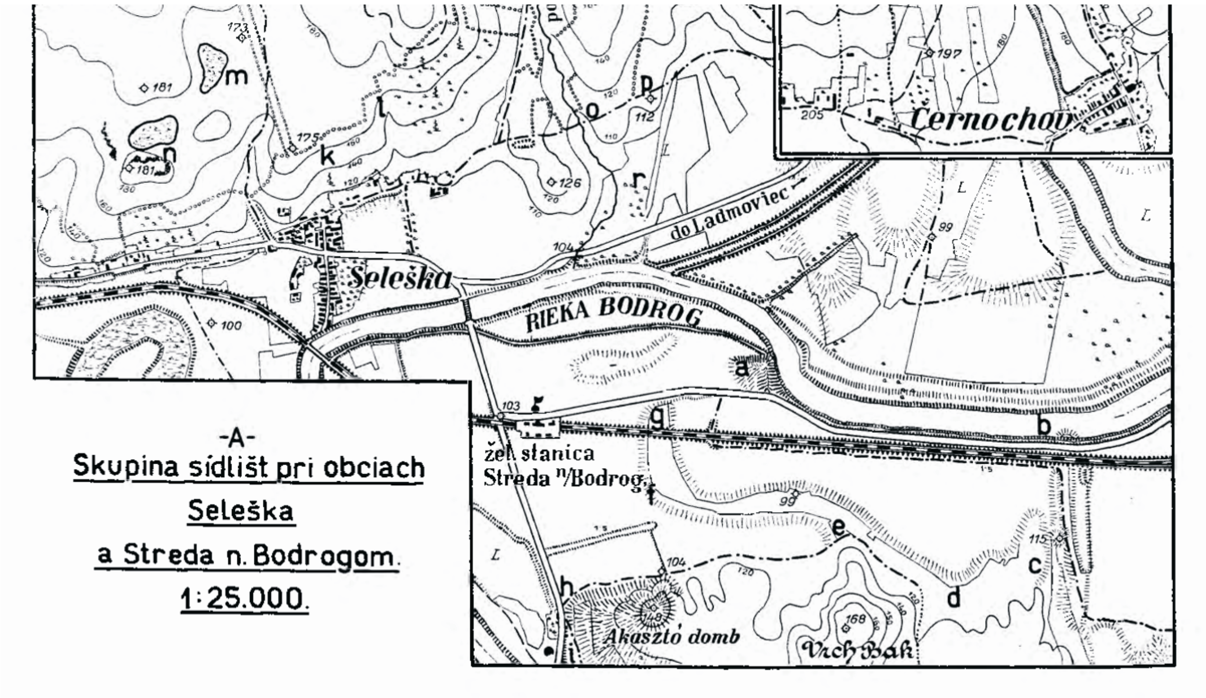


Fig. 1. Map of obsidian occurrences north of the Viničky (Seleška) village (k - l). According to Janšák (1935) - the map supplement No. 6. – here is presented a segment of the map.

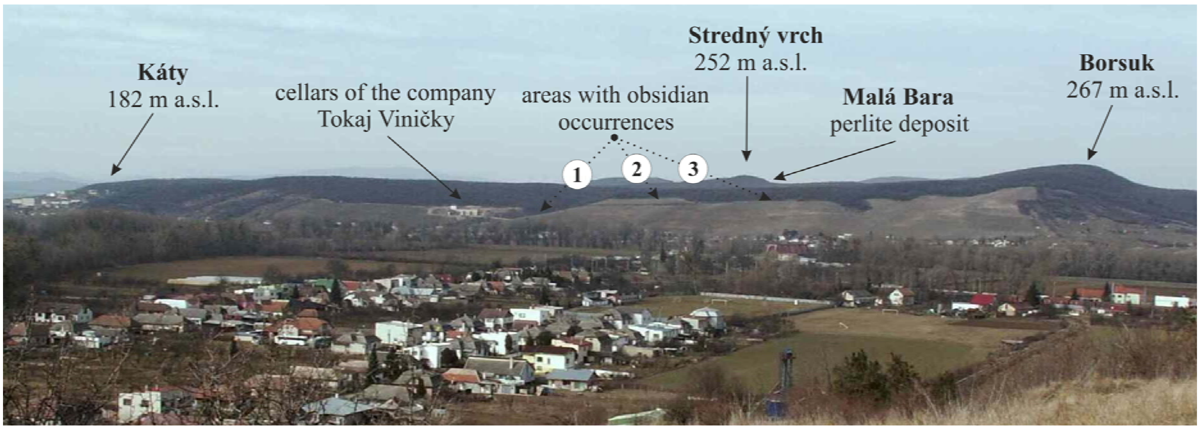


Fig. 2. Panorama of SW side of the Borsuk rhyolite dome/flow next to the Viničky village with obsidian and perlite occurrences, including the Tokaj Viničky Ltd. wine cellars. 1,2,3 – obsidian occurrences. View from the southeast. Photo: P. Bačo.

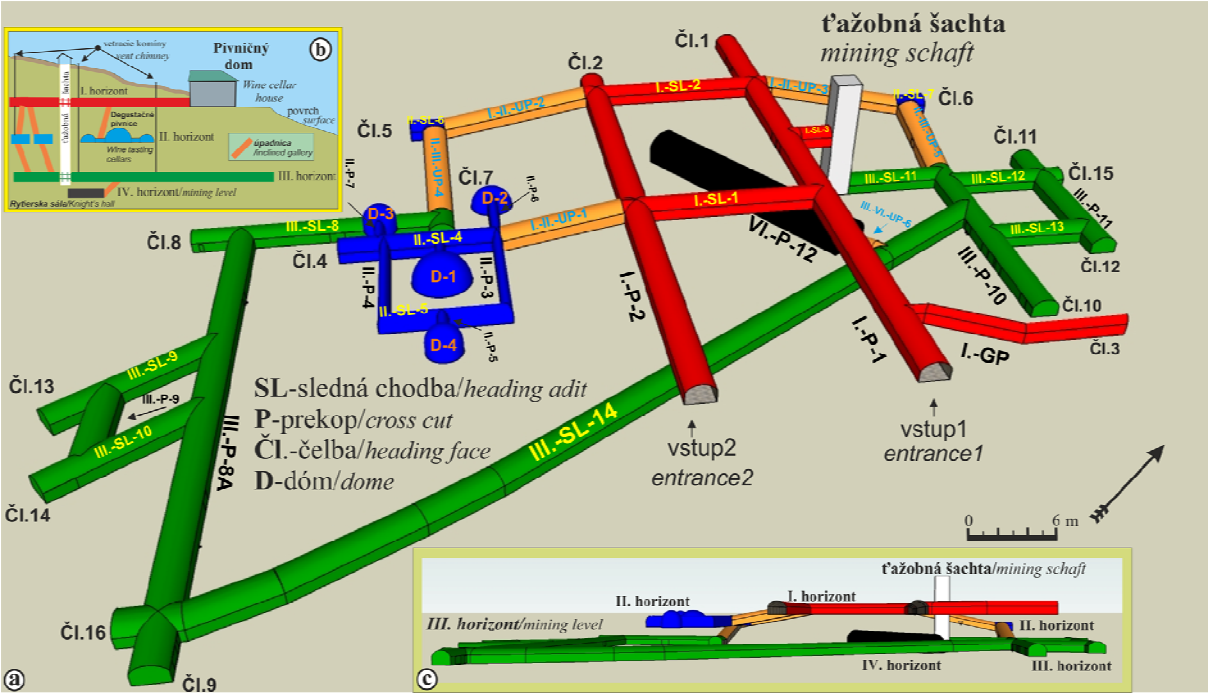


Fig. 3. 3D visualization of the cellars belonging to the firm Tokaj Viničky Ltd. in the Viničky village. Underground spaces were excavated in volcaniclastic products and partly in the extrusive body of the Borsuk elevation point (267 m a.s.l.). Different colours indicate underground spaces of different mining levels (3D processing by Z. Bačová)

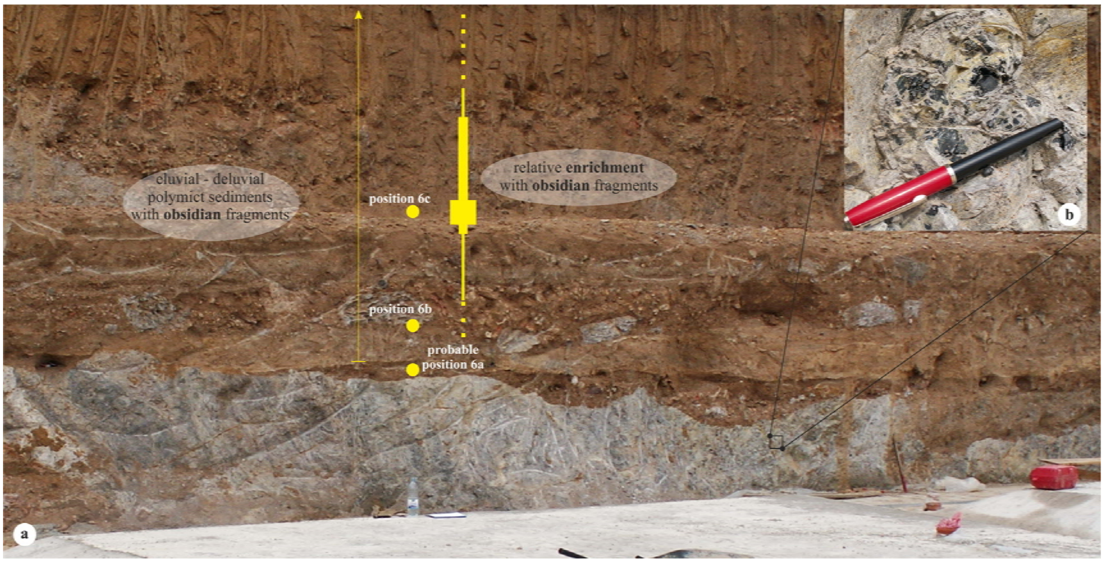


Fig. 4. The Viničky locality, groundwork section of the Tokaj Viničky Ltd. building: a – eroded top of the perlitized glassy rhyolite intrusion, b – detail of preserved obsidian nodules. Obsidian occurs in the central part of the perlitized intrusion having the width 5–7 m. Yellow column indicates relative abundance of obsidian nodules in eluvial/deluvial deposits. Yellow dots indicate finding positions of obsidian nodules in Fig. 6. Photo: P. Bačo.

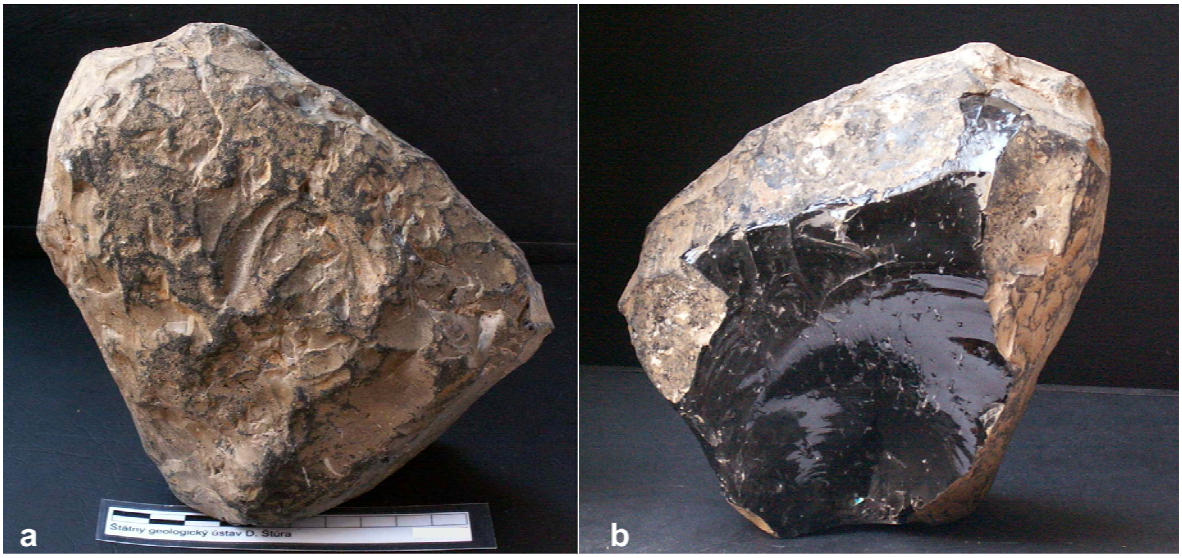


Fig. 5. The Viničky locality, a large obsidian nodule: a – initial stage of sculpturing with remnants of original contact planes with perlite shell; b – typical conchoidal fracture of obsidian. Mass: 1 735 g; dimensions: 14.5 x 11.5 x 9.5 cm. Photo: P. Bačo.

Fig. 6a, b, c. The Viničky locality, obsidian nodules from the site No. 2 in Fig. 2 showing a progressive evolution of their surface as a function of their position (compare Fig. 4): a – obsidian nodule from the weathered top of perlitized intrusion; b – obsidian nodule from eluvial deposits; c – obsidian nodule with initial surface sculpturing from eluvial/deluvial deposits. Photo: P. Bačo.

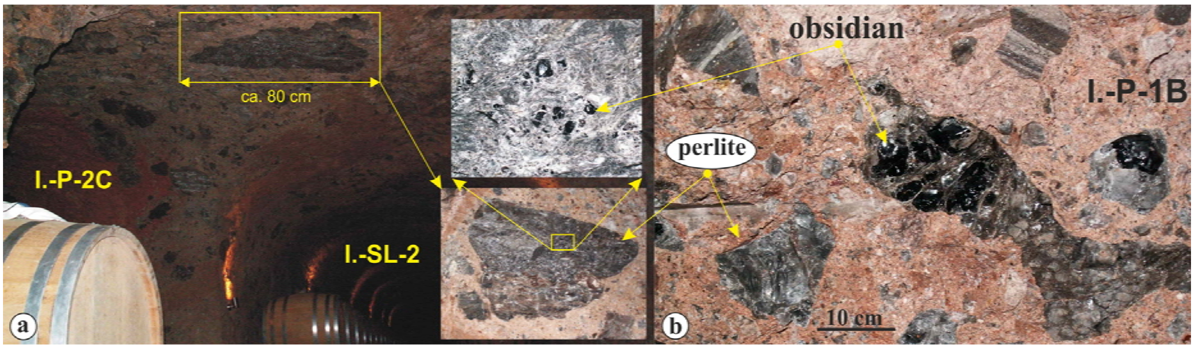


Fig. 7. The Viničky locality, Tokaj Viničky Ltd. wine cellars: a, b – autochthonous occurrence of obsidian nodules in perlitic breccias at the base of the Borsuk dome/flow. Photo: P. Bačo.

Fig. 8. The Viničky locality, Tokaj Viničky Ltd. wine cellars, gallery I-II/UP3: fragment of and a whole obsidian nodule from autochthonous perlitic breccias at the base of the Borsuk dome/flow. Mass/dimensions: a – 98 g / 6.5 x 6.1 x 3.1 cm; b – 187 g / 8.0 x 5.8 x 3.2 cm. Photo: P. Bačo.

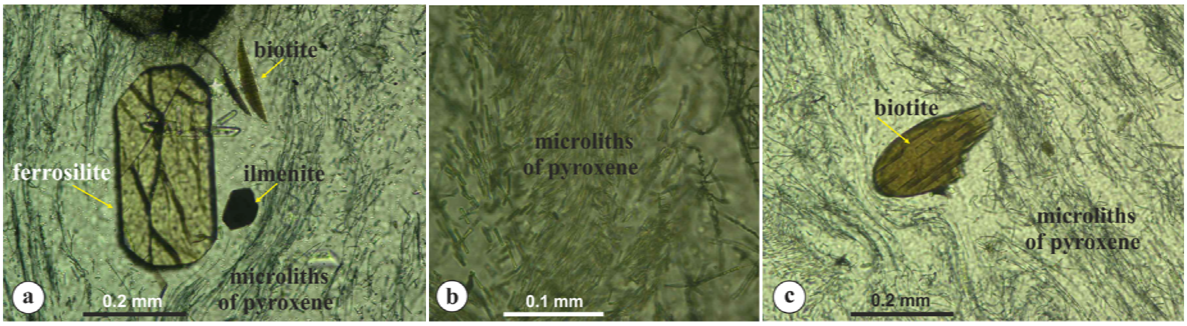


Fig. 9. The Viničky locality: microphotographs of obsidian thin-section (transmitted light, one nicol). Photo: P. Bačo.

Fig. 10. Panorama of the W side of the Zajačí skok area next to the Viničky village with obsidian and perlite occurrences in the eluvial and deluvial deposits. View from the north-northwest. Photo: P. Bačo.

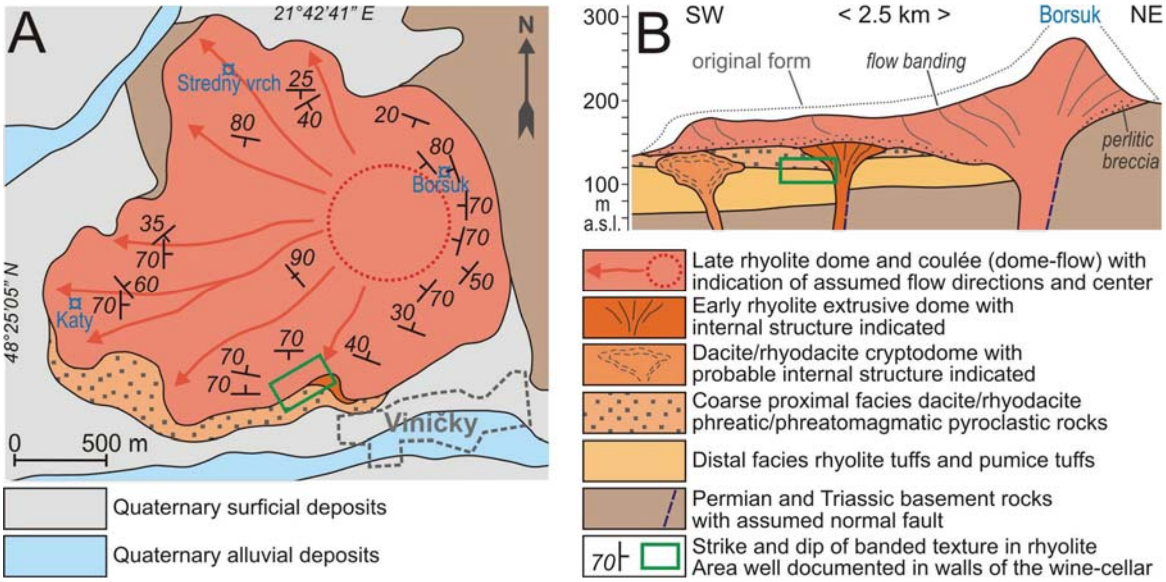


Fig. 11. Structural scheme of the Viničky rhyolite volcano (Lexa et al., 2014).

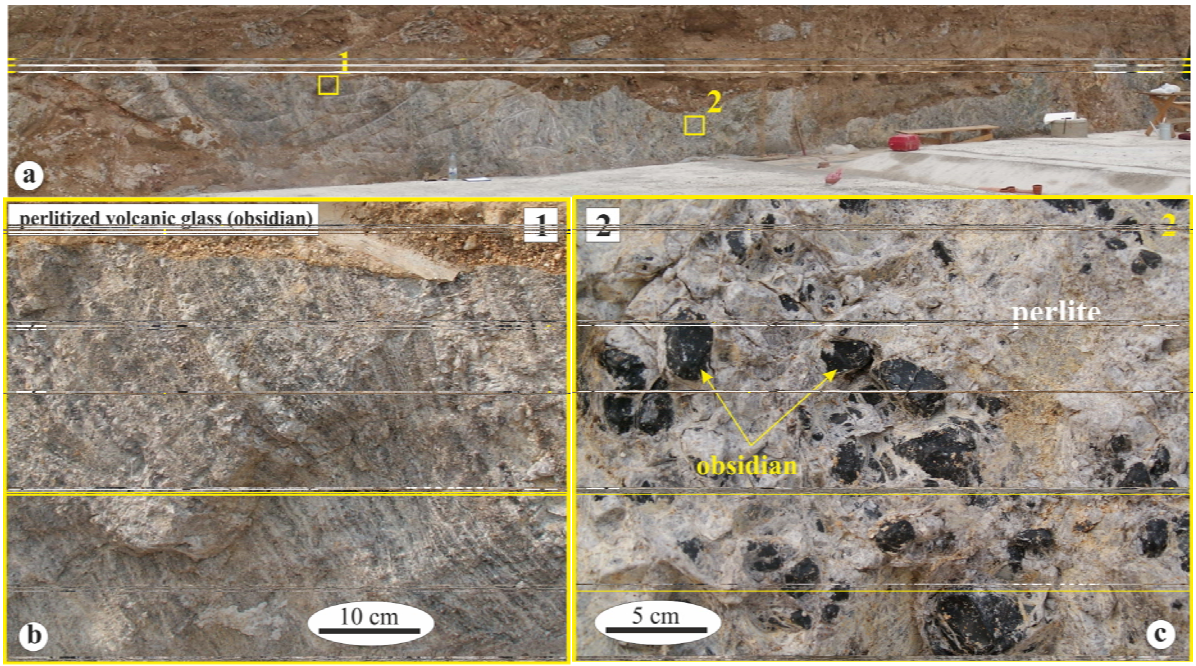


Fig. 12. a, b, c. Cut of artificial wall in glassy rhyolite body of dyke type (a) with typical fluidal development of its marginal part (b) and massive development in central part with preserved, non-perlitized obsidian (marekanite) (c). The Viničky locality, the wineries of the Promarco SA Company nowadays. Photo: P. Bačo.

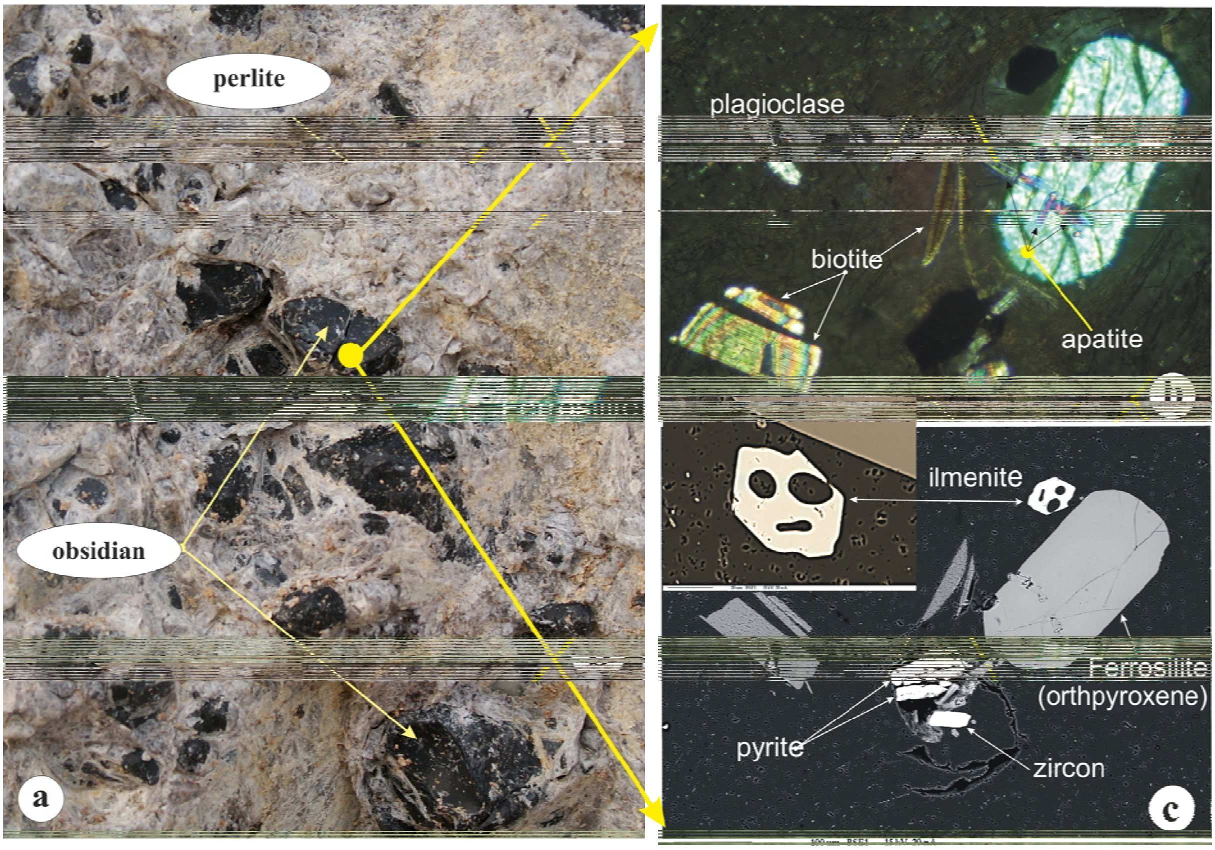


Fig. 13 a, b, c. Obsidian in perlite (hydrated phase of volcanic glass) from the wall visualized in Fig. 12c. Microscopically (b, c) there were identified biotite, plagioclase and pyroxene phenocrysts, accessory pyrite, zircon, ilmenite and apatite. Photos: P. Bačo (a, b - xx) and P. Konečný – BSE. Figure (c) is identical to figure (b).

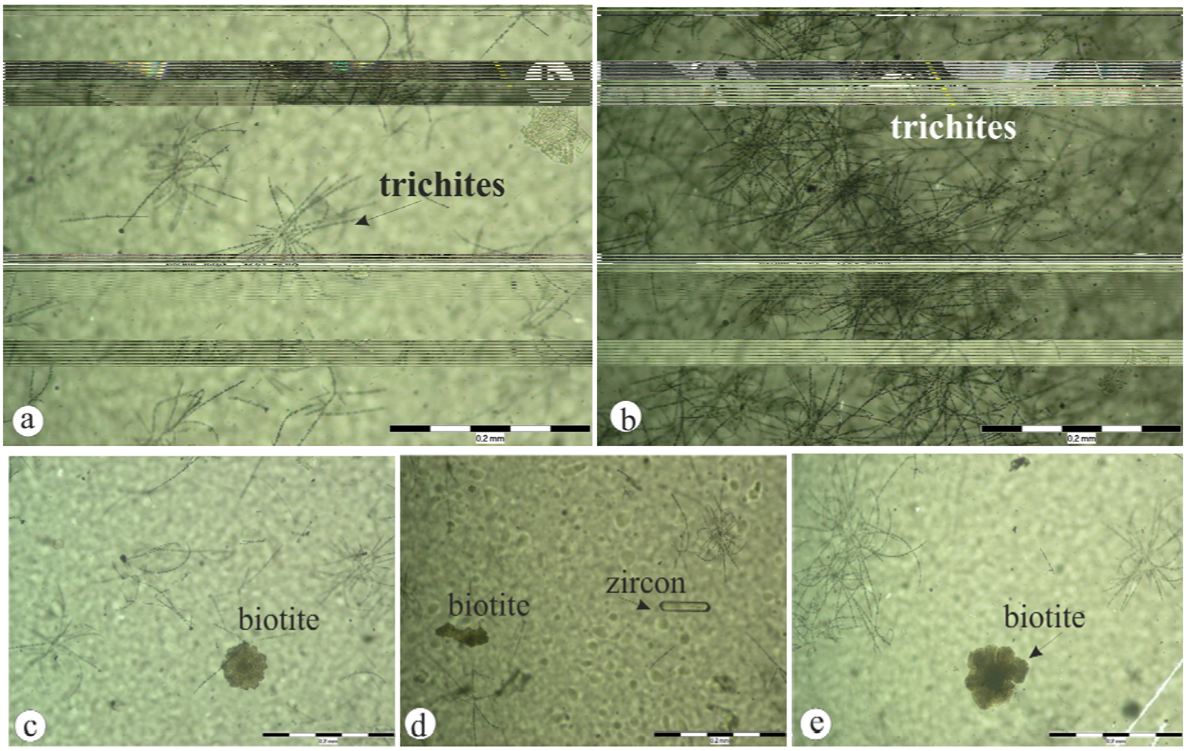


Fig. 14a, b, c, d, e. Locality Viničky. Types of the trichites forms in obsidian. Photo: P. Bačo.

Fig. 15. Locality Viničky - Zajačí skok. Obsidian nodules from the sites No. 1 and 2 in Fig. 2. Photo: P. Bačo.

Fig. 16. The Viničky locality: obsidian nodules from the site No. 1 in the Fig. 2. Photo: P. Bačo.

Fig. 17. Panorama of the NE side of the Šibeničný vrch hill next to the Streda nad Bodrogom village with obsidian and perlite occurrences in the redeposited pyroclastic rocks. View from the northwest. Photo: P. Bačo.

Fig. 18a, b, c. Locality of Streda nad Bodrogom – Šibeničný vrch hill. Historical - a (2003) and recent - b (2019) view on the wall with outcropped interbeds of redeposited obsidians and perlites (c). Photo: P. Bačo.

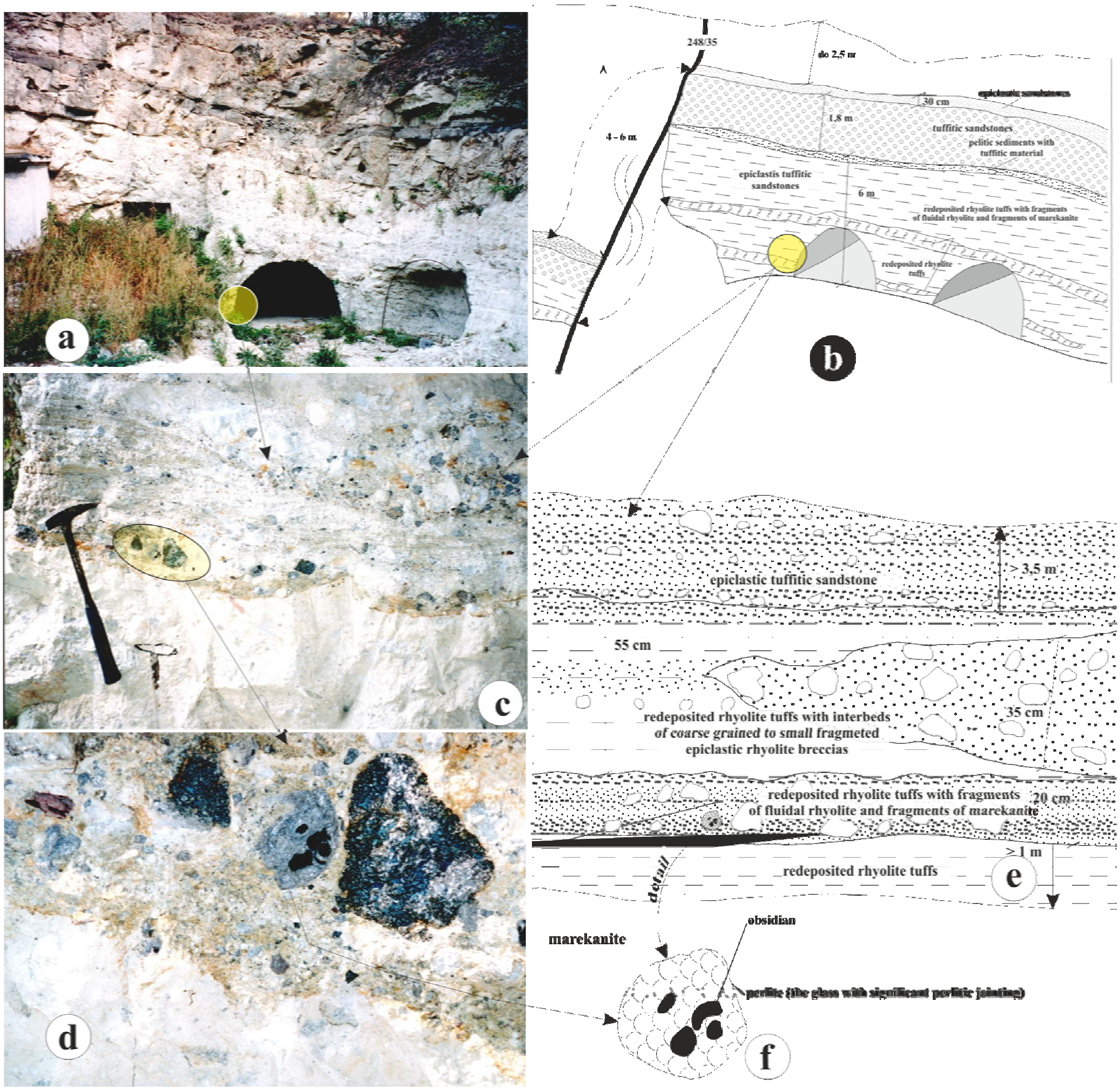


Fig. 19a, b, c, d, e, f. Documentation of originally exposed walls with redeposited rhyolite/rhyodacite tuffs bearing obsidian of marekanite type, epiclastic volcanic sandstones and gravels, as well as epiclastic volcanic breccias (Bačo et al., 2003, modified).

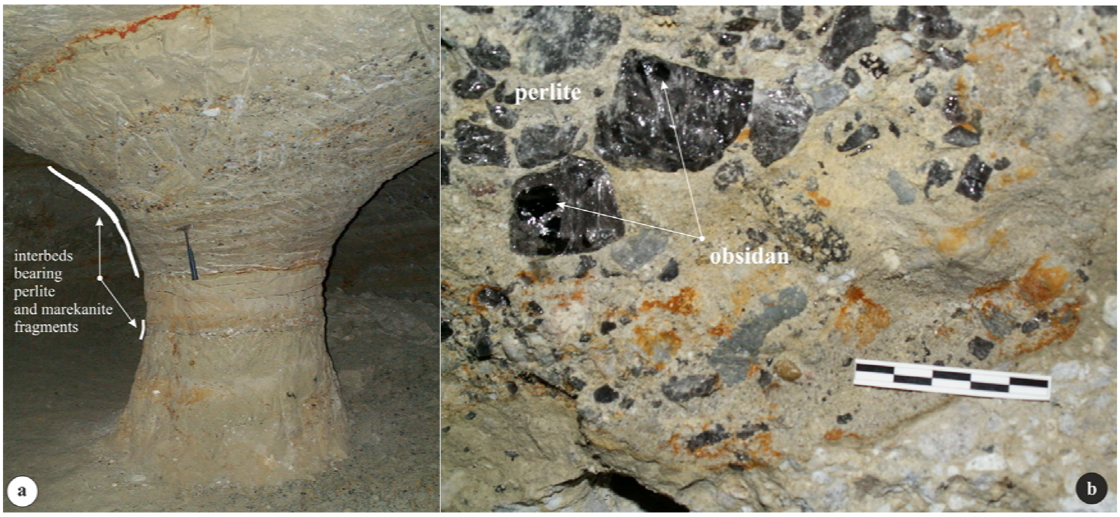


Fig. 20a, b. Locality of Streda nad Bodrogom, the wine cellar segment with pillar built of redeposited rhyolite/rhyodacite tuffs with interbeds of polymict lithoclastic breccia bearing perlite and marekanite fragments. Photo: P. Bačo

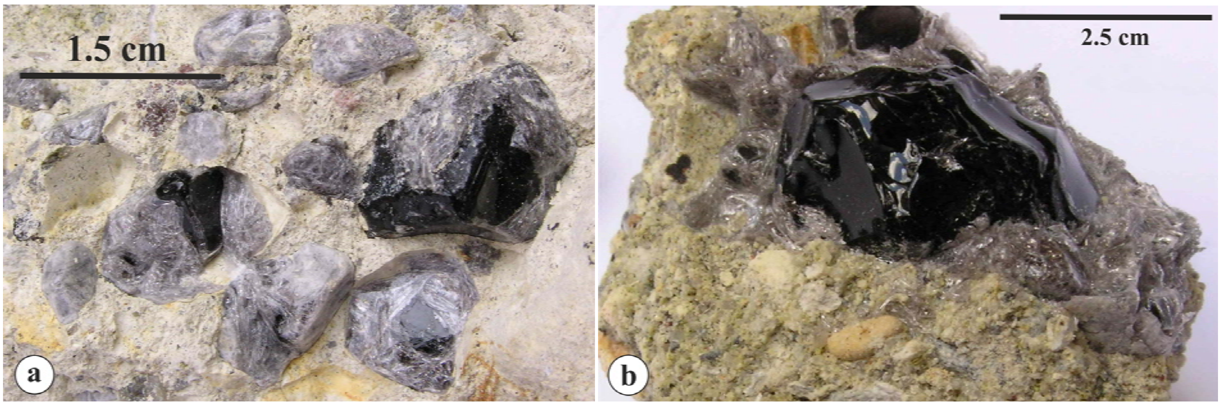


Fig. 21a, b. Locality Streda nad Bodrogom, abandoned quarry: a, b – obsidian in perlite shell (marekanite) occurring as fragments in redeposited polymict rhyolite volcaniclastic rocks. Photo: P. Bačo.

Fig. 22. Locality of Streda nad Bodrogom, abandoned quarry: obsidian in perlite shell (marekanite) occurring as fragments in redeposited polymict rhyolite volcaniclastic rocks. The size of obsidian fragments is up to 4 cm. Photo: P. Bačo.

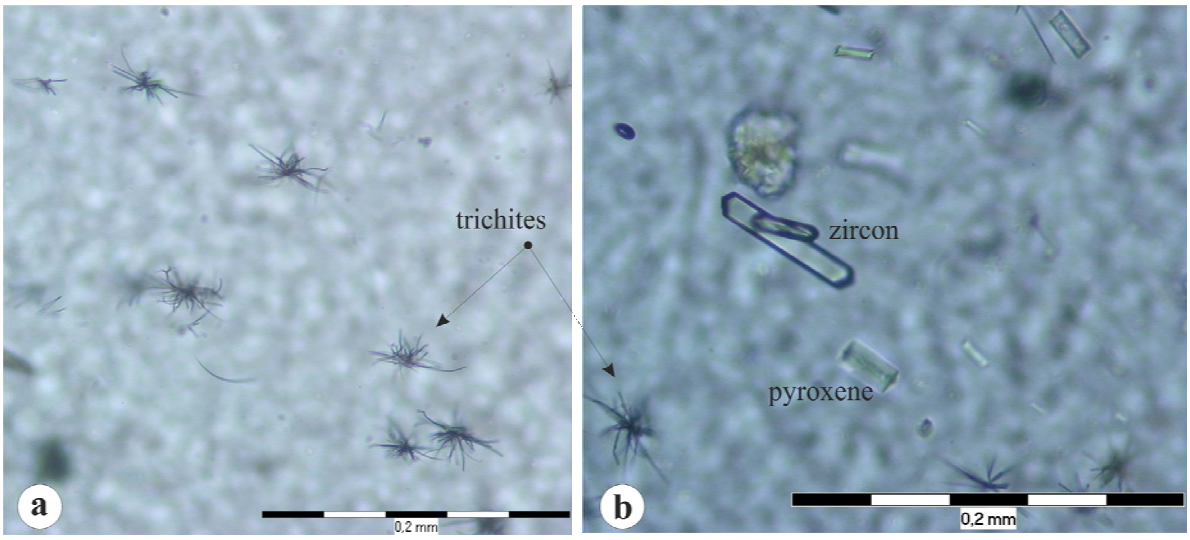


Fig. 23a, b. Locality of Streda nad Bodrogom. The arachnoid type of trichites represents a typical feature of obsidians from this locality. Photo: P. Bačo.

Fig.. 24. The obsidian occurrence (plowed field) east of the Cejkov village in the "Malé lúky–Žihľavník" area. The central part of historically beneficial area with position of caught springs in wells. Photo: P. Bačo.

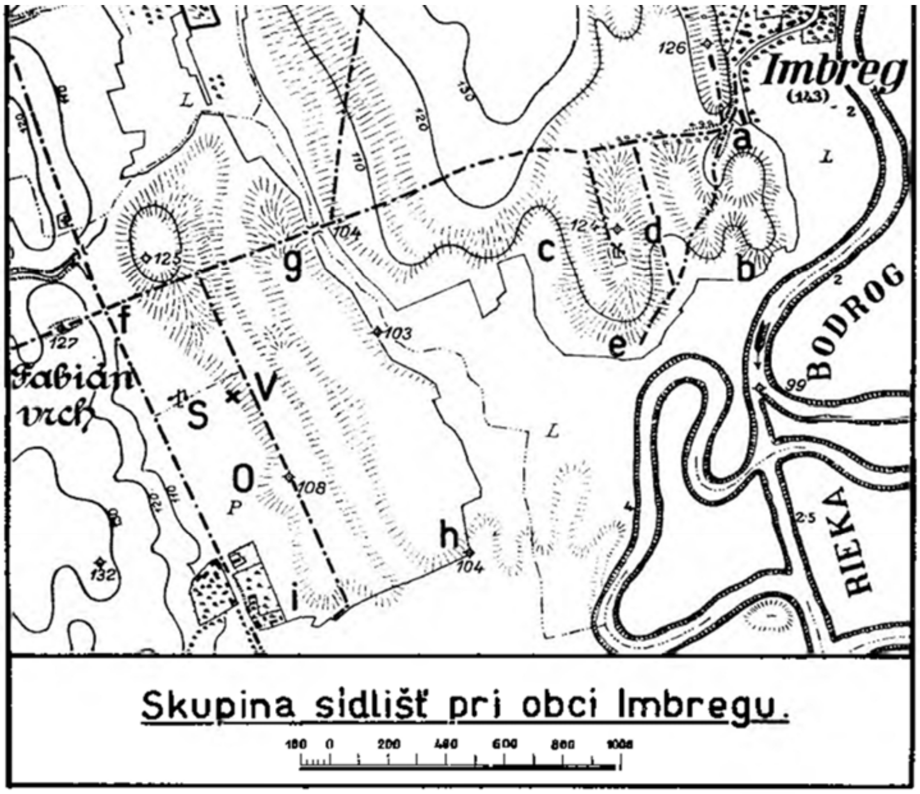


Fig. 25. Historical map of obsidian occurrences east of the Cejkov village (f-g-h-i) - segment according to Janšák, (1935); in the supplement of his repost it represents map No. 10. Imbreg = Brehov.

Fig. 26a, b. Locality of Cejkov – Malé lúky-Žihľavník: a – position of obsidian nodules; b – dominant types of their surface sculpturing. Photo: P. Bačo.

Fig. 27a,b. Locality of Cejkov – Malé lúky-Žihľavník: a – sculptured obsidian (nodule) fragment from the topsoil; b - obsidian nodule with Fe (Mn) oxide and hydroxide coating - red-brown colour and calcite - light brown colour. Photo: P. Bačo.

Fig. 28a, b, c. Locality Cejkov – Malé lúky-Žihľavník: a – finding position of obsidian nodule; b, c –surface sculpturing reflecting its fluidal texture. Dimensions: (b) 5.1x4.6x4.0 cm; (c) 8.5x7.5x5.0 cm. Photo: P. Bačo.

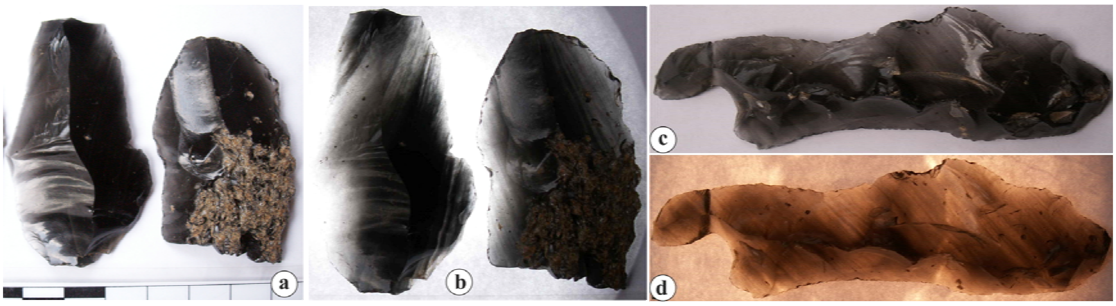


Fig. 29a, b, c, d. Fragments of split obsidian industry from the Hraň locality – Feljarő area. Figs. b and d show backlit obsidians with distinct internal setting of volcanic glass. The apparent "schliers" obsidian texture is caused by the fluid arrangement of the pyroxene microlites and trichites. Photo: P. Bačo.

CEJKOV

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Cejkov is the most important site of the late Gravettian in eastern Slovakia. Gravettian relics in Cejkov are situated in five places with the centre on Tokajský vrch hill (Cejkov I) and its nearby surroundings (**Fig. 1, 2**). Just under Tokajský vrch hill, towards the road, there is a slight elevation identified as Cejkov III. Other sites – Cejkov II, IV and V are situated higher on the slopes of the Zemplínske vrchy hills, near the source of the Lagaš stream. The gravettian sites in Cejkov are located from 150 m to 200 m above sea level.

CEJKOV I

Tokajský vrch identified as site Cejkov I (**Fig. 1, 2**) is the best researched site. Tokajský vrch is a flat saddle of a jut of the Zemplínske vrchy hills, which rises approx. 30 m above the Ondava's river flat. The Lagaš stream flows around its northern side.

History of research

The site was discovered by Š. Janšák (1935) in 1932. F. Prošek and L. Bánesz (1959; 1961c) researched the site in 1954 and 1957. L. Bánesz (1969; 1984; 1986; 1987; 1990; 1996; Bánesz & Pieta 1961) studied the site for 10 years, with breaks between 1960 and 1988. According to the published information, gravettian settlement was multi-phase but the exact location of trenches and the stratigraphic situation of individual layers as well as analysis of finds remained unprocessed to a great extent. With the aim to explain the stratigraphic-chronological position of find layers, a revision research of the site was carried out in 2001 (Kaminská & Tomášková 2004). Besides numerous lithic industry, artistic objects, a lump of burned clay, tools made of a reindeer antler and animal bones come from the site of Cejkov I.

Statigraphy

Tokajský vrch hill is made of rhyodacites which are covered with layers of loess of various thickness. Five trenches were located from the foot of Tokajský vrch hill to its top during the research in 2001 with the aim to detect more complex stratigraphic situation (**Fig. 3**). According to the documentation of the reseach, we attempted to detect the distribution of trenches from the investigations of L. Bánesz (**Fig. 4, 5**). The layers in the profile of trench 1/2001 were best documented (**Fig. 6**). Gravettian finds were found in the layers of loess and loess soil.

Dating

There are several datings available for the gravettian finds from Cejkov I – in the span from 19 600 BP (21 500 BP) to 24 800 BP (Table 1).

Natural environment

Charcoals and animal bones occurred in layers with finds during the researches. All analyzed charcoals belonged to coniferous trees. It was mainly spruce (Picea abies) and pine (Pinus sp.). Animal bones were badly preserved and disintegrated during extraction. Bones and tusks of mammoth, horse (Equus cabalus) and probably aurochs (Bos primigenius) were disocovered . Animal bones together with charcoals correspond with cold tundra to steppe with thin growth of coniferous trees and shrubs in the period before the last glacial maximum.

Settlement structures

Disturbed features and fire pits were detected at the site. During the research in 1960, two paleolithic features and a prehistoric tumulus were discovered on the top of the hill. Feature 2 loomed in brown backfill of a pit of irregular shape. It contained fragments of animal bones and lithic artifacts (Bánesz & Pieta 1961, 15-24). Feature 3 was situated in the southern part of the trench and its edges were disturbed by three prehistoric pits. The disturbed feature 3 was delimited by three pole pits. The pit's backfill was light-brown and there were more than 1000 artifacts, a stone pad, animal bones and charcoals.

The hearth in trench 1/2001 was oval and its diameter was 75-80 cm (**Fig. 7**). Nearby, there were several pieces of burned slate and sandstone (Kaminská & Tomášková 2004). The circular hearth with diameter of 110-120 cm from deep trench 1/1960 was about 15 cm sunk in the subsoil. It was tiled with stones and full of charcoals (Bánesz & Pieta 1960).

Chipped stone industry

We do not have the exact number of chipped lithic industry. 1,201 artifacts came from the investigation in 1960 (Bánesz & Pieta 1961). The industry was significantly of a blade character, from the Late Paleolithic. It contained end-scrapers, dihedral and truncation burins, truncations, backed bladelets. 600 pieces of industry, including 30 tools of 21 types were discovered in 1962. Obsidian complemented with hornstone, flint and radiolarite prevailed among the used raw materials (Bánesz 1971).

Researches were carried out at the site of Cejkov I in 1966 and 1967, when a considerable number of lithic industry was collected (**Fig. 8**). Mainly end-scrapers on large blades, dihedral and truncation burins, retouched blades were illustrated (Bánesz 1969, 287). 446 artifacts were found during the research in 1983 (Bánesz 1984). When publishing the investigations in 1985-1988, L. Bánesz does not state the numbers of lithic industry. He only presents its general characteristics. Artifacts were made mostly from obsidian and limnosilicite, less frequently from flint and radiolarite.

During the investigation in 2001 (Kaminská & Tomášková 2004, Tab. 1), 377 artifacts were collected from the topsoil, most of them made of obsidian and also from flint, limnosilicite, radiolarite, opal, menilite hornstone and silified sandstone. Flakes prevailed, blades were also rather numerous. Bladelets, cores, retouched tools and burin spalls are also represented. There were only 10 tools, burins were most numerous. In layers in trenches 1-4/2001, there were mainly obsidian flakes, rarely blades, bladelets and cores. 24 artifacts were discovered near the hearth in trench 1/2001 in layer 5. 13 of the artifacts were made of obsidian, 10 from limnosilicite and one from silified sandstone. The artifacts included two cores, four blades and 18 flakes. 30 artifacts were in trench 5/2001, thirteen of them made from limnosilicite, six from brown hornstone, five from radiolarite, three from hornstone, two from flint and one from obsidian (**Fig. 9**).

Antler tools

Thanks to a layer of calcinated loess, unique artifacts made from antlers probably used for digging were discovered in Cejkov I, in the environment of Eastern Slovakia. A T-shaped sledgehammer made of a reindeer antler (**Fig. 10: 4**) has been preserved (Bánesz 1986; 1996, 11). Fragments of an antler sledgehammer (**Fig. 10: 3**) and a T-shaped antler tool (**Fig. 10: 5**) have been documented (Bánesz 1990; 1996, 19-21).

Decorative and artistic artifacts

Cejkov I is the only gravettian site from eastern Slovakia with artistic items made of stone, bone and clay. During survey in 1954, a heart-shaped stone with remains of red paint was discovered in topsoil (**Fig. 10: 2**). It is considered a symbolical representation of a woman (Bánesz 1961).

In 1985, together with lithic artifacts, an animal bone decorated with a line of hollows under which a bunch of arcuated lines is situated was discovered (**Fig. 10: 6**). According to L. Bánesz (1996, 16), it is a fragment of a sculpture representing a hairy male face. A lump of burned modelled clay (**Fig. 10: 1**) comes from the layer in which an artifact made of a reindeer antler and a mammoth tusk were found (Bánesz 1996, 11).

Assesssment

The late Gravettian finds are situated in the topsoil on the slope of the hill, also at two or three sites in the last loess. On Tokajský vrch hill and its nearest surroundings, settlement repeated several times during the late Gravettian 25 000/24 000-21 500 BP. The Cejkov sites always prefered obsidian. However, since the beginning of the Late Gravettian, extra-regional raw materials occur, including limnosilicites. Although there is enough limnosilicite in eastern Slovakia (Kaminská 1991), coloured variants of the raw material used in Cejkov I are probably from sources in Hungary.

Cejkov II

It is a slight elevation on the slope of Vlčia hora hill west of Tokajský vrch hill, 200 m above sea level (**Fig. 2**). A small number of industry from the late Gravettian comes from a collection in 1955 (Bánesz 1959). Tools included an end-scraper, a drill, pointed retouched blades, broken retouched blades, blades and flakes. In 1987, a detection trench was excavated at the site (Bánesz 1988).

Cejkov III

45 artifacts were discovered during a survey in 1957, further 81 artifacts were found in 1958 (Bánesz 1959) and the survey in 1983 brought 220 more artifacts, mostly from obsidian but also from other raw materials (Bánesz 1984). Finds of gravettian industry come from depth of 210 cm from a 1987 trench. Thus, it is probably a site with several phases (Bánesz 1988).

Cejkov IV

A slight elevation northwest of Cejkov II (**Fig. 2**). Industry and an animal tooth were found during a collection (Bánesz 1982). Chipped industry was made from patinated limnosilicites, flints and mostly obsidians. Among tools, a burin, blades and flakes are mentioned. Finds of gravettian industry were found 90 cm deep in a trench from 1987.

Cejkov V

The site is situated southwest of Cejkov II (**Fig. 2**). Several pieces of industry made from patinated flint, limnosilicite and obsidian come from a collection. They include a complex blade, bladelets and flakes (Bánesz 1982).

Acknowledgement

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Cejkov I-Tokajský vrch hill. View of the site from southeast.

Fig. 1.

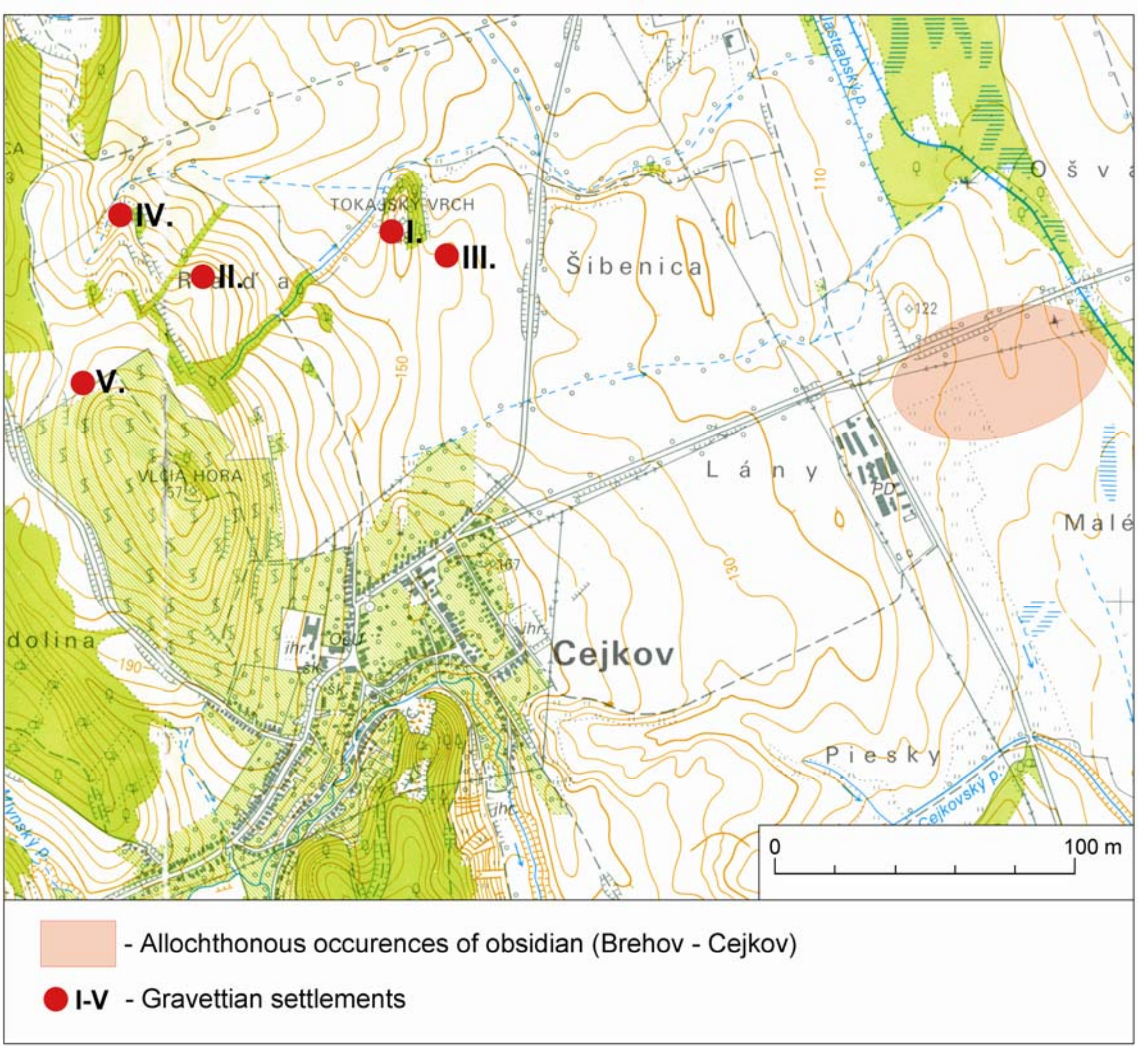

Fig. 2.

Cejkov. Map of gravettian sites (I.-V.) and allochthonous occurrences of obsidian (Brehov – Cejkov).

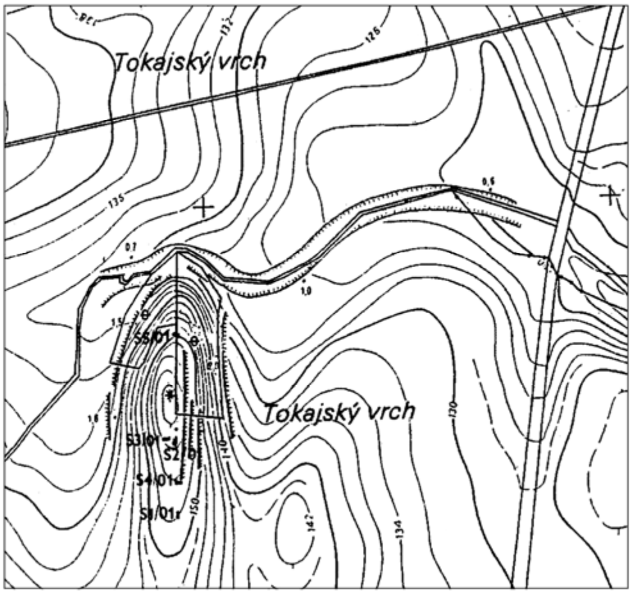

Fig. 3.

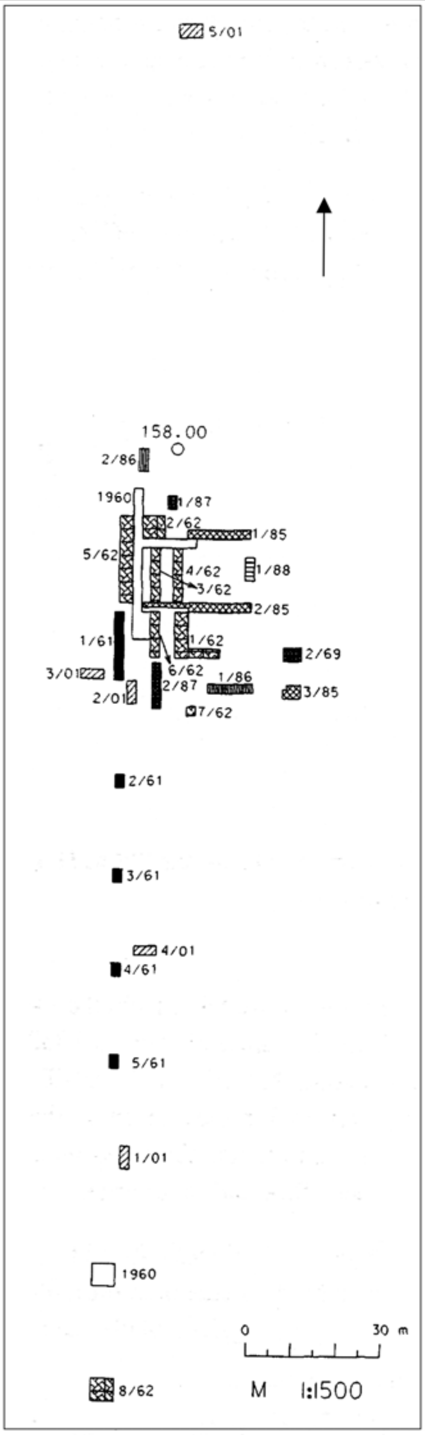

Fig. 4.

Fig. 3. Cejkov I-Tokajský vrch hill. Location of excavation trenches on Tokajský vrch hill in 2001 (after Kaminská & Tomášková 2004).

Fig. 4. Cejkov I-Tokajský vrch hill. Location of excavation trenches in 2001, together with trenches of L. Bánesz from 1960-1988 (after Kaminská & Tomášková 2004).

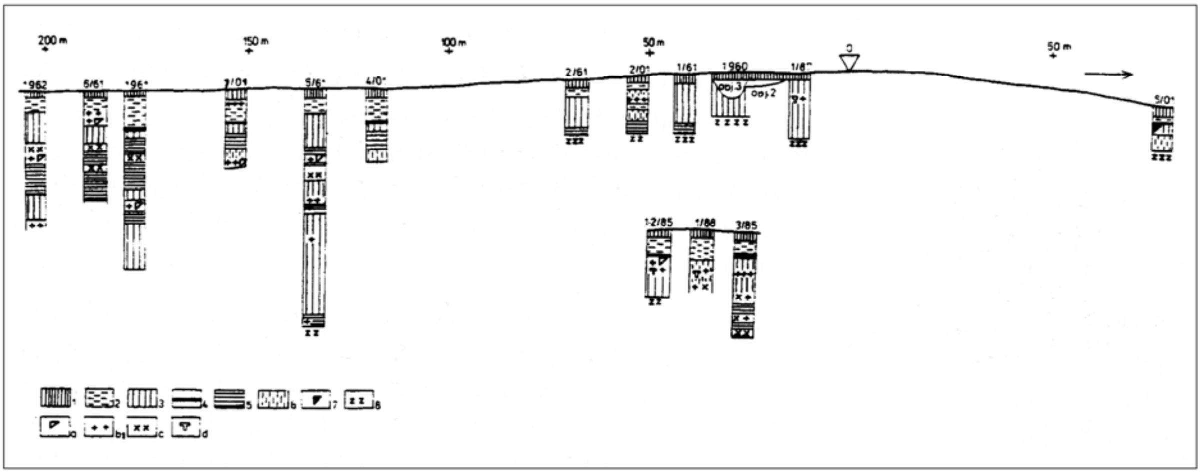

Fig. 5.

Cejkov I-Tokajský vrch hill. Reconstruction of the sequence of layers in the excavation trenches on Tokajský vrch hill according to the 2001 research and according to L. Bánesz's records from 1960-1988. Key: 1 – topsoil; 2 – decalcified loess; 3 – calcified loess; 4 – upper part of distinctly calcified loesss; 5 – fossil soil; 6 – calcified loess; 7 – brown soil; 8 – subsoil; a – animal bone; b – lithic industry; c – charcoal; d – reindeer tool (after Kaminská & Tomášková 2004).

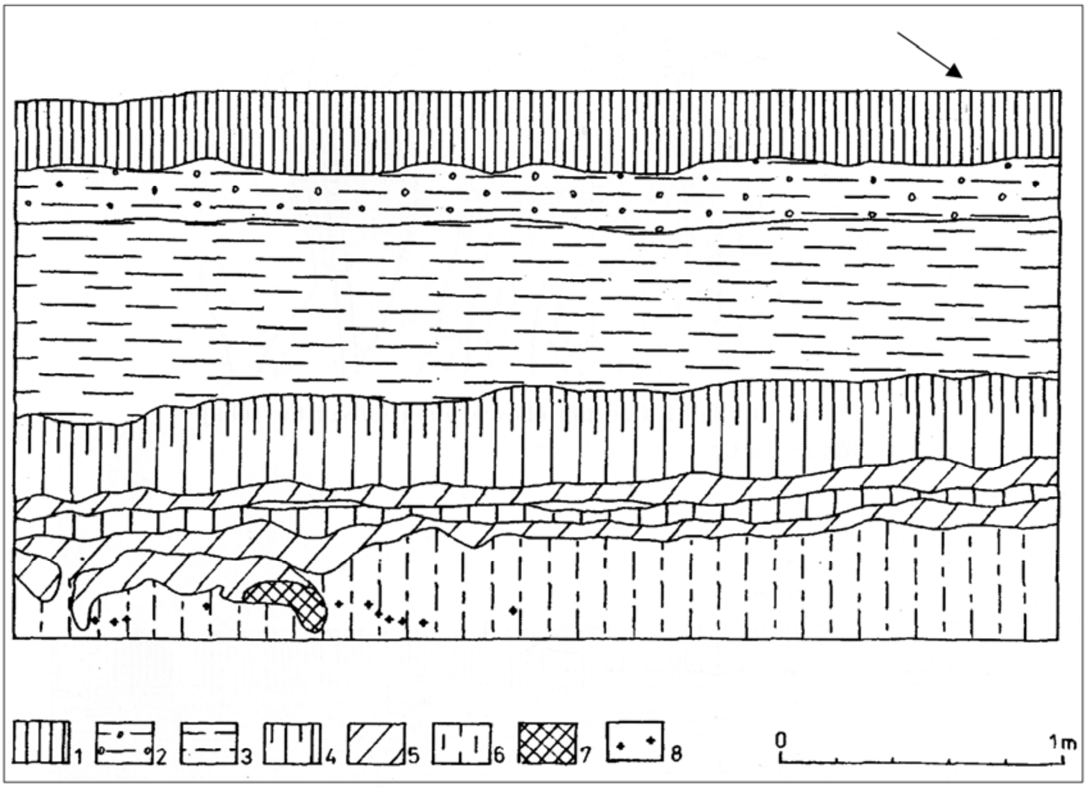

Fig. 6.

Cejkov I-Tokajský vrch hill. Western profile of excavation trench 1/2001: 1 – topsoil; 2 – transitional layer (2A); between the topsoil and layer 2; 3 – decalcified loess, layer 2; 4 – loess, layer 3; upper distinctly calcified; 5 – layer 4; 6 – calcified loess, layer 5; 7 – location of charcoal dated to 22 480 ± 120 BP; 8 – lithic industry (after Kaminská & Tomášková 2004).

Obr. 7.

Fig. 7. Cejkov I-Tokajský vrch hill. Hearth in layer 5 in trench 1/2001 (after Kaminská 2014).

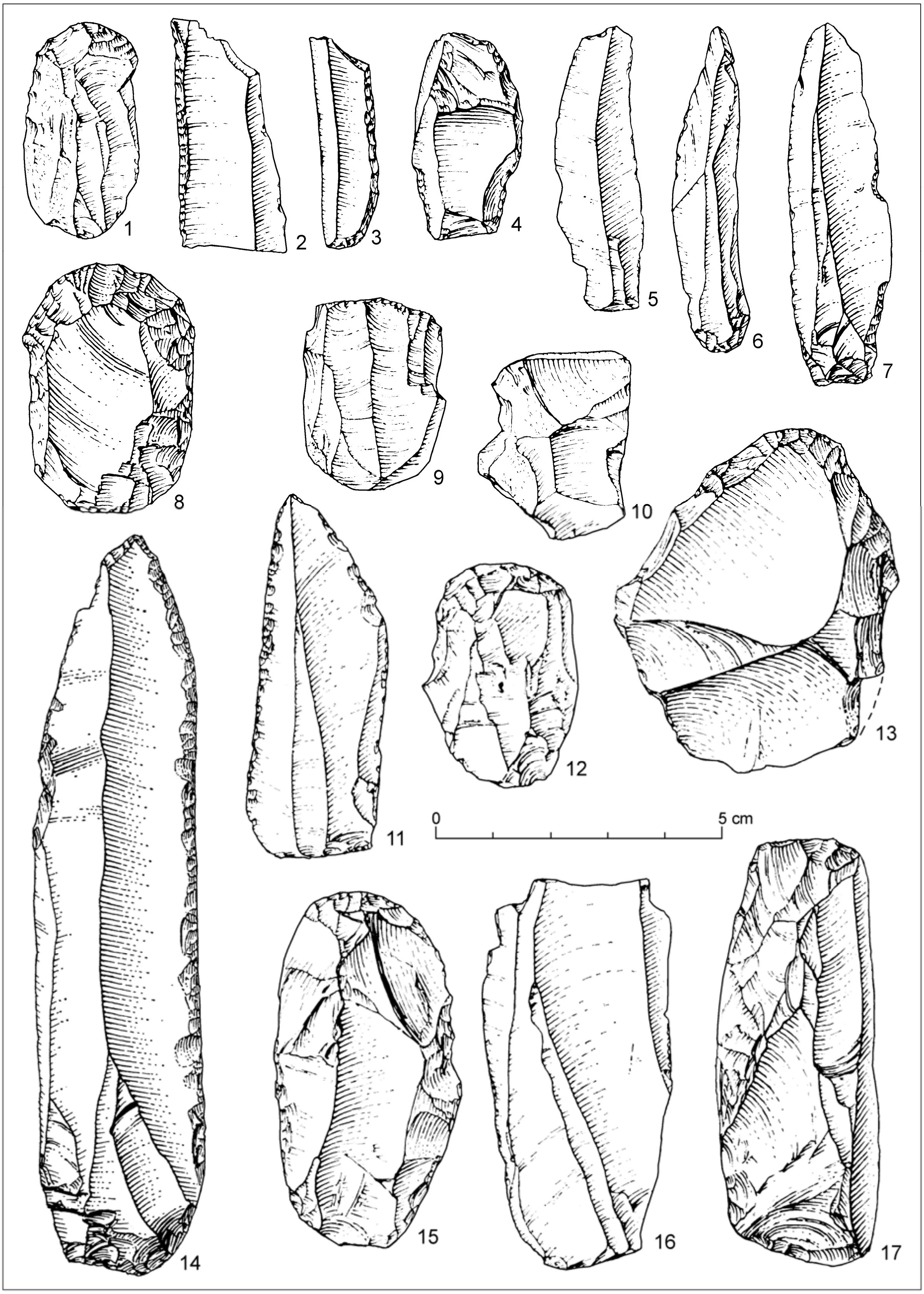

Fig. 8.

Cejkov I. Gravettian chipped industry (after Bánesz 1960c and Bárta & Bánesz 1971, modified).

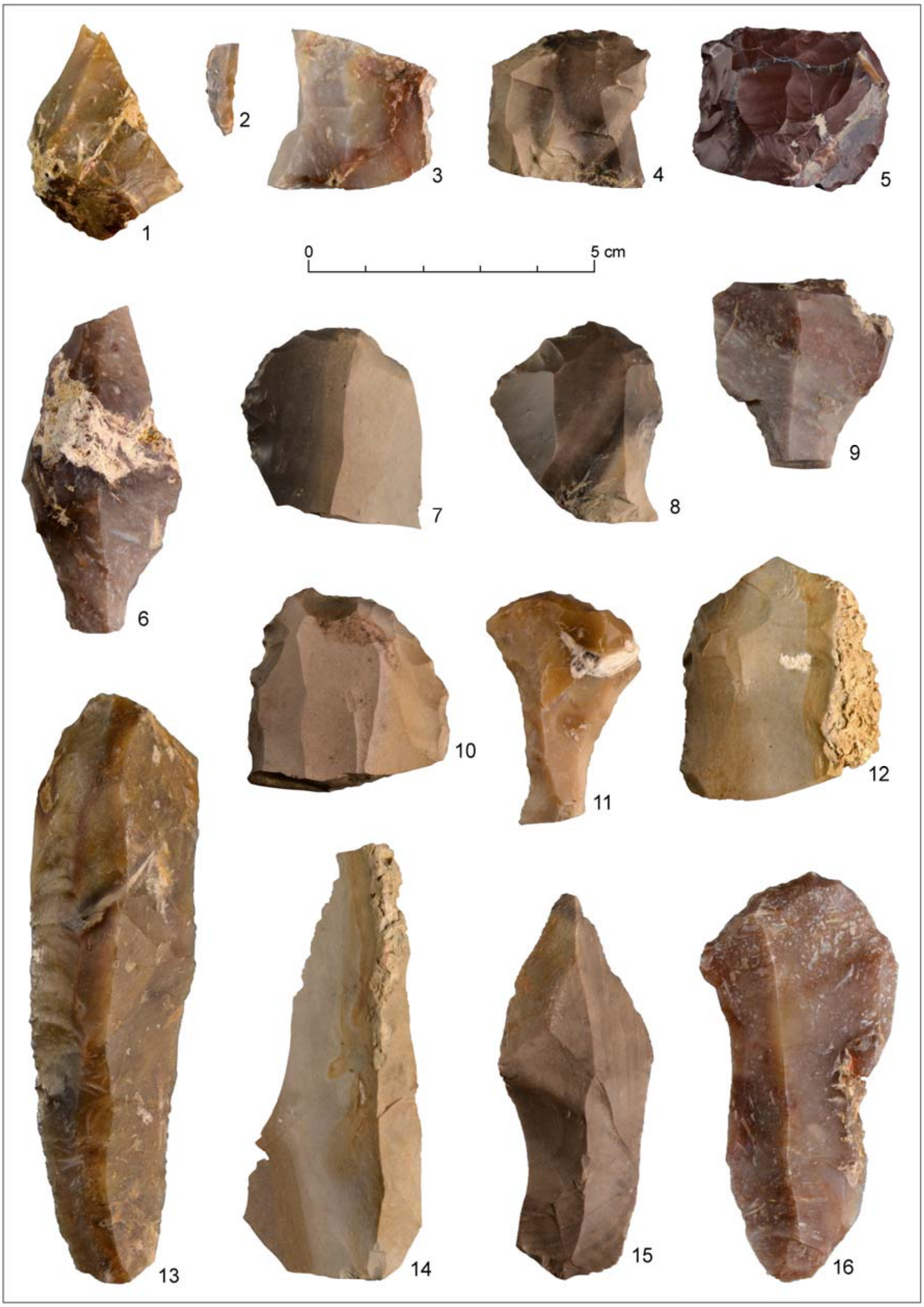

Fig. 9.

Cejkov I-Tokajský vrch hill. Chipped stone industry of the Gravettian from trench 5/2001 (after Kaminská 2014).

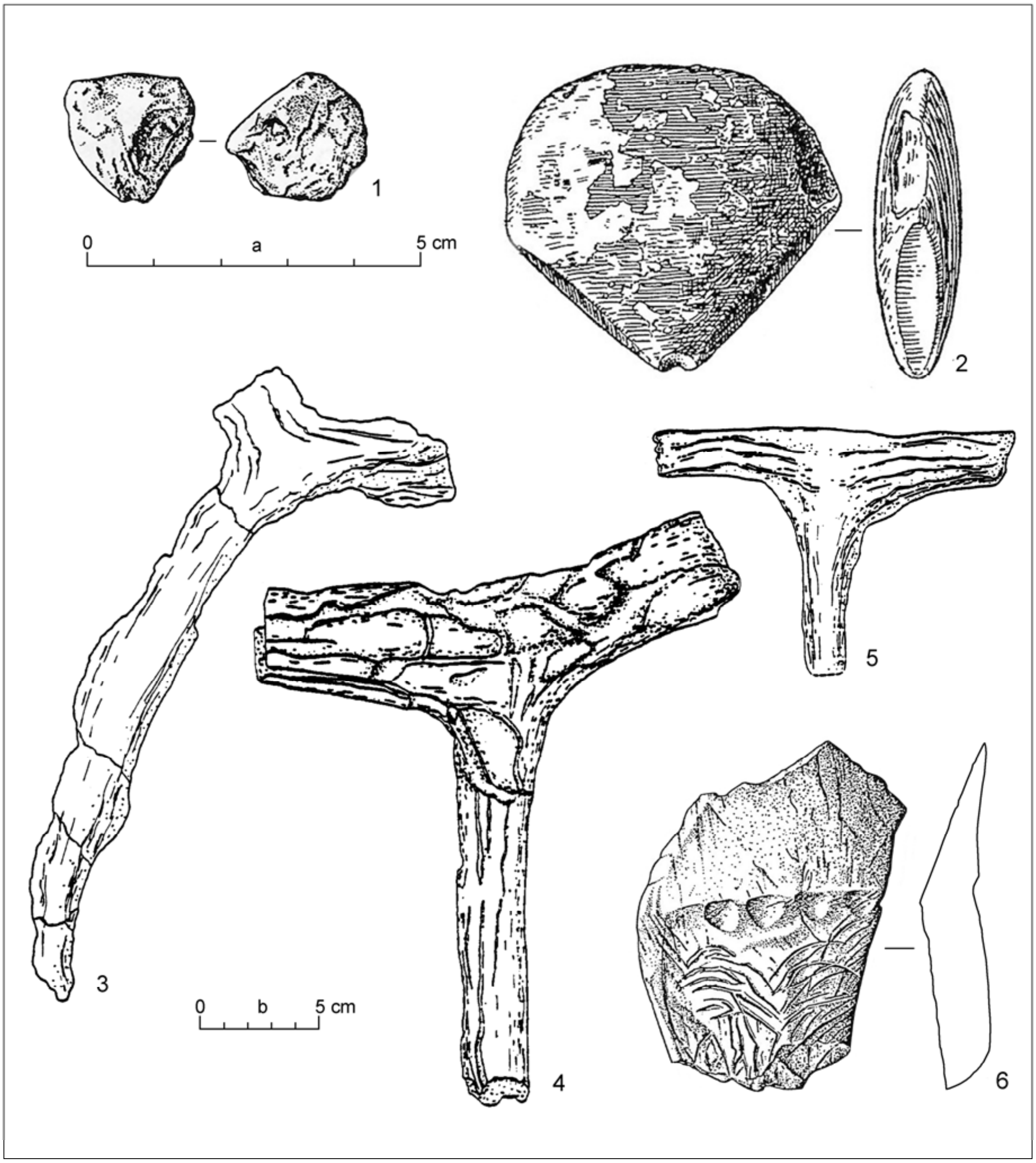

Fig. 10.

Cejkov I-Tokajský vrch hill. Artistic and utility artifacts of the Gravettian. 1 – lump of fired clay; 2 – lithic idol with remains of red paint; 3-5 – tools made of reindeer antlers ; 6 – bone artifacts with engraved lines (after Bánesz 1996, modified).

KAŠOV

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There are several sites from the Stone Ages in the territory of the village of Kašov. Two of them are the most important ones. Settlement from the Gravettian and Epigravettian from the Late Paleolithic has been studied at the site of Kašov I-Spálenisko. At the site of Kašov-Čepegov I, there was a feature of the Bükk culture from the Middle Neolithic.

KAŠOV I-Spálenisko

The site is situated on a jut of the northeastern foothills of the Zemplínske vrchy hills (**Fig. 1**) in altitude of 200 m above sea level. The Javorový potok stream flows around its northern part.

History of research

The site was discovered by Š. Janšák (1935, 66, 67). Later, F. Prošek and L. Bánesz carried out collections there. L. Bánesz (1985) supervised the research of this site in 1960, 1966-69, 1971-72, 1979-1984 (**Fig. 2: 2-6**). Two phases of settlement were detected. The older lower layer with the Late Gravettian was found only over a small area. The younger upper layer was studied within 5,400 m2. With the number of 43,540 artifacts, it is the largest epigravettian site in Central Europe (Bánesz 1985). Besides chipped artifacts, processed stones, fragments of mineral paint, charcoals and three artifacts made of fired clay were preserved there (Bánesz 1996). Stratigraphical-pedological research of the site (**Fig. 3**) was executed in 1991 (Bánesz 1992).

Kašov I – the lower layer, Gravettian

The lower layer with finds was detected only in the northern part of the site over an area of 12 x 8 m (Bánesz 1969; 1985) which was 55-80 cm deep. It was separated from the upper layer with a sterile layer which was 1-10 cm thick. L. Bánesz (1969b) briefly evaluated the gravettian industry. Spatial analysis of finds from the lower layer and their more detailed analysis were done by M. Novák (2002; 2004).

Dating

Dating of the lower layer by 14C method to 20 700±350 BP (Bánesz 1993) corresponds with the period immediately preceeding the last Würm Plenioglacial.

Settlement structures

11 spots with ash-coloured soil (with diameter of 0.5-1.5 m), charcoals and burned artifacts were preserved in the uncovered area of almost 60 m2. The highest concentrarion of artifacts was detected in the middle of the area and on its western edge (**Fig. 4**).

Chipped stone industry

968 finds including 959 artifacts and 9 processed and unprocessed stones come from the lower layer with finds (Bánesz 1969; Novák 2002). Almost half the tools – 49.32% - were made of patinated flint (**Fig. 5**) which mainly means erratic flint from Silesia complemented with Krakow-Jurrasic flint from the south of Poland and maybe Volhynian flint from the Dnester river basin. Local obsidian made 33.26%, other artifacts were chipped off limnosilicites (8.9%), chert (5.42%), radiolarite (2.29%), jasper (0.52%) and quartz (0.21%).

The most numerous group (**Fig. 6**) contained fragments of flakes, small flakes and splinters, followed by blades, retouched pieces (17.8%), burin spalls and least frequent cores. Burins (40.3%) prevail in the inventory of tools, followed by retouched blades (22.8%) and end-scrapers (12.9%). There were 69 burins – mostly made from flint – altogether and 22 end-scrapers. 15 exemplars were combined tools. Retouched blades and bladelets were the second most numerous group (45 exemplars). There were four backed bladelets and a bladelet with lower retouch was also found. As for other types of tools, there was a plane, a drill, two notches, a chisel, a side scraper, two end-scrapers and three fragments of retouched tools (**Fig. 7**).

Assessment

The gravettian industry from the bottom layer in Kašov is characterized by several features: high percentage of raw materials from remote sources (flints – distances between 250 and 500 km), burins prevailed over end-scrapers in the group of tools, a significant proportion of combined tools and a considerably high number of retouched blades. Despite the almost 50% share of flints in the composition of the inventory, only one core was discovered. A probably hunting group which had arrived from the northwest from behind the Carpathian Arc brought some supplies of a raw material which they ran out of in the course of time. Since contacts with the original territory were not renewed, flints were later replaced with obsidian.

The site was probably not a place of workshops. The technological-typological composition of the industry more likely suggests common household activities related to preparation of food. It was a short-term seasonal station of a smaller group of hunters migrating in the territory between the Carpathian basin and the area above the Carpathians (Bánesz 1969, 287; Novák 2002; 2004). Unfavourable pedological conditions did not allow preservation of animal bones, so some knowledge of hunting strategies and more detailed environmental conditions is absent.

Kašov I – the upper layer, Epigravettian

The younger upper layer has been investigated within 5,400 m2. Besides chipped artifacts, processed stones, pieces of mineral paint, charcoals and three objects made of fired clay were preserved in it (Bánesz 1996).

Stratigraphy

On the basis of a sedimentological and mineralogical analysis of five distinguished layers, a conclusion was drawn that the upper layer with the Gravettian (layer 3) was created after the last glacial maximum (20 000-18 000 BP).

Dating

The absolute age of the charcoals from the hearth in the upper layer is 18 600±390 BP (Gd-6569) (Bánesz 1992), i. e. after the last Würm Pleniglacial.

Settlement structures

Finds from the upper layer have been only partially assessed. Analysis of settlement structures, spatial distribution of the finds and chipped stone industry was made only from concentrations within an area of 20 x 12 m (Bánesz 1990; Bánesz et al. 1992). Areas with ashes and charcoals which were remains of hearths (**Fig. 8**) were situated over the area of the seasonal repeatedly visited campsite. Everyday life and common household activities usually concentrated around them.

Chipped stone industry

In the 30 analyzed concentrations, obsidian totally prevails (81.73%) over limnosilicite (9.92%), radiolarite from northeastern Slovakia, erratic flint from moraines in southern Poland (2.45%), Volhynian flint from the Dnester region (0.40%), quartz porphyry from Hungary (0.04%) and other minerals. Industry consisted of 153 cores, 594 flakes, 712 fragments of flakes, 560 blades and bladelets and 234 retouched tools (**Fig. 9**).

In the typological composition of 234 retouched tools, end-scrapers prevailed (43.9%) over burins (23.1%). Combined tools reached 3.8% share. Retouched blades were more frequent (9.6%), however, there was only 0.12% of backed tools. Microlithic bladelets with retouch include a small number of backed shapes. Other types of tools are represented by drills, side-scrapers, splintered pieces, retouched flakes, notched and denticulated retouched artifacts.

Artifacts made of fired clay

Four artifacts made of fired clay come from Kašov-the upper layer. First one was discovered in 1960 (Bánesz 1961a, 779, obr. 271). It has damaged – originally conical – shape with a flat base with diameter of 38 mm (**Fig. 10: 2**). Also a shapeless fired lump of modelled clay was found (Bánesz 1961b, 221). Two fired lumps were discovered in 1984. L. Bánesz (1996, 21, obr. 17) interpretes them as bear heads (Fig. 10: 1, 3).

Assessment

The epigravettian settlement was concentrated in various aggregates. According to the typological composition of inventories, they were defined as workshops (containing numerous flakes and fragments) and areas with household activities (smaller concentrations with higher numbers of retouched tools). The spatial distribution of tools shows that it was a short-term subsequent settlement associated with the high mobility of the groups near the site. Groups of hunters could have existed simultaneously near one hearth, leaving 2-3 concentrations of finds (Bánesz et al. 1992, 20).

On the basis of the numerous collection of finds from the upper layer in Kašov, L. Bánesz (1990, 16) considered calling the local Epigravettian kašovian. This name is currently suggested to identify the whole sphere of epigravettian industries from the eastern part of Central Europe after the last glacial maximum (Svoboda & Novák 2004, 475).

KAŠOV – Čepegov I

The site is situated 600 m northwest of the village of Kašov on the eastern slope of the Zemplínske vrchy hills, above the southern bank of the stream.

The site was discovered by Š. Janšák (1935, 62-67). Other collections come from 1969-1985, when most of 13 pyramid-shaped cores of obsidian and sherds of the Bükk culutre were found on top of the topsoil. During the investigation in 1985, L. Bánesz (1991) uncovered a sunken feature with sherds, daub and chipped industry. He distinguished workplaces 0-IIIa within the feature (Fig. 11). Chipped stone industry comprising 2,486 artifacts was almost exclusively made of obsidian (97.10%). It contained mainly flakes but also tools such as burins, sickle baldes, retouched and unretouched blades, a drill and cores in various stages of processing. Stone anvils and hammerstones were also found.

The most distinct pyramid-shaped cores were found above the feature (**Fig. 12, 13**). Sizes of the cores varied from 76 x 57 x 52 cm to 148 x 59 x 50 cm and weighed from 0.28 kg to 0.72 kg. The average number of negatives of knapped blades was 11.

The feature was interpreted as a workshop for production of pyramid-shaped cores which were used in household jobs and as exchange articles as well (Bánesz 1991). According to the newer assessment, the sunken feature with finds is considered rather a place of household industry production than a specialized workshop (Allard et al. 2017).

Sherds from pottery vessels belong to the Bükk culture from the Middle Neolithic (Šiška 1991).

Acknowledgement

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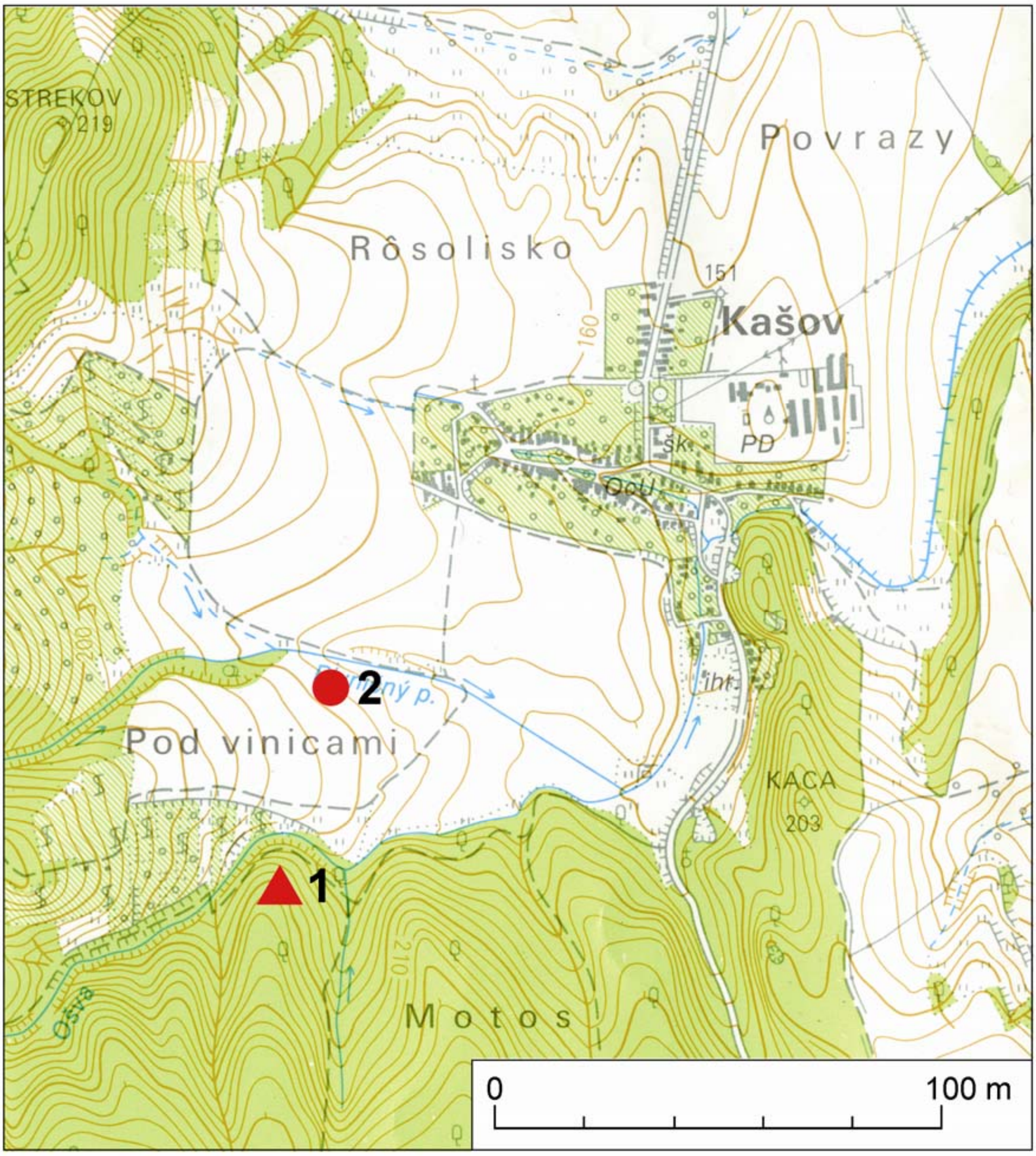

Fig. 1.

Map of the most important archaeological sites in the cadastral area of the village of Kašov. 1 – Kašov I-Spálenisko, settlement of Gravettian and Epigravettian cultures, Late Paleolithic; 2 – Kašov-Čepegov I – settlement of the Bükk culture, Middle Neolithic.

Fig. 2.

Kašov I-Spálenisko. 1 – location of the site; 2-4 – investigation in 1960; 5-6 – investigation in 1984 (Photo by: IA SAS, L. Bánesz).

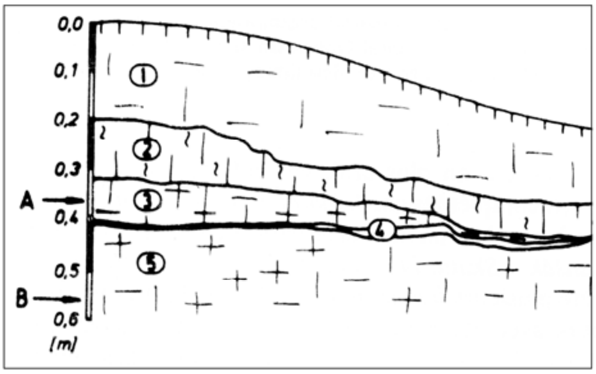

Fig. 3.

Kašov I-Spálenisko. Profile of the trench from 1991: 1 – humus layer; 2 – clay sediment of brown colour; 3 – clay sediment of dark-brown colour, upper layer with finds from the Epigravettian from the period after the LGM (20 000-18 000 BP); 4 – lens of yellowish clay sediment; 5 – dark-brown clay sediment, lower layer with industry of the Gravettian from the period just before the maximum of the last Pleniglacial (23 000-20 000BP). A – the upper layer with finds of the Epigravettian; B – the lower layer with finds from the Gravettian (after Bánesz et al. 1992).

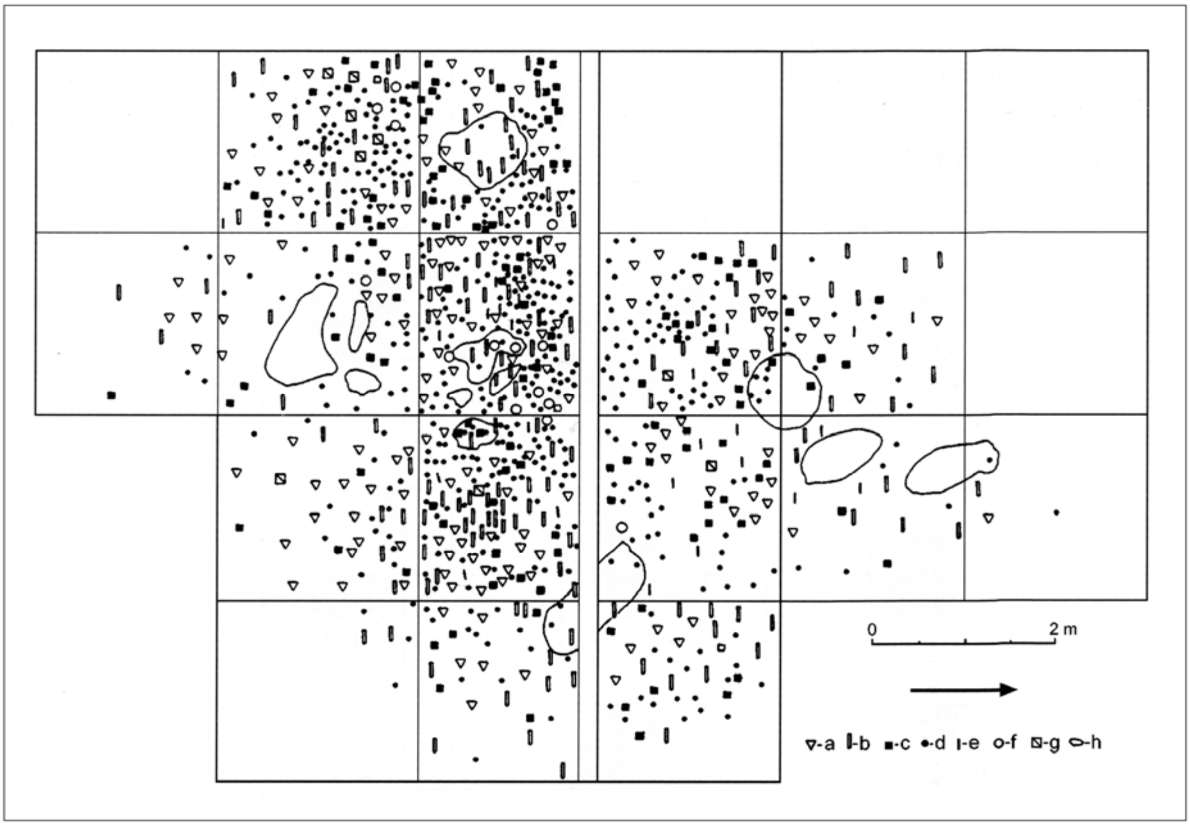

Fig. 4.

Kašov I-Spálenisko, the lower layer, Gravettian. Map and spatial distribution of artifacts (Bánesz 1967). Key: a – retouched tools; b – blades; c – flakes; d – fragments and chips; e – burin spalls; f – cores; g – worked and unworked stones; h – ash-coloured spots (after Novák 2004).

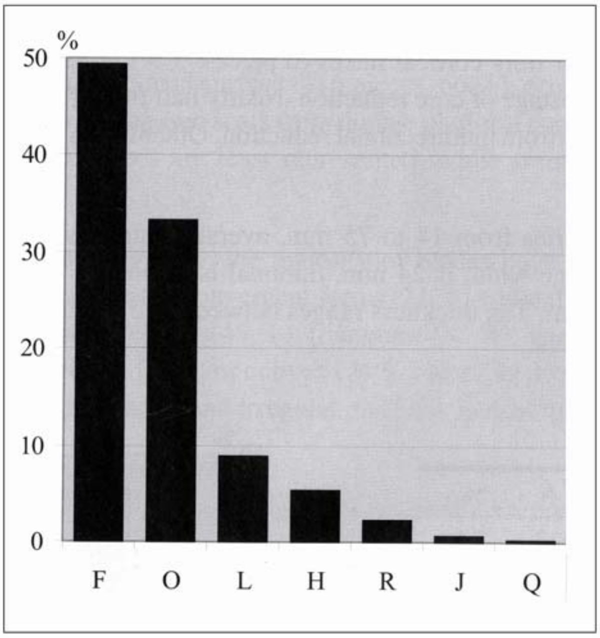

Fig. 5.

Kašov I-Spálenisko, the lower layer, Gravettian. Raw material composition of the chipped industry. Key: F – flint; O – obsidian; L – limnosilicite; H – hornstone; R – radiolarite; J – jasper; Q – quartz (after Novák 2004).

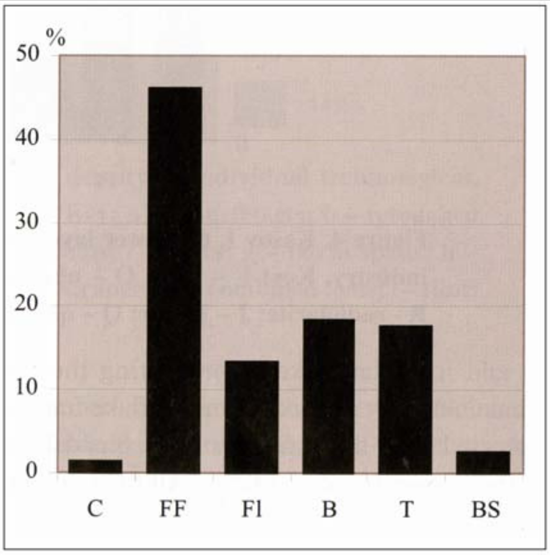

Fig. 6.

Kašov I-Spálenisko, the lower layer, Gravettian. Composition of the major chronological groups. Key: C – cores; FF – fragments and chips; F1 – flakes; B – blades; T – retouched tools; BS – burin spalls (after Novák 2004).

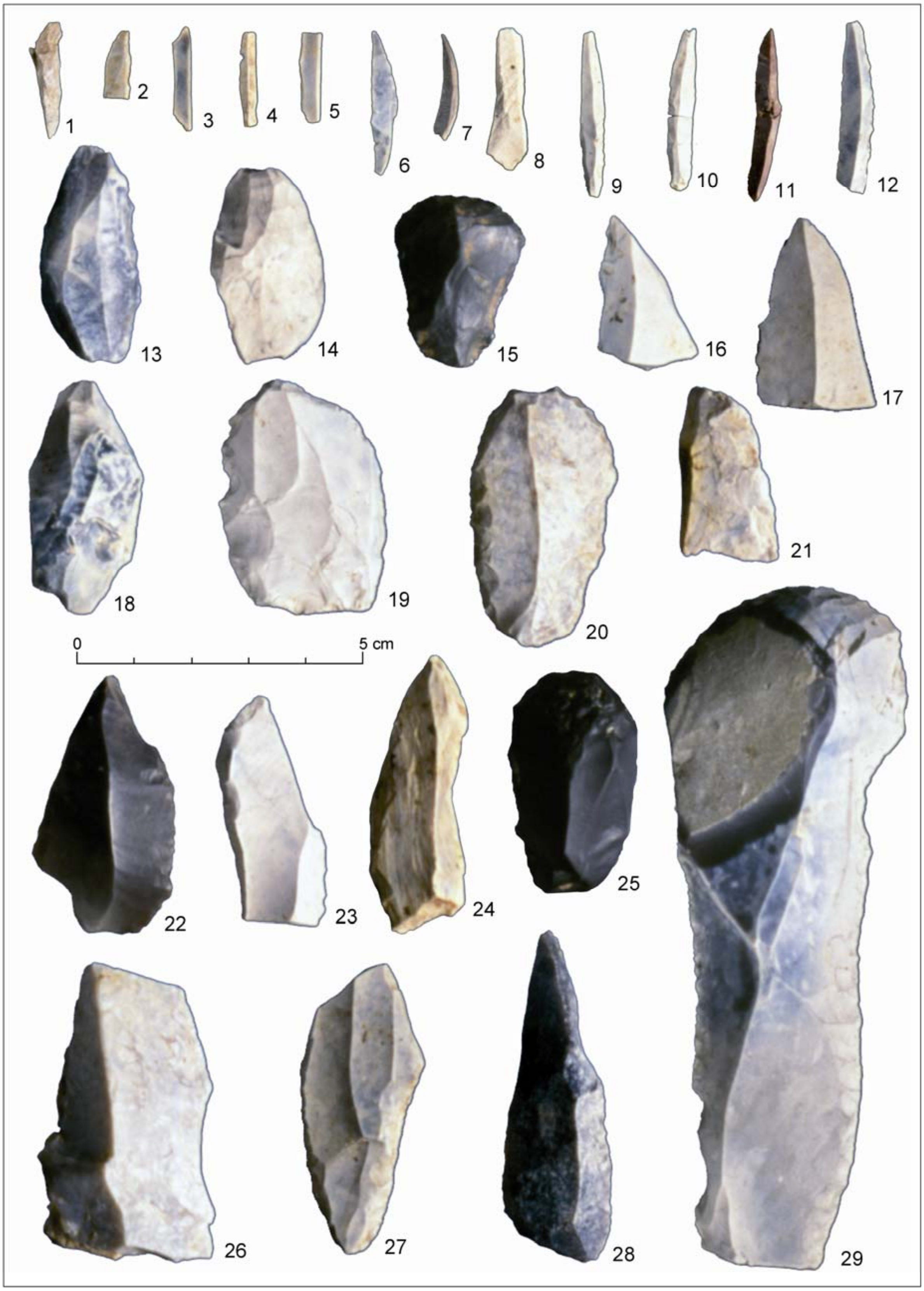

Fig. 7.

Kašov I-Spálenisko, the lower layer, Gravettian. Chipped stone industry of the Gravettian culture (photo by A. Marková).

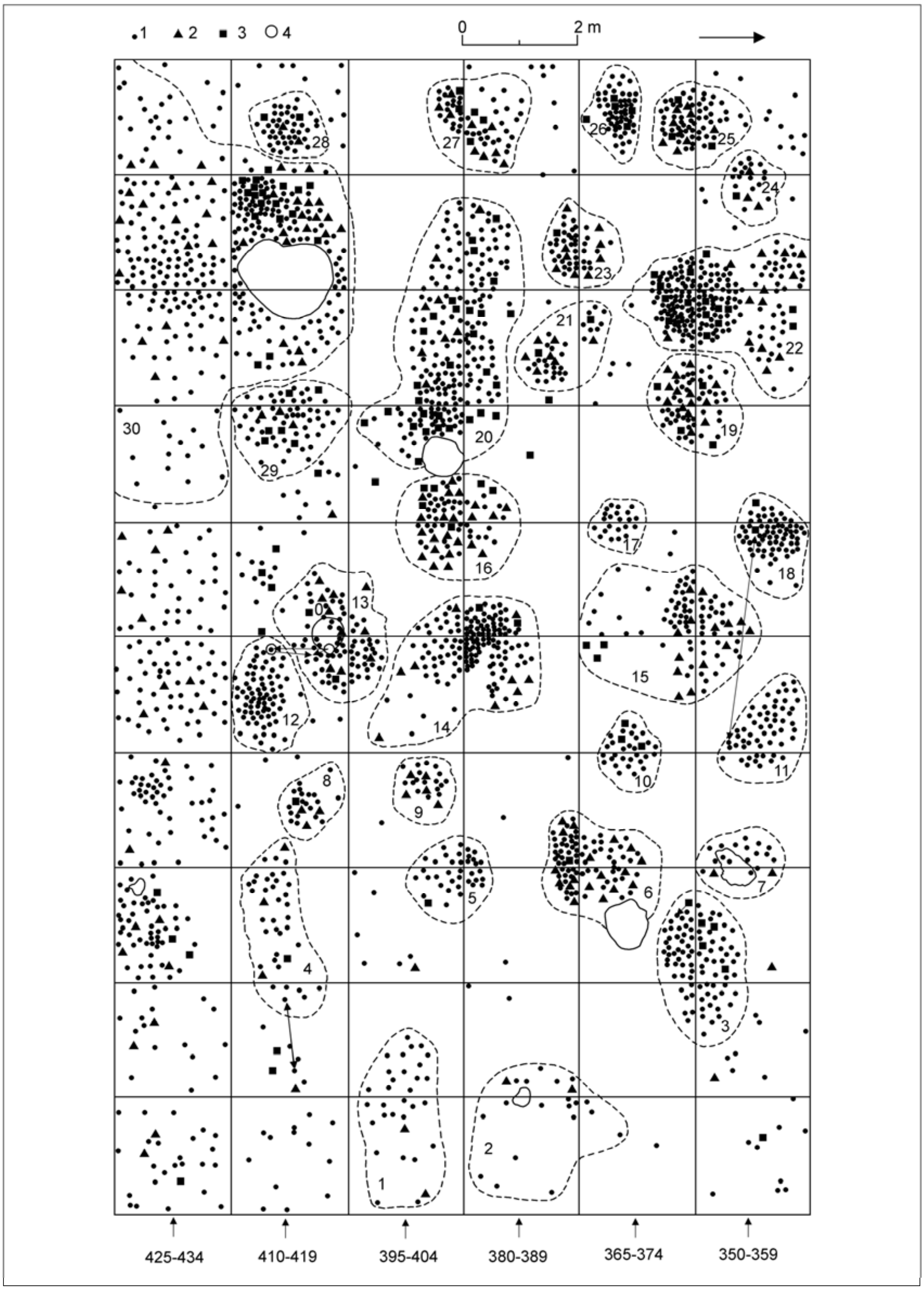

Fig. 8.

Kašov I-Spálenisko, the upper layer, Epigravettian. Plan of research. Key: 1 – flakes, blades, fragments; 2 – tools; 3 – cores; 4 – ash-coloured areas (after Bánesz et al. 1992).

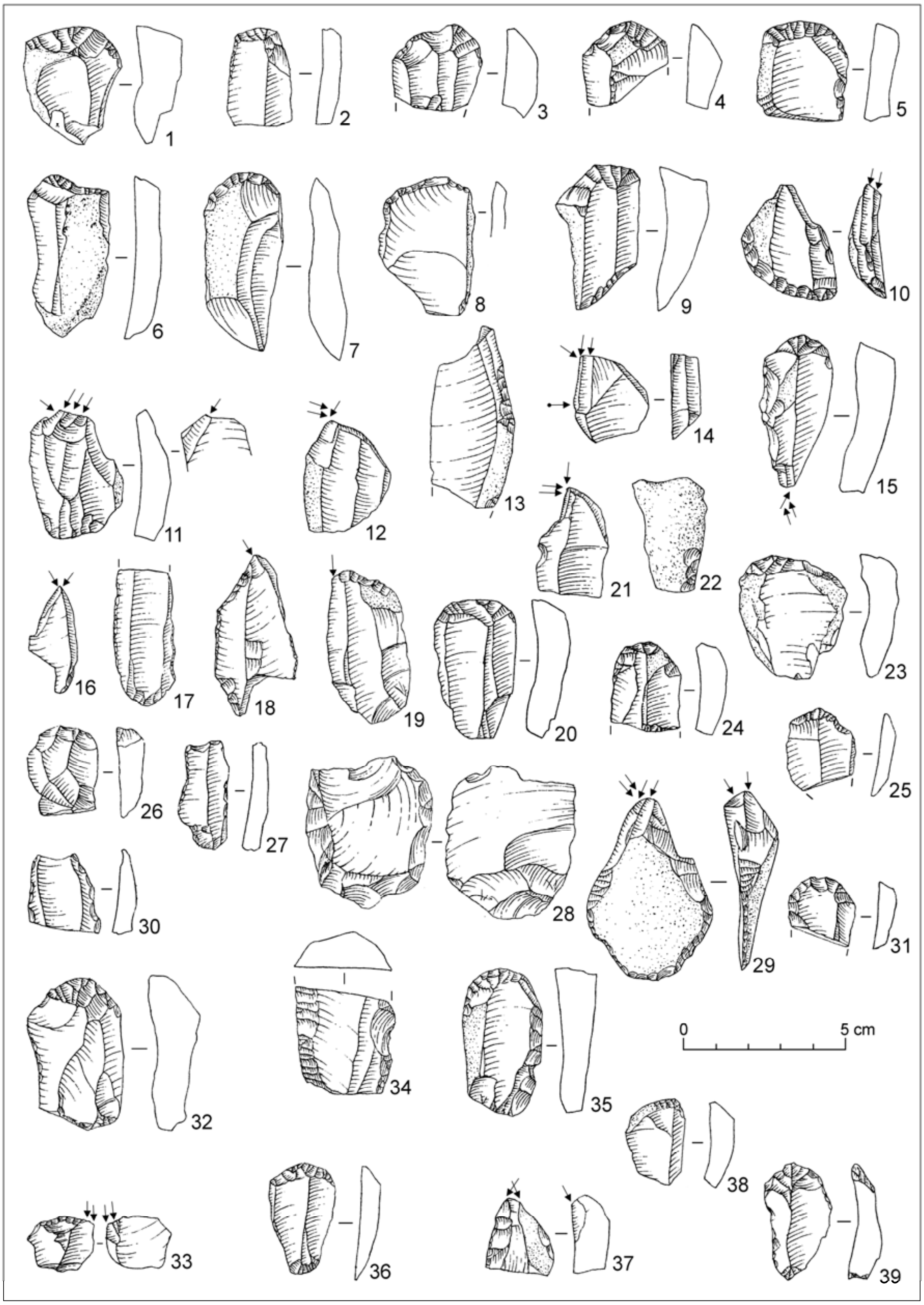

Fig. 9.

Kašov I-Spálenisko, the upper layer, Epigravettian. Chipped stone industry (after Bánesz et al. 2002).

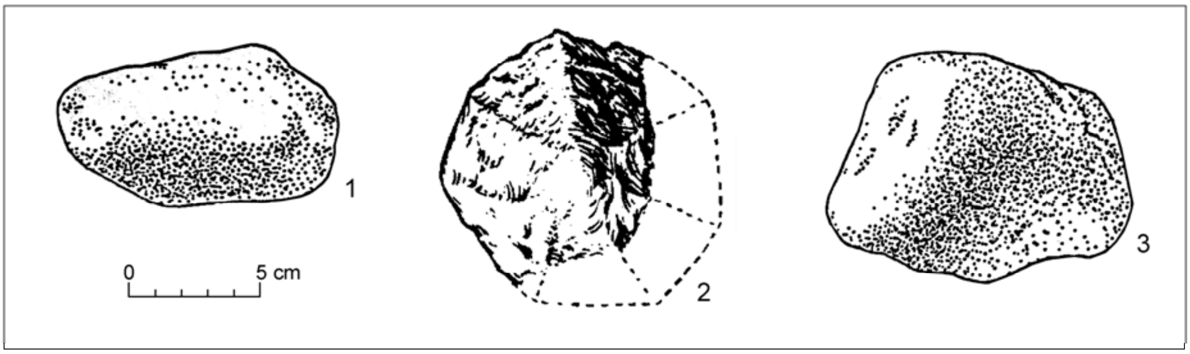

Fig. 10.

Kašov I-Spálenisko, the upper layer, Epigravettian. Artifacts made of fired clay. 1, 3 – bear heads; 2 – conical artifacts (after Bánesz 1996).

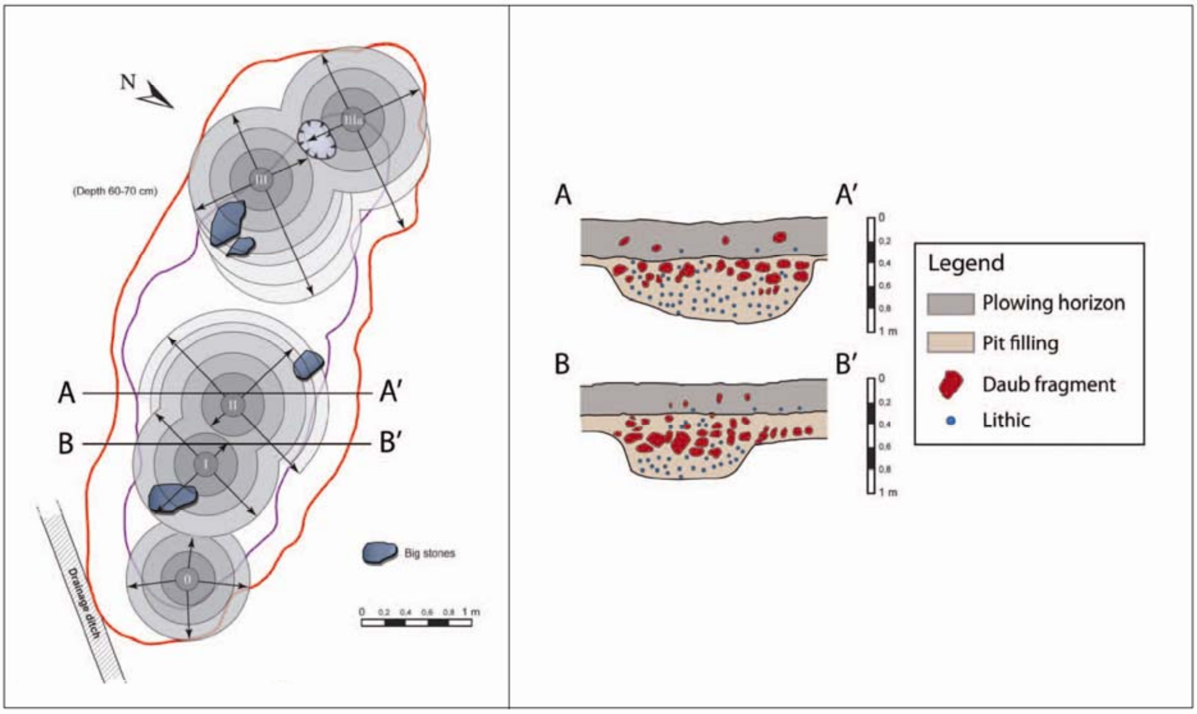

Fig. 11.

Kašov-Čepegov I. Plan and stratigraphy. The Bükk culture (after Allard et al. 2017 and Bánesz 1991, modified).

Fig. 12.

Kašov-Čepegov I. Blade core from obsidian. The Bükk culture (after Allard et al. 2017, edited).

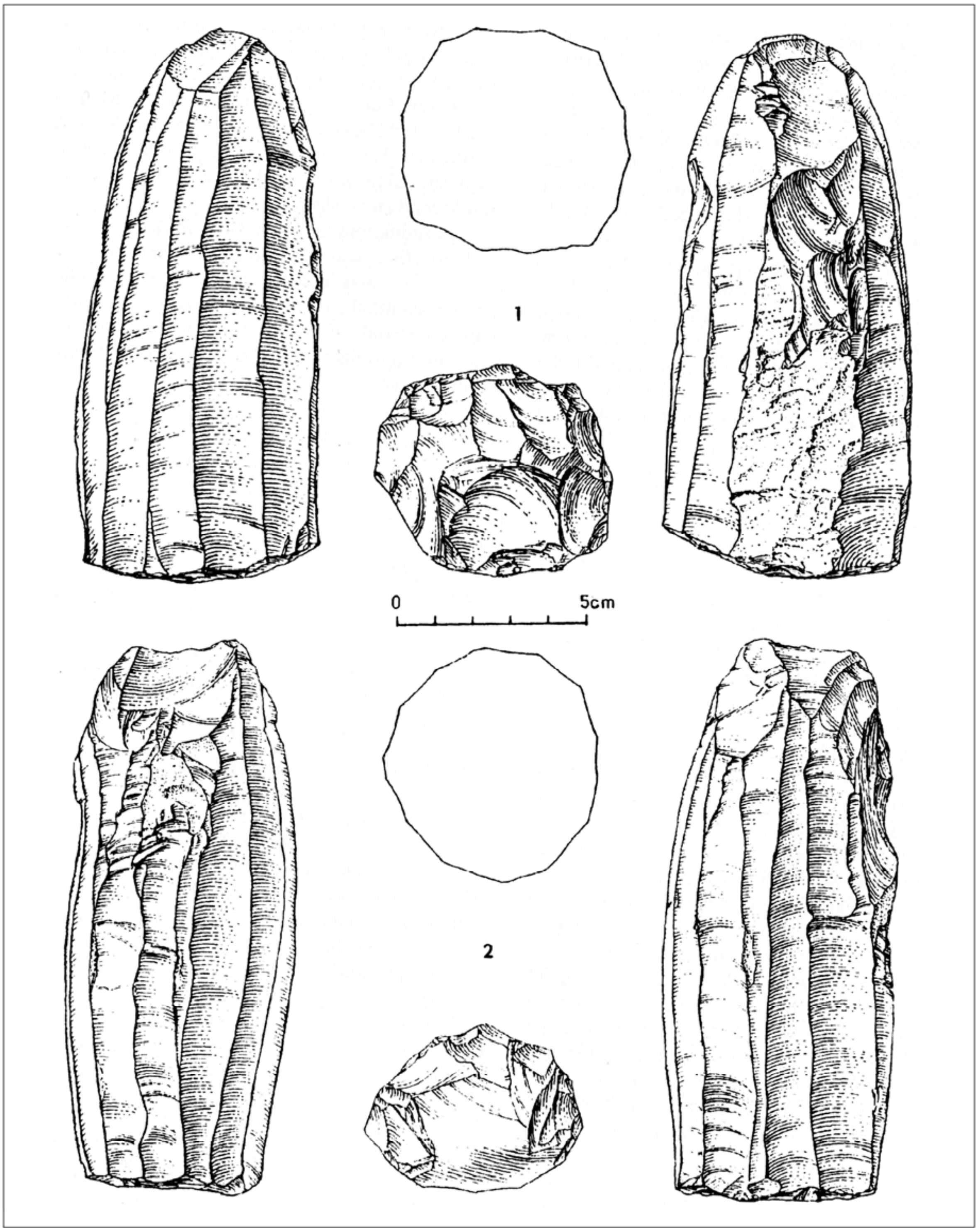

Fig. 13.
Kašov-Čepegov I. Blade cores. The Bükk culture (after Bánesz 1991).

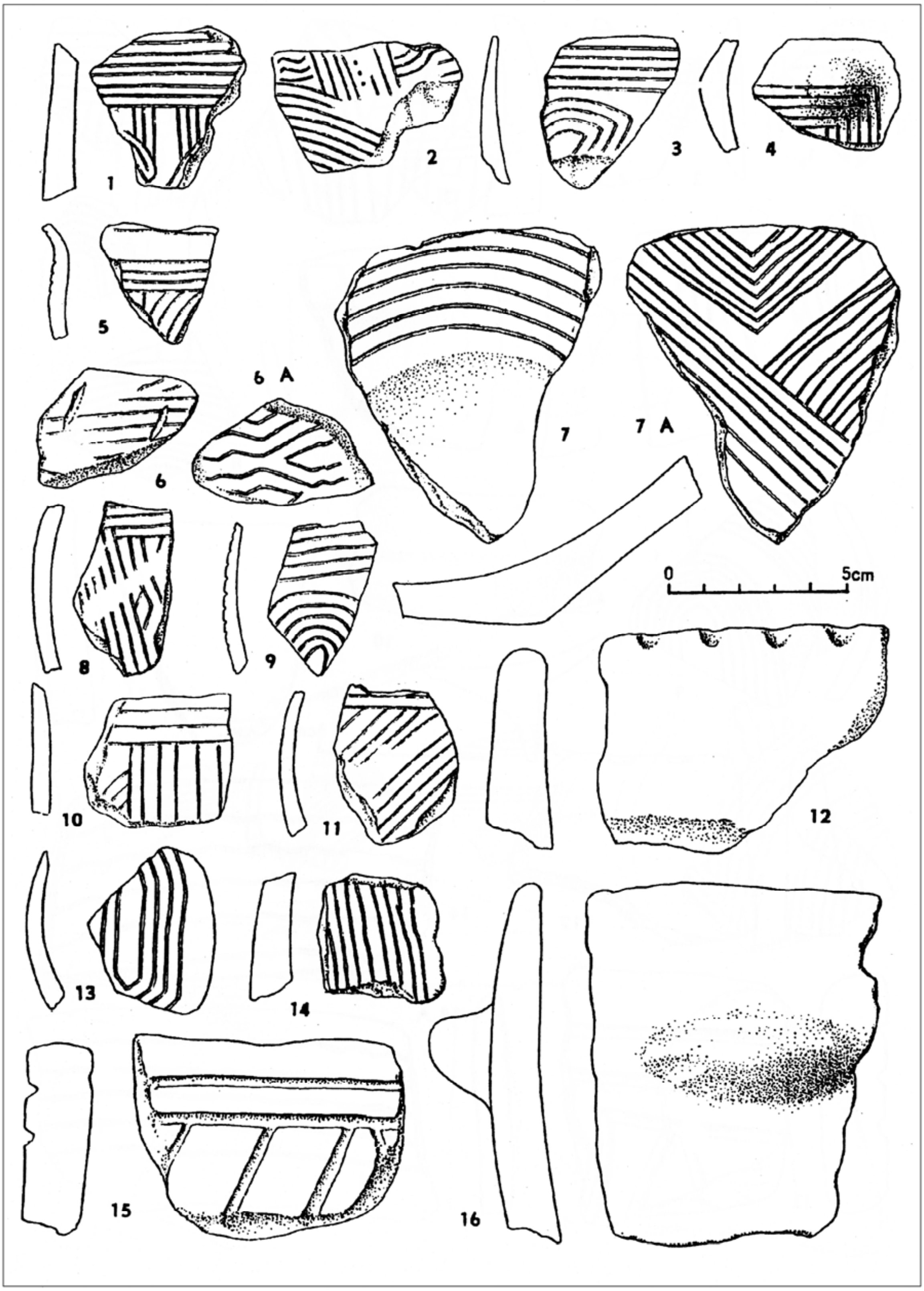

Fig. 14.

Kašov- Čepegov I. Sherds of the Bükk culture (after Šiška 1991).

Excursion to Ukrainian obsidian localities

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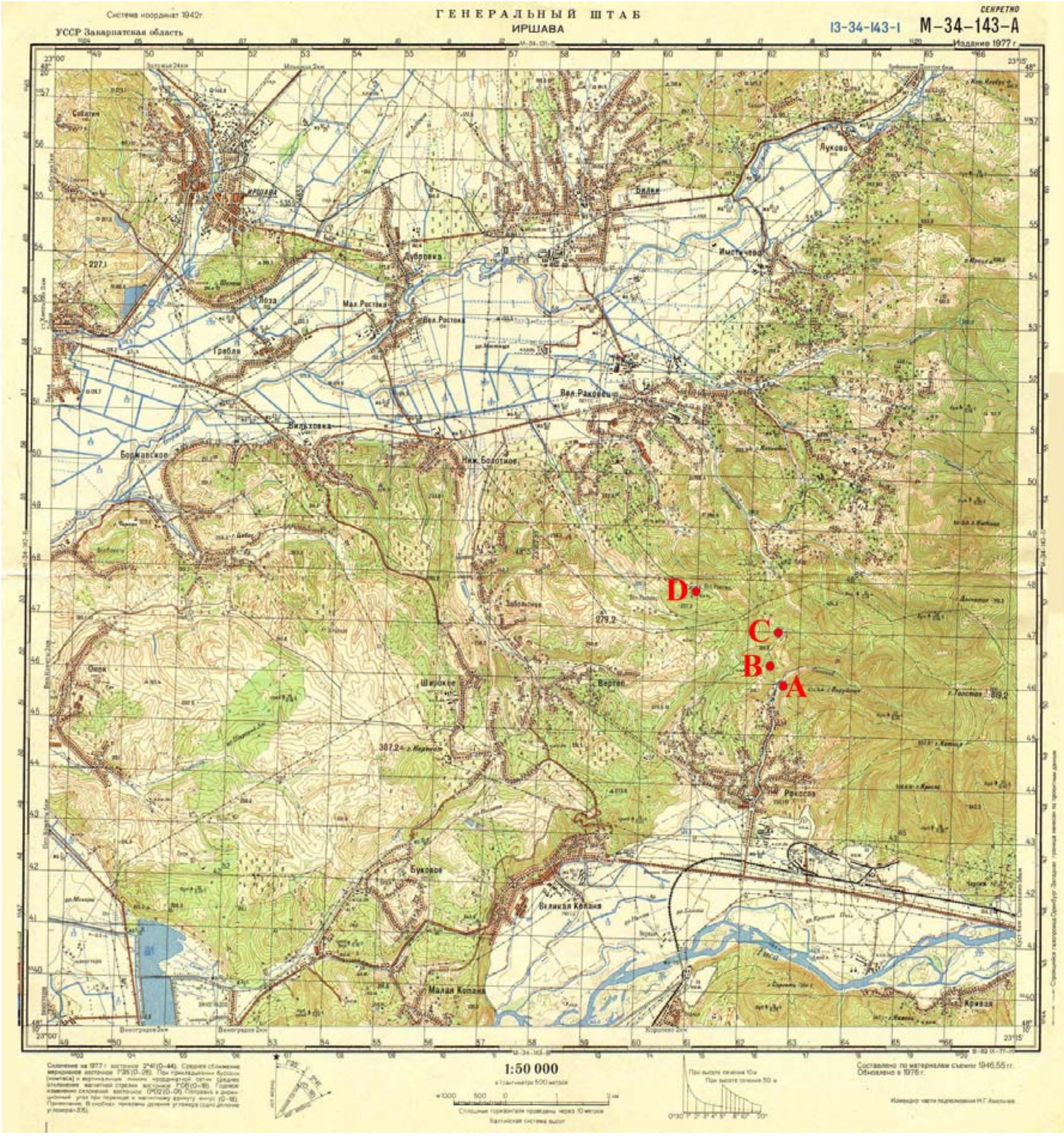
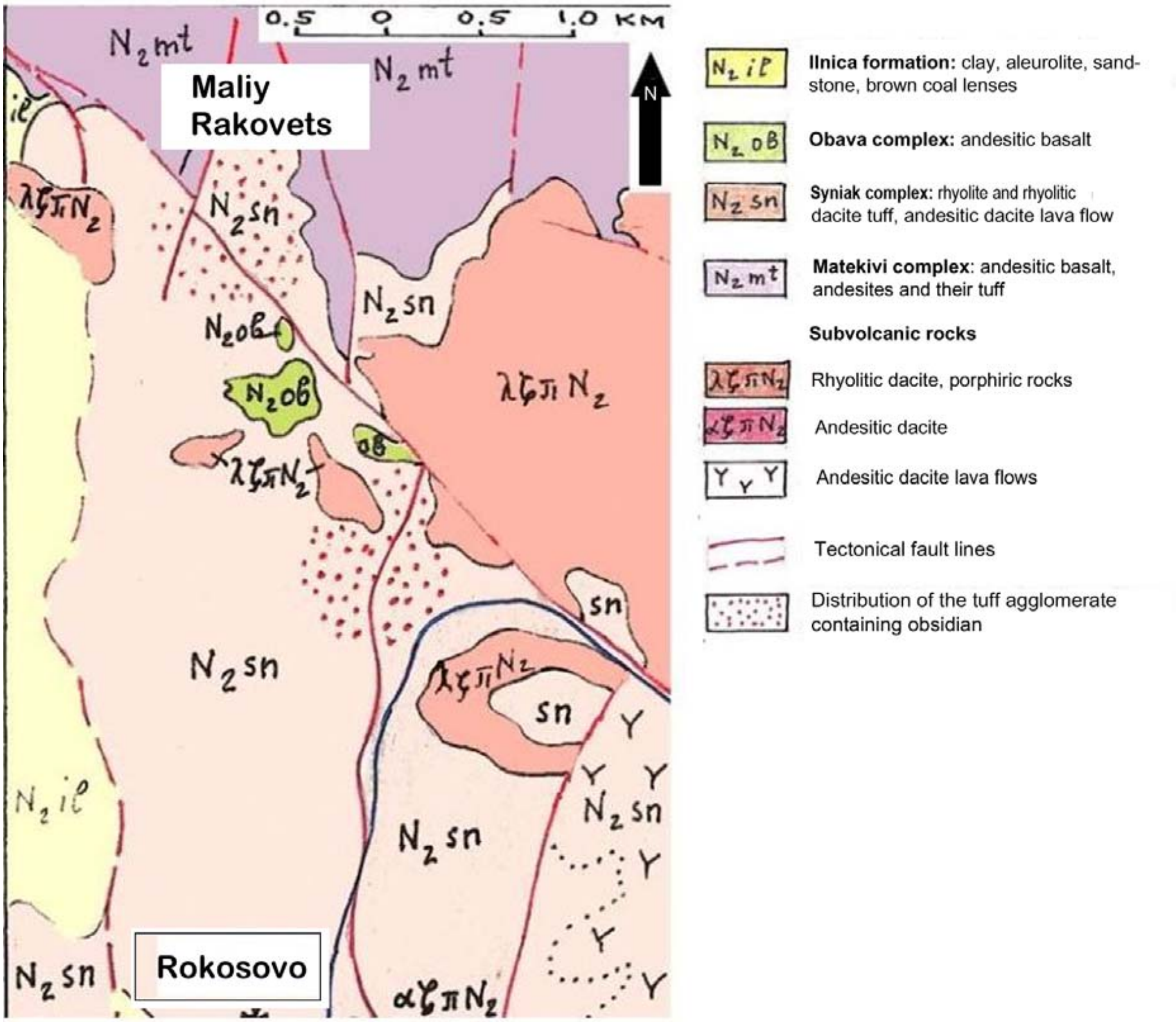
(Participants of the Ukrainian tour will receive a more detailed field guide on spot)

Obsidian from Rokosovo (Rakasz, Transcarpathian Ukraine)
The geological source of the Carpathian 3, i.e. Rokosovo obsidian can be located at the Hust and Irsava districts of Transcarpathian Ukraine between the villages Rokosovo and Maliy Rakovets' (in Hungarian: Rakasz and Kisrákóc). It is part of the Vihorlat-Gutai mountain range at the central part of the Velikiy Sholes mts. (**Map 1.**). The utilisation of the rock for chipped stone artefacts is confirmed by archaeological research for the Lower and Middle Palaeolithic.
The geological environment of the obsidian is outlined on **Map 2**. According to recent radiometric dating of the series (by K-Ar method) obtained on andesite and dacite, the series cannot be younger than Pannonian, dated to 10.61±0.49 Ma (**Pécskay et al., 2000**).
The formation of the obsidian is related to the last acidic phase of the Carpathian Neogene volcanism, that took place in the Pannonian phase of the Miocene period (**Pécskay *et al.*, 2000**). The volcanic activity produced rhyolite, dacite, andesite as well as basalt and their tuffs.
In the times of the formation of the Rokosovo obsidian, the area was covered by a lake where rhyolitic lava gushed in from the eruption centre (**Sobolev et al., 1955**). The quenched lava solidified as volcanic glass, i.e. obsidian. Rhyolitic obsidian occurs in agglomerate tuffs between the two villages (GPS: N48°13'54.0" E23°11'03.4" – N48°13'44.0" E23°11'15.2") in the form of bombs, boulders ranging between a few cm till a few dozen cms. Boulders can be collected West of the road connecting Rokosovo and Maliy Rakovets'. It is often occurring together with blocks of perlite. The natural pieces of obsidian are often accompanied by worked pieces, i.e., artefacts.
Carpathian 3 (C3) obsidian was recently described by **Rosania et al., 2008**. Its detailed description has been the subject of several studies (**Rats, 2009; Rácz, 2012, 2013; Ryzhov, 2014;, Suda et al., 2014; Rácz et al., 2016**). Natural pieces of C3 obsidian typically have a light or darker grey weathering crust, with often weathered mineral inclusions. The fresh broken surface is black with glassy lustre, with macroscopically observable mineral inclusions. The fracture of the rock is conchoidal. It is non-transparent, even in thin flakes. Two sub-types can be separated within C3 obsidians, with more or less grey stripes. (**Rácz, 2013**).
In this section, both varieties have a vitroporphyric texture with visible fluidal character. The matrix contains lighter and darker stripes with microliths and phenocrysts often clustered in aggregates. They comprise plagioclase, orthorhombic and monoclinic pyroxene, amphibole and biotite (**Rácz, 2013**).
Apart from petrographical microscopy, the C3 obsidians were investigated by electron microprobe, ICP-OES and ICP-MS as well as Prompt Gamma Activation analysis. Analysis of geological and archaeological obsidians confirmed that they are of the same source.
The archaeological research of the C3 obsidian started with the work of V. F. Petrun' who separated the 'Rokosovo type' from the obsidian of the Tokaj-Prešov mts. (Petrun', 1972). Archaeological excavations were performed only at the settlement Maliy Rakovets IV (**Ryzhov, 1999, 2003; Ryzhov *et al,* 2009**). More localities are known from surface collections. The collected items were classified as Lower and Middle Palaeolithic.



Map 1.: Topographical map in 1:50 000 scale with planned route of the excursion
A – Parking possibility to the North of Rokosovo by the stream ‘Falusi-patak’.
B – Wooded area with eroded surface with collectable C3 obsidian
C – Road junction to Maliy Rakovets tuff quarry and the Tupoj-Mt. – viewpoint
D – Tuff quarry with stratigraphical sequence.



Map 2.: Simplified geological map of Rokosovo and Maliy Rakovets environs, based on data by **B. Matskiv and V. Kuzovenko** (2003)

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