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OF SOUTHEASTERN EUROPE

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Participants of THE FLOW Conference at Viminacium.



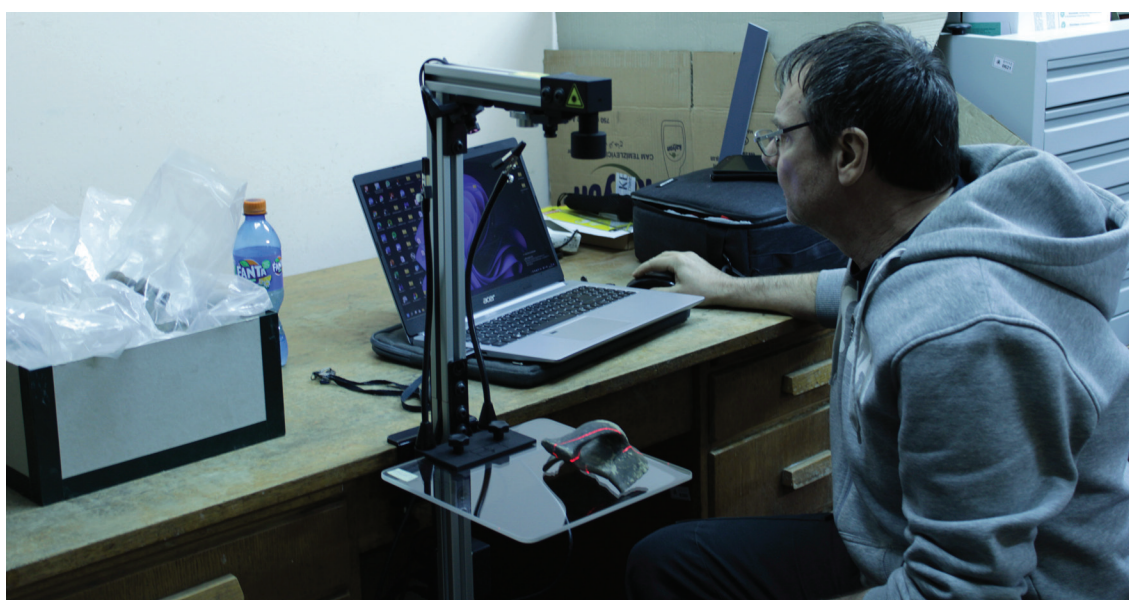
The Kick-Off meeting, presenting the background of the project.



Meeting at the Science Fund of the Republic of Serbia.

The background of **THE FLOW** project developed through individual and coauthored works and publications by its team members. In a sense, each of the team members focused their studies on the subjects of mutual connections between communities of the Metal Ages in the Central Balkans, with particular attention on the origin and circulation of different raw materials, and various forms of material culture. The project officially started in 2022, since it was approved and funded by the Science Fund of the Republic of Serbia, Grant No. 7750074.

The project was imagined as a multidisciplinary collaboration between three institutions, the Institute of Archaeology in Belgrade, Vinča Institute of Nuclear Sciences, and the University of Belgrade - Faculty of Philosophy. The members of the team were gathered together with the idea to optimise the realisation of the project, based on the researchers' fields of study and previous successful mutual collaboration. The principal investigator of the project was Dr. Aleksandar Bulatović (Institute of Archaeology), and the team members were Dr. Aleksandar Kapuran (Institute of Archaeology), Dr. Vojislav Filipović (Institute of Archaeology), Dr. Maja Gajić Kvašček (Vinča Institute of Nuclear Sciences), Dr. Marija Ljuština (Faculty of Philosophy, University of Belgrade), Dr. Ognjen Mladenović (Institute of Archaeology), Dr. Petar Milojević (Institute of Archaeology),¹ and Dr. Bogdana Milić (Spanish National Research Council, Barcelona)²



Pottery sampling, Museum of Mining and Metallurgy in Bor.

The long-distance connections between Copper and Bronze Age communities in the Central Balkans were recognized by the team members as one of the key issues regarding the studies of mobility and migrations in the later prehistory of Europe. One of

¹ At the time, both Ognjen Mladenović and Petar Milojević were enrolled in PhD Studies at the University of Belgrade - Faculty of Philosophy, and mentored by Dr. Marija Ljuština, also a team member.

² At the time Dr. Bogdana Milić was affiliated to the Institute for Oriental and European Archaeology, Vienna.

the issues was the traditional interpretation of the so-called “imports” or foreign objects and raw materials based solely on their stylistic and typological characteristics. Hence, **THE FLOW** project aimed to apply a multidisciplinary research framework on such objects through cutting-edge methods of archaeological science, with a particular focus on provenance studies, spatiotemporal distribution, and the analyses of networks between prehistoric communities. The project was based on a diachronic perspective, covering



Regular meetings of the project team.



Team members at the International Workshop in Vienna.

the period between the mid-5th to the end of the 2nd millennium BCE, or the Copper and Bronze Age in the Central Balkans. The design of the project was based on four complementary case studies, based on artifacts made of copper, obsidian, ceramics, and bronze, in order to evaluate the complex links between production based on locally available raw materials and imported objects/raw materials from other regions.

Through previous research and studies of its team members, **THE FLOW** project had access to various data from a number of well-documented and key archaeological sites for the Copper and Bronze Age in the Central Balkans. Such direct access to a variety of artifacts gave the project the opportunity to revise traditional archaeological and



Sampling of copper axes for isotope analyses, National Museum in Šabac.



Sampling of ceramic vessels from the site of Velika Humska Čuka.

anthropological theoretical frameworks regarding the long-distance connections and offer new models of interactions between prehistoric communities of Southeastern and Central Europe, from the Central Balkans perspective. Some of the main results of the project are distribution maps of targeted artifacts for each of the studied periods, a database of absolute dates, a database of various archaeometric results, and diachronic spatiotemporal models.

During the project duration, the team collected samples and analyzed more than



Taking first steps in magnetometry.

400 pieces of pottery, 90 copper artifacts, 225 bronze artifacts, 35 obsidian artifacts, and 25 deposits of clay and copper in the territory of Serbia. The analyzed artifacts originate from 158 sites, and the team members visited and collaborated with 12 museums. Additionally, the project resulted in 30 new AMS dates and 11 OSL dates.

The dissemination of the project background, methodology, and results was conducted throughout the project duration. In the last 33 months, the team members published 3 articles in international peer-reviewed journals and 3 articles in national peer-



Sampling clay pits in Northeastern Serbia.

reviewed journals. Further, the results of the project were to a certain extent incorporated into 3 monographs and 2 PhD theses. The project was also presented at international conferences, workshops, and fairs in Belgrade, Brugges, Lisbon, Athens, Belfast, Vienna, Barcelona, and Varna, and two national conferences in Prokuplje and Niš.

Besides the scientific results of the project, which are partially published in this volume, **THE FLOW** project acquired several pieces of state-of-the-art equipment that will serve as a solid base for our future research. *The Olympus BTX II Compact Benchtop*



Team members at the 29th EAA Annual Meeting in Belfast, Northern Ireland.

XRD is a portable and compact device designed for precise mineralogical analyses. It has a wide array of applications, of which the most important is its potential to identify and quantify crystalline phases within geological samples. The device has a solid application in pottery provenance analyses, as demonstrated through the analyses conducted as a part of **THE FLOW** project. For testing the nature and magnetic characteristics of potential clay pits in the vicinity of archaeological sites, the project acquired the *Bartington Fluxgate gradiometer Grad601*. It is an instrument that is commonly used in archaeology for detecting variations in the magnetic field. Its high sensitivity and portability make it an elementary tool for non-invasive research, ideal for detecting archaeological features. So

far, the application of the instrument provided outstanding results on a number of projects conducted by the Institute of Archaeology in Belgrade.

The unexpected, yet major result of the project is the establishment of the **VinArh** Center for Archaeometry in 2024, by the Institute of Archaeology and the Vinča Institute of Nuclear Sciences. It was formed with the idea of becoming an accredited interdisci-



Sampling of copper axes, National Museum in Užice.



Team meeting at the Institute of Archaeology.

plinary Center of Excellence, which would conduct wide-scale research and support the works of colleagues from institutions for the protection and study of cultural heritage. Currently, the center offers various analytical services to the archaeological community and encourages the integration of scientific methods into the study of different aspects of cultural heritage. The **VinArh** Center currently possesses an EDXRF spectrometer, XRD instrument, FTIR instrument, instruments for Gamma-ray spectrometry, high-quality stereo and digital microscopes, and professional UV lamps with various wavelengths. Further, the **VinArh** Center possesses a reference collection of clay samples, that is being used for the pottery provenance analyses. The analytical techniques conducted at the Center are



In search for pigments.

focused on the analyses of archaeological materials, such as pottery, metals, stone, and various pigments, with a goal of identifying the origin of raw materials, provenance, and production technologies. The acquisition of new state-of-the-art equipment, as a novelty in the region, is planned in the near future.

Our final step was the organization of the international conference that would gather scholars from different disciplines, institutions, and countries, in order to exchange the most recent results and ideas in the fields of archaeometry, archaeological materials and settlement patterns, metal transmission and communication networks, and general interactions, transmission and transformations in the societies during the Metal Ages. The international conference *Interactions-Transmission-Transformation: Long-distance Connections in Metal Ages of South-eastern Europe* was held at the Domus Scientiarum of the archaeological site of Viminacium, from the 31st of October to the 3rd of November 2024. Parallel to the conference, colleagues had a chance to attend LANTERNA II, an



THE FLOW project at the International Fair of Technics and Technical Achievements.



Presenting at the Kick-Off meeting.

archaeometry conference co-organized by the Academy of Arts, University of Novi Sad. The conference gathered scholars from Austria, Bulgaria, Croatia, Germany, Greece, Hungary, Italy, North Macedonia, Poland, Romania, Serbia, Slovenia, the United Kingdom and the United States of America.

The presentations at the conference, published in this volume and complemented by a number of completely new, thematically related studies, provided

Introduction

a fresh insight into the results of implementing new research techniques, state-of-the-art theoretical approaches, and interpretations, establishing new and consolidating already recognized networks of trade and exchange. A significant number of case studies - on specific categories of artifacts and their archaeological contexts, different raw materials, and deposits - provided a solid base for research into past economic systems and their agents.

Last but not least, we would like to thank our colleagues, friends, and associates for fruitful collaboration during the realization of the project.

THE FLOW team



Preparing the samples for pottery provenance analyses.

OBSIDIAN ARTEFACTS IN POST-NEOLITHIC CENTRAL BALKANS: EXPLORING ASSEMBLAGE FEATURES AND REGIONAL DYNAMICS

Bogdana Milić¹
Ognjen Mladenović²
Marija Ljuština³
Vojislav Filipović⁴
Aleksandar Bulatović⁵

Abstract: The study of obsidian artefacts in the Central Balkans has predominantly focused on the Neolithic period, leaving the role of this material in the subsequent Copper (Eneolithic) and Bronze Ages largely underexplored. This paper presents the initial results of a detailed technological analysis of 39 obsidian artefacts recovered from four archaeological contexts dated between 5th and 2nd millennium BC in Serbia. The study examines the features related to the production and use of these artefacts and it is complemented by macroscopic observations of their colour, texture, transparency, and banding. The analysis provides insights into the characteristics of obsidian products, suggesting that they were most likely imported as ready-made products (mainly blades) and thicker flakes or chunks, while highlighting evidence of further on-site full exploitation towards exhaustion. The primary objective of this study is to contribute to our understanding of the post-Neolithic use of obsidian at sites in the central Balkans located far from known sources, while also laying the groundwork for future provenance studies and broader interpretations of exchange systems.

Key words: Obsidian, Eneolithic, Bronze Age, Central Balkans, Exchange Networks.

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Introduction

Obsidian, a volcanic glass renowned for its exceptional sharpness and knapping properties, has held a prominent position in the prehistoric archaeological record. Its appeal as a raw material comes not only from its excellent physical properties but also from its perceived exotic nature, which made it a desirable commodity in prehistoric exchange systems. In regions far from well-known sources, the presence of obsidian often signifies participation in long-distance trade networks and cultural interactions, reflecting complex socio-economic dynamics.¹ During the Neolithic period, obsidian was extensively utilized across Southeast Europe and beyond, demonstrating its undeniable practical value. However, its procurement and distribution were not merely economic activities; they were integral to the social organization and technological choices of early farming communities, playing a crucial role in shaping interactions across different regions.²

Obsidian artefacts found in the Central Balkans are exclusively of exogenous origin, as no local sources containing knappable obsidian raw materials have been identified in the study area. The nearest obsidian outcrops are located in the Carpathians to the north and on the Aegean islands to the south. In the Central Balkans, obsidian artefacts were used throughout the Neolithic period, already from the Early Neolithic Starčevo phase in the final centuries of the 7th and first half of the 6th millennium BC,³ but most extensively during the Late Neolithic period of the Vinča culture (second half of the 6th to the first half of the 5th mill. BC).⁴ Previous provenance studies have shown that obsidian use in the Late Neolithic was predominantly associated with Carpathian sources, primarily Carpathian 1, while at some sites, such as Vinča-Belo Brdo, the presence of Carpathian obsidian became surprisingly numerous in the assemblages in 6th millennium,⁵ despite the sources being approximately 400 km away. This extensive use suggests the existence of well-established long-distance exchange routes and a sustained demand for high-quality raw materials. However, potential links to specialized production or symbolic practices known from the other contexts in Anatolia or Aegean,⁶ remain uncertain and require further investigation in the Balkan case.

Despite this documented presence of obsidian in Neolithic contexts, its use in the subsequent Eneolithic and Bronze Age periods in the Central Balkans remains extremely poorly understood. As societies transitioned into these periods, profound socio-economic changes – such as the advent of metallurgy and shifting subsistence strategies – likely influenced the perception and utilization of obsidian. In general, chipped stone artefacts have received little attention during these periods, as their use coincides with the gradual introduction of metal technologies, raising important questions about continuity and change in lithic traditions. Furthermore, the extent to which obsidian continued to be valued and utilized in post-Neolithic contexts, whether for functional or symbolic purposes, has not been systematically explored.

This paper is the first attempt by the authors to address this research gap by focusing on obsidian artefacts from post-Neolithic contexts in the Central Balkans, specifically modern-day Serbia. Within the framework of the FLOW project (*Interactions-Transmission-Transformation: Long-distance connections in the Copper and Bronze Age of the Central Balkans*), obsidian finds

¹ E.g. Renfrew 1969; Tykot 1996; Ibáñez et al. 2015.

² Perlès 2001.

³ Several obsidian artefacts from the site of Svinjarička Čuka have been analyzed by B. Milić and M. Brandl and are awaiting provenance study results.

⁴ Tripković 2004; Bogosavljević-Petrović 2015.

⁵ Tripković, Milić 2009; Milić 2016, 211.

⁶ Milić 2019a; 2019b.

from both old and recent excavations in the country have been examined to gain insights into the production and circulation of exotic goods.

The primary objective of this study is to conduct a detailed techno-typological analysis of obsidian artefacts recovered from four archaeological sites in Serbia (fig. 1), and provide first macroscopic observation of finds. By examining their technological attributes, potential function, and raw material characteristics, including colour, texture, transparency and banding, the study aims to provide a foundational understanding of the role of obsidian in post-Neolithic contexts. Additionally, it seeks to lay the groundwork for future provenance studies and broader interpretations of exchange systems in the region, ultimately contributing to a deeper understanding of long-distance interactions and resource management strategies in the Central Balkans.

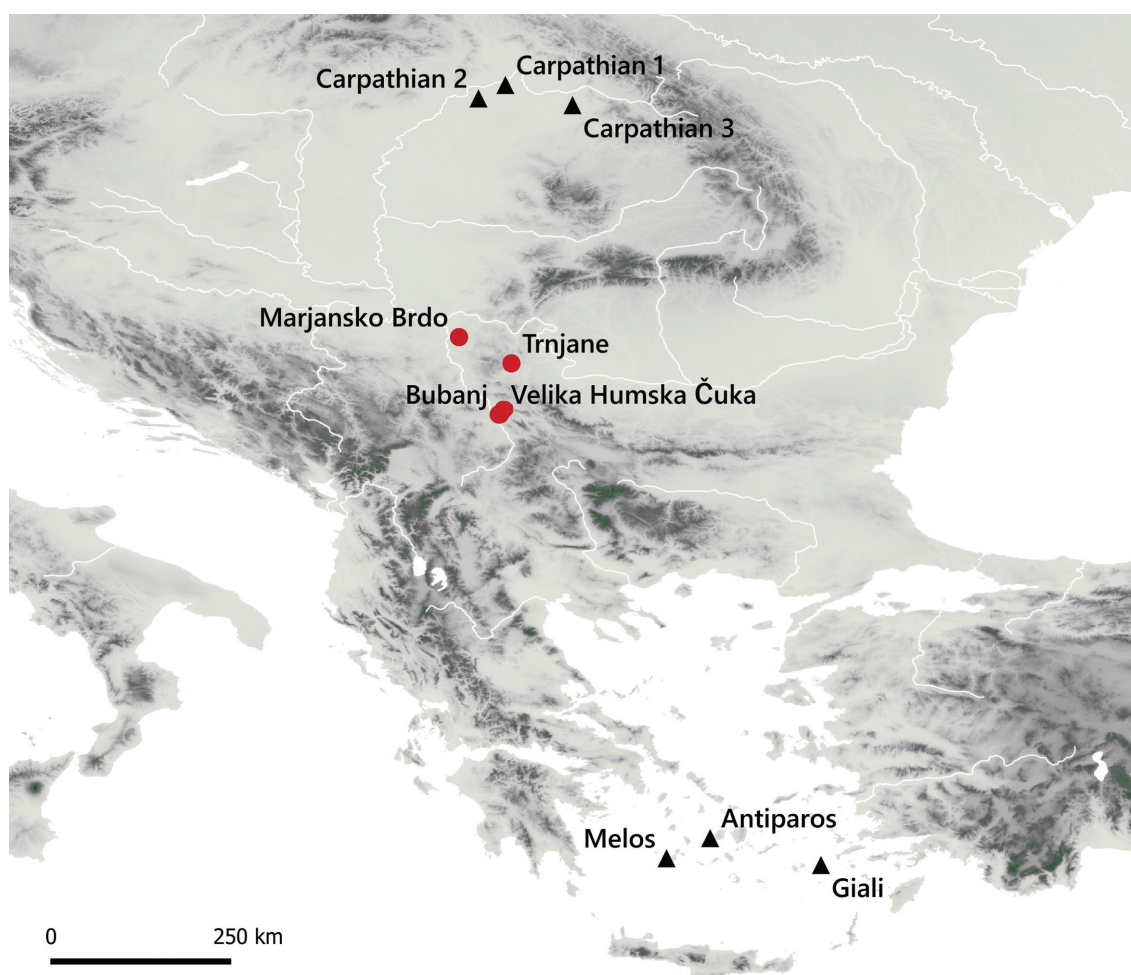


Fig. 1 – Distribution of known obsidian sources and the sites analysed in this study (© B. Milić).

Materials and method

This study examines a total of 39 obsidian artefacts recovered from four archaeological contexts across eastern and southeastern Serbia. The analysed collections originate from distinct sites representing also different chronological and cultural phases (spanning between the second half of the 5th and the 2nd mill. BC), although the majority comes from the Early Eneolithic context. The sites included in the study are as follows:

• **Marjansko Brdo** (near Veliko Gradište): Three obsidian artefacts were recovered from Marjansko Brdo most recent excavations in 2023 by the Institute of Archaeology team (Belgrade), where the chronological framework lined to finds is rather complex. One artefact is securely attributed to the Late Eneolithic, another to the Late Bronze Age, and the third was found above a Vinča culture house but in a stratigraphic context mixed with Late Bronze Age (Žuto Brdo group) materials (fig. 2:a).

• **Bubanj** (Niš): The collection from Bubanj consists of four obsidian artefacts, with one recovered during the 2009 excavations and three from the 2014 excavations led by A. Bulatović from the Institute of Archaeology in Belgrade (fig. 2:b). The artefact from 2009 originates from an Early Eneolithic context, while the three artefacts from 2014, although primarily associated with the Early Eneolithic phase, show evidence of potential stratigraphic mixing with Middle Eneolithic layers. Notably, these three artefacts are the only ones published to date from the entire assemblages concerned in this paper.⁷

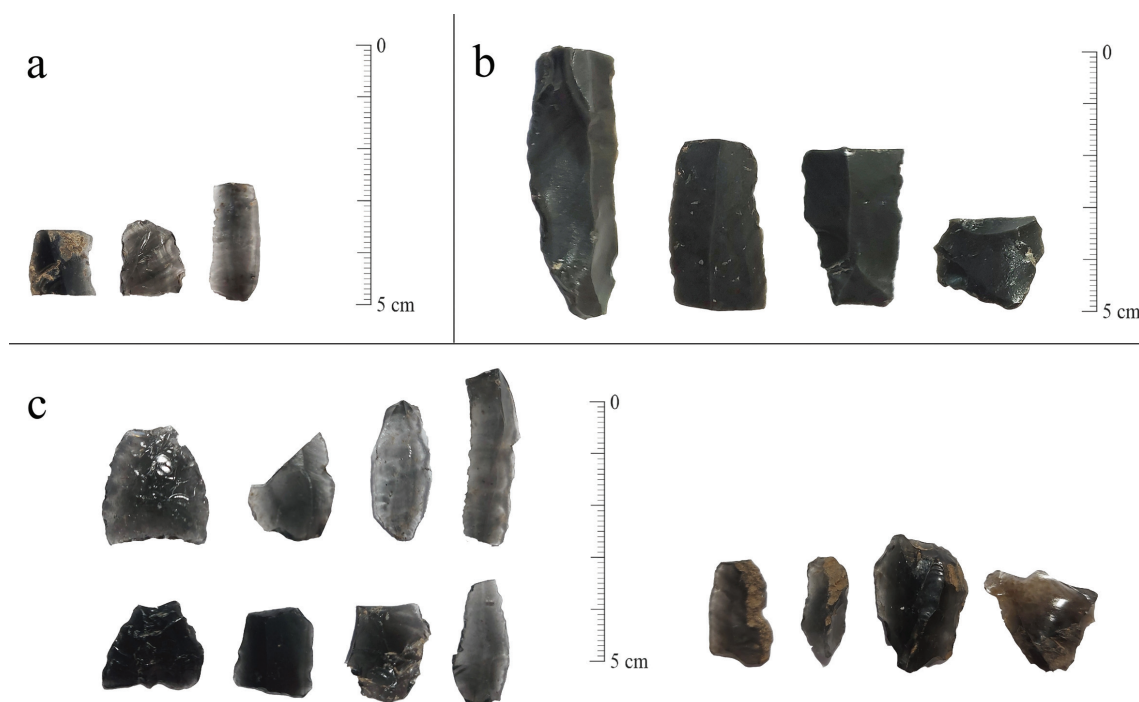


Fig. 2 - Obsidian from the studied sites/excavations
(a-Marjansko brdo, b-Bubanj, c-part of Velika Humska Čuka collection) (© B. Milić).

• **Velika Humska Čuka** (Niš): This site yielded the largest collection of obsidian in this study and, until now remains the most extensively documented post-Neolithic obsidian assemblage in the Central Balkans for this period, comprising 31 obsidian artefacts. Fourteen artefacts, which were recovered during the excavations of A. Bulatović, Institute of Archaeology, Belgrade conducted between 2014 and 2021, are securely dated to the Early Neolithic based on recent stratigraphic investigations. Additionally, 17 artefacts were found during earlier excavations in 1934 and 1954, which, according to archival records and documentation, are most likely all associated with the Early Eneolithic (fig. 2:c). The entire assemblage from this site is attributed to the second half of the 5th millennium BC.⁸

⁷ Šarić 2020, fig. 8:3,4, 399, fig. 9:1, 400).

⁸ Bulatović et al. 2018.

- **Trnjane** (near Bor): This is a single obsidian artefact (fig. 3), discovered during a survey around the settlement and necropolis at Trnjane. The entire archaeological material from this site is attributed to the Middle Bronze Age, dated to 1900–1700 cal BC, which could suggest the same dating of obsidian find in the direct vicinity of the site as well.⁹

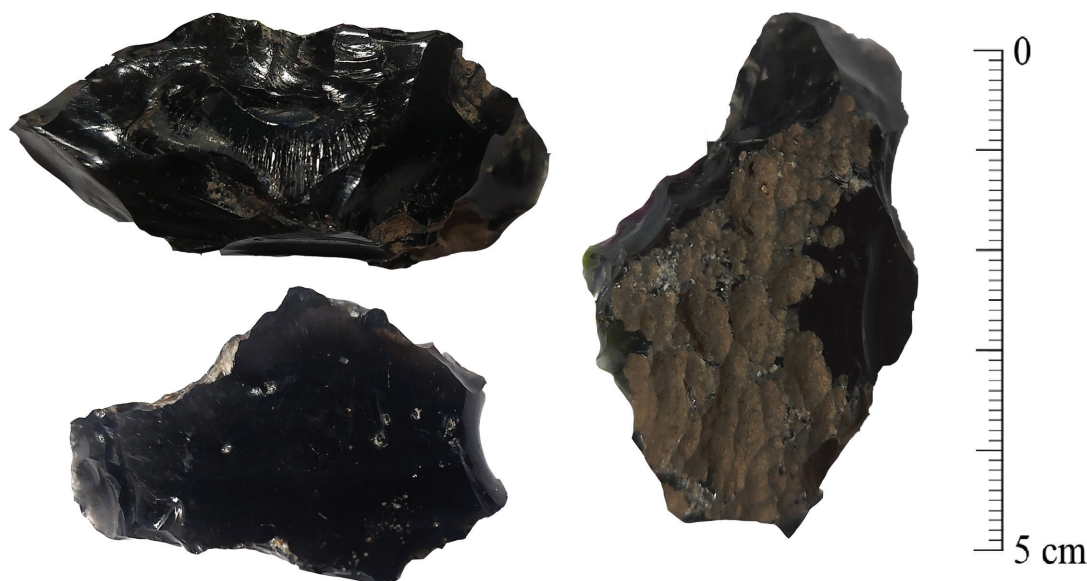


Fig. 3 - Obsidian from the survey of Trnjane (© B. Milić).

The techno-typological analysis in this study is based on a structured database comprising 35 recorded attributes per artefact, following the methodology established for documenting obsidian artefacts in Anatolia and the Aegean.¹⁰ The database categorizes artefacts into core types, core maintenance elements, central blades, flakes, and debris. Key aspects such as core reduction strategies, knapping direction on cores and blanks, platform preparation and butt types, platform and surface treatments, blade shape-profile-section features, among others are systematically recorded to reconstruct production techniques and overall aim of production. Additionally, the presence of cortex is documented, alongside precise measurements of artefact size and weight. Further analysis records secondary modifications of blanks by assessing the continuity and position of retouch, distinguishing intentional retouch from natural edge damage and artefacts with edge use without modification. Macroscopic characterization of raw materials focuses on the visual characteristics of the artefacts, including colour (black, grey), surface texture (shiny/matt), transparency ((semi-)transparent, glass-like) and banding (if present), allowing for a refined assessment of material properties, while serving as an initial step in provenance studies. Final aims of these studies are to determine whether obsidian artefacts were introduced as ready-made tools, or blanks and small unworked nodules for local production.

⁹ Kapurran et al. 2020.

¹⁰ Milić 2018.

Results

The obsidian assemblage from **Marjansko Brdo** consists of three fragmented blades of relatively small size (fig. 2:a), with the largest measuring 22.2 mm in length. Two of the blades exhibit different core reduction strategies – one showing unidirectional and the other bidirectional reduction – both achieved through percussion techniques. Additionally, one blade has retouch, while the other displays macroscopic use-traces along the edges. The third artefact, a medial blade fragment, was turned into mini core, as evidenced by the extraction of tiny micro-blades through bipolar percussion supported by an anvil. This process is indicated by the preparation of a “platform” through truncation and an end-crushing. The blades range in weight from 0.57 to 0.88 g and share consistent macroscopic characteristics, being grey, shiny, and transparent.

The obsidian assemblage from **Bubanj** consists of four artefacts – three blades and one flake – exhibiting distinct technological characteristics. Among the blades, two are central fragments (without traces of cortex or preparation traces, coming from the central phase of core reduction), while the third originates from core preparation or rejuvenation, as indicated by the presence of a crest, however without implying on-site production. The blades, all unidirectional and preserved as proximal or medial fragments, are ranging in lengths between 30 and 50 mm. In contrast, the flake, which is the only complete unfragmented piece in the assemblage, is shorter, measuring 15 mm in length and displaying a hinged termination and a hard percussion butt. Notably, one blade fragment is likely a fragment of a much longer pressure blade, potentially produced using standing pressure with a long crutch. The artefacts vary in weight, ranging from 1.7 to 5.5 grams per piece. The assemblage differs significantly from others in terms of raw material properties, with all pieces exhibiting a dark grey color, either matt or slightly shiny, but lacking any transparency. Two pieces show parallel lighter gray bands.

The obsidian assemblage from **Velika Humska Čuka** represents the largest collection in this study, comprising 31 artefacts distributed across different excavation sectors. The analysis of primary blank production reveals an almost equal distribution of flake and blade blanks, followed by lateral (cortical or crested) blades and flakes, with a small number of cores also present (fig. 4). The core assemblage includes two bipolar cores set on anvils, both associated with blade and flake recycling. One of these cores is a thick flake with regular bladelet removals and crushed ends, measuring over 30 mm in length. The other core made on a thicker flake, exhibits only a few removals, suggesting it was tested but not fully utilized. Additionally, four specimens derive from the core preparation or rejuvenation stage prior to the central reduction phase. These include cortical and crested blades, a plunging blade, and a crested flake. The central blades are predominantly unidirectional, with only three fragments displaying regularity indicative of pressure blade production. The remaining blades were likely produced through direct percussion, as suggested by their large, often natural, non-prepared or faceted butts, or perhaps in some cases, indirect percussion. The flake assemblage consists mainly of small flakes under 25 mm, along with flake fragments measuring between 20 and 30 mm. Additionally, a few bipolar flakes, produced as by-products of anvil-supported production, suggest that on-site knapping activities likely took place. This interpretation is further supported by the presence of reused flakes repurposed as cores, also set on anvils. Fragmentation is consistently high across the entire assemblage, with artefacts reaching a maximum length of 35 mm. The majority of pieces weigh between 0.2 and 2 grams, with a few larger, thicker artefacts ranging from 3.2 to 3.7 grams. Additionally, one flake that was reused as a core weighs 6 grams.

The typological analysis of **Velika Humska Čuka** assemblage reveals that 41.9% of artefacts are secondarily modified blanks with retouch, while an additional 16% exhibit traces of use without initial edge modification (based on edge scaling). Only three pieces display traces that appears to be associated with post-depositional alteration rather than intentional use due to discontinuity and random orientation of little edge removals. The assemblage presents a diverse range of tool forms, with a notable emphasis on blade-based tools (fig. 5) although number of flake blanks in the assemblage was even higher (fig. 4). The most represented category consists of macroscopically used blades (without retouch), accounting for the highest frequency (n=5). Laterally retouched blades, with either one or both edges modified, are also well-represented (n=4). Bifacially retouched arrowheads, with either one or both edges modified, are the most chronologically sensitive category due to their fully covering retouch.

One complete arrowhead is preserved, measuring 30 mm in length, while the other two are either laterally fractured or broken at the tip. However, further microscopic analysis is needed to determine whether these tip fractures are linked to impact damage from hunting or projectile-related activities, as macroscopic observations alone are not diagnostic. The presence of other tool types, such as truncations (n=2), end-retouched flakes (n=1), an end-scraper (n=1) for instance, can provide new insights into the use of tools on the site with the assistance of functional studies planned in the future.

Macroscopic observations of the **Velika Humska Čuka** obsidian assemblage reveal variability in raw material characteristics. The majority of the assemblage consists of glass-like transparent pieces (n=11), followed by regular grey transparent obsidian (n=10). Ad-

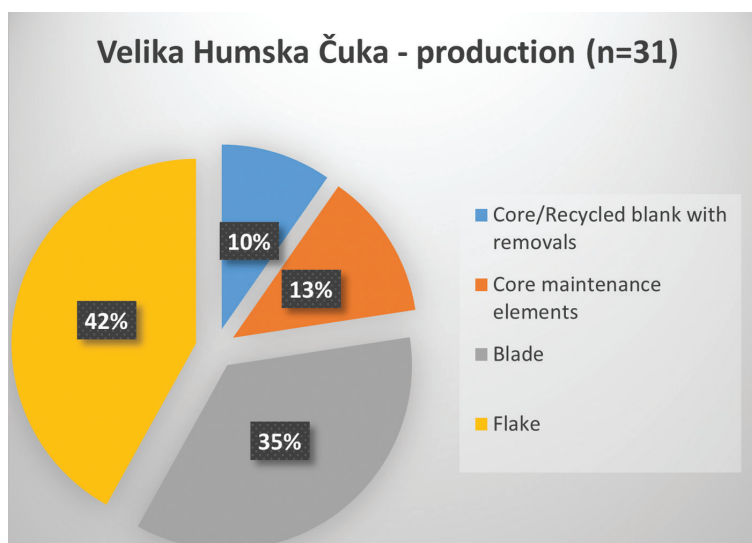


Fig. 4 - Obsidian technological categories and tool types at Velika Humska Čuka (© B. Milić).

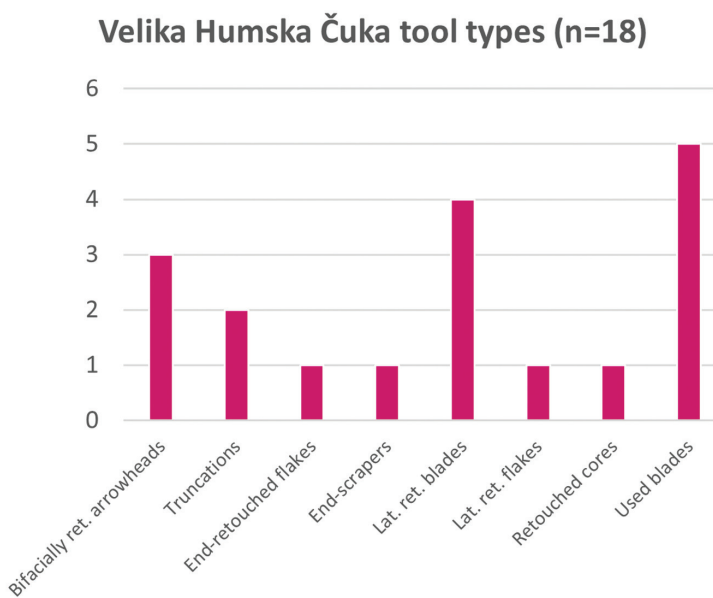


Fig. 5 Obsidian tool types at Velika Humska Čuka (© B. Milić).

ditionally, a significant number of artefacts (n=8) exhibit semi-transparent grey attributes. Surface alterations are observed on two artefacts – one displaying grey transparent material with patina, and another showing semi-transparent grey material with minor patina and surface rubbing traces. These variations in macroscopic features – such as transparency, patina, and surface alterations can provide insights into raw material selection, potential exposure conditions, and post-depositional processes affecting the assemblage. However, apart from a certain number of glass-like translucent artefacts from the site, the assemblage contains many thin pieces resulting from the additional knapping of thicker flakes. This secondary reduction process makes the thinner artefacts appear more transparent compared to naturally thicker pieces, and are unlikely to be different in sources from the other studied assemblages that lack his features.

Finally, the single obsidian artefact from the **Trnjane survey** is a thick flake measuring 30.8 mm in length, 20.7 mm in width, and 1.6 mm in thickness, with a weight of 13.84 grams. The flake retains cortex covering approximately 80% of its dorsal side, suggesting that it was initially brought to the site either as a cortical unprepared larger chunk or cortical flake. However, evidence of additional local knapping is indicated by small flake removals, marking a second phase of use as a recycled flake. The obsidian is black, shiny, and semi-transparent, likely due to its thickness.

Discussion and future directions

The initial study of obsidian artefacts collected within the FLOW research project confirms that obsidian continued to be exchanged across the Central Balkans long after the Neolithic period, persisting until the 2nd millennium BC. However, a gradual decline in quantities is observed after the mid-5th millennium BC, with a significant drop during the Bronze Age. This suggests a shift in material preferences and exchange dynamics over time, evolving in parallel with the introduction and intensification of metal use. While obsidian was often perceived as an exotic material valued for its aesthetic appeal, the assemblages analyzed in this study demonstrate that it was also intensively used and recycled on-site, indicating an additional utilitarian and economic value that extended its lifecycle alongside its symbolic significance. This long-term utilization highlights the adaptability and importance of obsidian beyond its initial procurement.

Post-Neolithic obsidian in the Central Balkans was not exclusively imported in the form of carefully selected blanks or ready-made blades; the assemblages under study also include cortical artefacts and core preparation by-products, potentially indicating indirect procurement of the raw material. The presence of crested and plunging flakes, as well as small bipolar and larger flakes, suggests that obsidian imports were then re-knapped at the sites, including also partially reduced cores and unmodified nodules that were arriving initially. This implies a flexible procurement strategy that balanced external acquisition with local reduction activities.

Evidence from Marjansko Brdo and Velika Humska Čuka reveals a clear pattern of on-site core reduction and recycling, despite the limited number of pieces (three) available from the former site, which come from completely different chronological contexts. Imported blanks were locally knapped, producing by-products that were further utilized or repurposed, extending the functional lifespan of the raw material. Flakes and blades were

reworked after primary use with additional but likely minimal preparation, suggesting a practical approach to resource management. In particular, the assemblage from Velika Hum-ska Čuka provides compelling evidence for the full exploitation of obsidian, with flakes and blades being repurposed through secondary modifications and in several case re-knapping on anvils, for which both “cores” and by-products are recorded. The controlled reduction of small pieces, supported by anvil techniques, represents an opportunistic behavior rather than a culturally transmitted practice. This pattern of resource efficiency is consistent with other assemblages from Southwest Asia to the Balkans, spanning various periods, including the Epipaleolithic, Neolithic, and Chalcolithic.

The typological diversity within the Velika Humska Čuka assemblage suggests a mixed technological approach, combining formal tool production with expedient use. The presence of bifacially retouched arrowheads indicates specialized activities alongside everyday domestic tasks, which were likely maintained by retouched blades which appear in the assemblages most commonly among the varieties of tool types. However, these observations remain preliminary until further use-wear analyses are conducted.

The collections presented here highlight possible variability in exchange networks, particularly evident at Bubanj, where the “largest” blade fragments exhibit distinctive macroscopic characteristics – appearing matt grey and exclusively non-transparent. This differs from other assemblages and potentially suggests an alternative procurement network. The presence of obsidian in Early Eneolithic contexts at Bubanj, despite potential stratigraphic mixing, aligns with observations that the procurement of exotic raw materials, such as Balkan flint, continued after the Late Neolithic Vinča period.¹¹ This pattern underscores the sustained importance of specific raw materials in lithic production during the transition from the Neolithic to the Eneolithic.

The collections presented here highlight possible variability in exchange networks, particularly evident in the Bubanj site, where the “largest” blade fragments exhibit distinctive macroscopic characteristics – appearing matt grey and non-transparent. This differs from other assemblages and potentially suggests an alternative procurement network. The presence of obsidian in the Early Eneolithic contexts at Bubanj, despite potential stratigraphic mixing, aligns with observations that the use of cherts and opals, alongside procurement of exotic raw materials including other raw materials such as Balkan flint in a way continued after the Late Neolithic Vinča period. This pattern highlights the sustained importance of specific raw materials in lithic production during the transition from the Neolithic to the Eneolithic. However, future studies will aim to determine whether these procurement patterns were exclusively linked to the same cultural connections, and in this case with communities in the Pannonian Basin, evidenced by the presence of ceramic forms typical of Pannonia found alongside Bubanj–Hum I materials as already suggested,¹² or if multiple exchange networks existed, therefore introducing new trade routes after the end of the Neolithic. Provenance analyses of obsidian artefacts will provide further insights into the complexity of exchange systems and the broader socio-economic dynamics of the Early Eneolithic in the Central Balkans. The presence of dark grey, semi-transparent, and banded obsidian material from Bubanj, which is at least macroscopically different from the Carpathian 1, but also Carpathian 2 sources, has the strongest potential to examine the existence of southern connections based on lithic raw materials.

¹¹ Šarić 2020, 390.

¹² Bulatović 2020, 32.

This study demonstrates that obsidian in the post-Neolithic Balkans was more than an exotic traded good; it held intrinsic value at the local level, being carefully curated, recycled, and used until its complete exhaustion. The evidence of on-site processing, core reduction, and secondary modifications reflects a complex *chaîne opératoire* that maximized the utility of this prized material. While this paper provides initial insights into the *nature of obsidian exchange*, future provenance analyses will refine our understanding of *exchange directions*, shedding further light on resource procurement strategies and the interconnectedness of the Balkans with surrounding regions.

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