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**11<sup>TH</sup>**  
INTERNATIONAL  
SCIENTIFIC  
CONFERENCE  
METHODOLOGY & ARCHAEOLOGY  
Zagreb, 7<sup>th</sup> – 8<sup>th</sup> December 2023

## **IMPRESSUM**

### **PUBLISHER**

Faculty of Humanities and Social Sciences of the University of Zagreb  
Ivana Lučića 3, HR-10000 Zagreb

### **FOR THE PUBLISHER**

Domagoj Tončinić

### **EDITOR**

Ina Miloglav

### **DESIGN & DTP**

Srećko Škrinjarić

ISBN: 978-953-379-132-6

### **CONFERENCE ORGANISED BY**

Department of Archaeology, Faculty of Humanities and Social Sciences of the University of Zagreb  
and the Croatian Archaeological Society

### **FINANCIAL SUPPORT**

This year's conference has been financially supported by the Croatian Archaeological Society and the Faculty of Humanities and Social Sciences of the University of Zagreb.

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## eBook of abstracts

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**T**he scientific conference *Methodology and Archaeometry* is being organised by the Department of Archaeology, Faculty of Humanities and Social Sciences since 2013. The goal of the conference is to entice interdisciplinarity, critical thinking, new insights and approaches as well as new theoretical frameworks in contemporary archaeological science.

Coverage of a wide spectrum of themes and scientific disciplines has resulted in papers and discussions that promote scientific issues in the fields of methodology, documentation and interpretation of archaeological data.

The interdisciplinary character of the conference brings together archaeologists and researchers from other scientific disciplines with whom archaeologists collaborate closely; and who – through their work, projects and ideas – promote new insights about Interpretation of the human life in the past. Coverage of a wide spectrum of themes and scientific disciplines has resulted in papers and discussions that promote scientific issues in the fields of methodology, documentation and interpretation of archaeological data.

The interdisciplinary character of the conference brings together archaeologists and researchers from other scientific disciplines with whom archaeologists collaborate closely; and who – through their work, projects and ideas – promote new insights about Interpretation of the human life in the past.

### **Section Methodology**

Obtaining and collecting data is an essential part of the archaeological research process. How we collect and interpret data defines the validity of our interpretation. We use different techniques, approaches and tools which help us to reconstruct past processes and to give a more objective and comprehensive picture of the past. Contemporary interpretation tools alleviate and speed the data collection and also provide us with countless possibilities for the interpretation, protection and presentation of archaeological sites and the landscapes encompassing them.

### **Section Archaeometry**

Having in mind the limited information we obtain from archaeological excavations and from the classification of archaeological material, cooperation with other scientific disciplines becomes necessary, to obtain as much information as possible on the conditions and the way in which humans lived in the past. Contemporary archaeology is a very heterogeneous discipline encompassing interest groups focussed on various periods, regions, theoretical frameworks and methodological techniques. Aside from the description of mechanical and physical features of a specific artefact or material, various archaeological analyses help us to direct our scientific focus to questions regarding the ways and features included in the social and cultural life of people who made, used, exchanged and discarded those objects. Cooperation with the natural sciences provides answers to many questions, but it also demands an additional level of caution when selecting adequate scientific analysis for a specific archaeological problem. It also demands continuous cooperation of a specific expert and an archaeologist from sample collection to the final interpretation.

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## *PROGRAMME*



## Thursday, 7<sup>th</sup> of December

10:00 – 10:15

*Conference opening*

**Keynote lecture:**

*Chair: Ina Miloglav*

10:15 – 10:55

**Mario Novak**

*Novel analytical methods in (bio)archaeology - some examples from Croatia*

11:00 – 11:30

**Coffe break**

**Session 01**

*Chair: Jacqueline Balen*

11:30 – 11:45

**Zoran Čučković**

*Introducing the total mobility field: an algorithmic solution for the analysis of prehistoric mobility practices*

11:50 – 12:05

**Dimitrij Mlekuž Vrhovnik**

*Assesing human impact and past land use patterns on Kras using airborne laser scanning data*

12:10 – 12:25

**Miroslav Vuković, Janja Mavrović Mokos & Franka Ovčarić**

*Prehistoric sites on LiDAR data in the region of Prigorje*



12:30 – 12:45

**Martin Bažoka, Filomena Sirovica, Mario Bodružić & Lujana Paraman**

*Field survey methodology and lithic scatters in Dinaric karst landscapes – a case study from Bristivica in the Trogir hinterland*

12:50 – 13:10

**Coffe break**

**Session 02**

**Chair: Miroslav Vuković**

13:10 – 13:25

**Nikolina Nikolova**

*Identifying phases of construction, maintaining and refilling of ditch enclosures. Case studies from the Early Neolithic of Upper Thrace*

13:30 – 13:45

**Saša Kovačević**

*Building materials and the constructional sequence of the burial mound Gomila in Jalžabet*

13:50 – 14:05

**Luka Gruškovnjak, Agni Prijatelj, Petra Vojaković, Jaka Burja, Barbara Šetina Batič, Manca Vinazza, Borut Toškan, Tjaša Tolar, Rok Brajkovič, Helena Grčman & Matija Črešnar**

*The floor of a smithy under the microscope*

14:10 – 14:25

**Selena Vitezović**

*Rabbit holes of bone technology: production and the use wear of perforations on bones, shells and teeth*

14:30 – 15:30

**Lunch break**

**Session 03**

**Chair: Filomena Sirovica**

15:30 – 15:45

**Predrag Đerković**

*The use of 3D photogrammetry in analysing the Roman epigraphic monuments: a case study from Kremna village*

**15:50 – 16:05**

**Domagoj Perkić & Miroslav Vuković**

*Image-based 3D models of late medieval tombstones – Stećci*

**16:10 – 16:25**

**Andrej Bašić, Tina Bareša, Ana Curić, Željana Bašić, Ivan Jerković & Ivana Kružić**

*Creating a physical 3D atlas of cranial morphological traits: a pilot study*

**16:30 – 16:45**

**Predrag Novaković**

*On Epistemic Relationship between Academia and Practice*

**16:50 – 17:00**

**Coffe break**

**Session 04**

**Poster presentation**

**17:00 – 17:30**

**Valentina Lončarić, Mafalda Costa, Hrvoje Potreblica & Degryse Patrick**

*Archaeometric investigations of Iron Age amphora-shaped glass beads from Gradac near Pleternica (Croatia)*

**Sara Igljić & Šime Vrkić**

*The fortified site of Babin grad, Croatia*

**Petra Nikšić & Jana Škrgulja**

*Interpretation of the northern part of the late antique hilltop settlement in Lobar, northwestern Croatia, based on the spatial distribution of pottery finds*

**Gil Vilarinho**

*Seeing the Unseen: Assessing the scope and limitations of remote sensing data for the study of Iron Age hillforts in northern Portugal*



## Friday, 8<sup>th</sup> of December

### Session 05

*Chair: Selena Vitezović*

**10:00 – 10:15**

**Dijana Škorić, Renata Šoštarić, Olivera Maksimović Carvalho Ferreira, Lana Vogrinec, Jurica Bezak & Denis Kutnjak**

*Do antique olives have antique viruses and how do we investigate that?*

**10:20 – 10:35**

**Petra Petković, Sara Essert & Mladen Pešić**

*Archaeobotanical research of the Roman port Barbir in Sukošan (Croatia)*

**10:40 – 10:55**

**Ilaria Calgaro, Miljana Radivojević, Mark Altaweel, Paula Doumani-Dupuy & Antonina Yermolayeva**

*Metal production in the Eurasian Steppe Bronze Age Case studies from the 2nd millennium BC sites of Taldysai, Myrzhyk and Koken (Kazakhstan)*

**11:00 – 11:30**

**Coffe break**

### Session 06

*Chair: Jasna Vuković*

**11:30 – 11:45**

**István Fórizs, Kata Dévai & Friderika Horváth**

*Glass vessels from the fortress of Ságvár (Pannonia): Preliminary results*

**11:50 – 12:05**

**Jurica Bezak & Stefano Nisi**

*The provenance of the Roman lead ingots cargo from the Pupak shallows shipwreck site in the Adriatic Sea*

**12:10 – 12:25**

**Mirja Jarak & Andreja Sironić**

*Building phases of the triconch church complex at Bilice with regard to mortar dating*

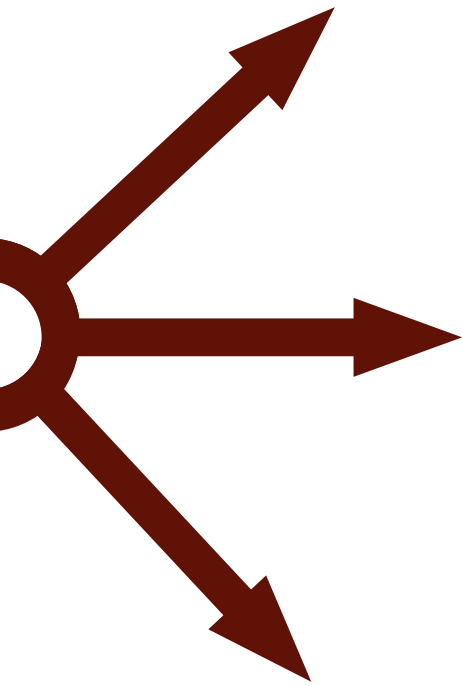
**12:30 – 12:45**

**Andreja Sironić, Alexander Cherkinsky, Damir Borković, Jadranka Barešić, Anita Rajtarić  
& Ines Krajar Bronić**

*Experience of the Zagreb Radiocarbon Laboratory in mortar dating*

**12:50**

**Closing**





## *ABSTRACTS*

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**Mario Novak**

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**Novel analytical methods in (bio)archaeology - some examples from Croatia**

**D**uring the last couple of decades, we are witnessing a tremendous development of (bio)archaeology, especially in relation and in close collaboration with natural sciences. The so-called “Third Scientific Revolution in Archaeology” enabled the development of numerous analytical methods. The widespread application of these techniques resulted in the occurrence of large amounts of new, previously, unknown information about various aspects of life and death of our distant ancestors. This presentation will show the importance of these methods in our study of general health, diet and subsistence, population structure and migrations of ancient individuals and communities based on the selected examples from Croatia. Here we will focus on the following techniques used in our research: pathogen aDNA analysis, strontium isotopes analysis, ZooMS, peptide analysis of tooth enamel, and lead concentration analysis.

**Zoran Čučković**

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**Introducing the total mobility field: an algorithmic solution for the analysis of prehistoric mobility practices**

**T**he mobility of men and women, of animals and traded goods, is a key research issue in archaeology. Recent advances in chemical and biochemical analysis, such as ancient DNA sequencing or isotope analysis, have revealed a hitherto unknown scope of the flow of human and animal populations. However, prehistoric communication routes remain very poorly known and even less so the mobility practices of those on the move. What is more, much of the prehistoric movement may not have relied on specific infrastructure, as in the case of pastoralism and other landscape wide subsistence activities.

Digital modelling provides a particularly promising angle to the prehistoric mobility problem. Indeed, the simulation of optimal paths, linking a departure and a destination point, has already become a relatively commonplace approach, especially for historical periods. However, the movement out of trodden paths, across the landscape, remains largely unexplored. This problem is particularly pertinent for prehistoric periods, characterised by diffuse movements and, quite probably, informal and unstable infrastructure. Our approach has thus focused on modelling all theoretically possible movement corridors, irrespective of specific points of departure or arrival. Such total mobility field is simulated using a dedicated algorithm, developed with speed and efficiency in mind. The resultant model reveals theoretical movement corridors, visible as bundles and overlaps of multiple paths while tracking movement intensity in every corner of a given geographical area.

The potential of this approach will be demonstrated on two study areas, the Jutland peninsula (Denmark) and the Dolenjska region (Slovenia). Both regions have extensive archaeological databases for, respectively, Bronze and Iron Ages. The existence of prehistoric movement corridors or pathways can be confidently postulated for both regions, even if the archaeological record has remained ex-



tremely terse on the infrastructure involved. In Denmark, Bronze Age burial mounds quite plausibly tend to gather along communication corridors, while in Slovenia important hillfort settlements may have benefited from the proximity of local or long-distance routes. The total mobility field approach will help us to place these geographical patterns into the context of theoretical movement practices.

### **Dimitrij Mlekuž Vrhovnik**

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#### **Assessing human impact and past land use patterns on Kras using airborne laser scanning data**

**A**ny cultural landscape can be seen as an artefact, a cumulative result of interaction between the environment and cultural practices in the long term. The landscape played a central role in the subsistence of pre-industrial societies, as growing crops and raising animals were the focus of daily life of most people and communities in the past. The landscape should be seen as a cumulative artefact, and this especially rings true with the Kras.

Kras (it. Carso, germ. Karst) is a cultural landscape; it is a heavily modified and transformed landscape with its own time-depth and history of formations and transformations. Landscape transformations involve a series of reorderings, reuses and representations of the landscape. In the Kras, natural processes act slowly; there are no fast episodes of erosion and accumulation that would destroy or bury older remains. Human interventions leave almost permanent scars on the surface as topographic anomalies.

We examine the elements of past landscapes that are still preserved in the modern landscape using airborne laser scanning. One of the most common features that can be recognised on ALS high-resolution topographic data are numerous circular mounds that can be interpreted as clearance cairns. Cairnfields are often bounded by low linear positive features, which could be interpreted either as collapsed dry stone walls or linear cairns.

We mapped these features using airborne laser scanning. Features were digitised and quantified, allowing us to calculate various aspects of land use and human impact, especially the intensity of use, type of use and relation to the settlements. Kraslandscape testifies that pre-industrial societies did not have only local and transitory environmental impacts, that human impact on landscape did not begin decades ago, but we have been profoundly influencing for thousands of years.

### **Miroslav Vuković, Janja Mavrović Mokos & Franka Ovčarić**

Department of Archaeology, Faculty of Humanities and Social Sciences, University of Zagreb, Croatia

#### **Prehistoric sites on LiDAR data in the region of Prigorje**

**T**he project „TRANS RIVERS“ funded by the Croatian Science Foundation deals with the study of prehistoric sites and communication routes along the Sava and Sutla rivers in the Croatian region of Prigorje (roughly corresponding to the administrative boundaries of modern-day cities of Samobor, Zaprešić and Zagreb). The area presents a challenging landscape for archaeological study due to natural (flooding and erosion) and man-made effects (quarrying and urbanization). One of the main goals of the project revolves around identifying and confirming new prehistoric sites, especially on the slopes of Medvednica mountain, and other lower-lying hills which have not

been influenced by the above-mentioned destructive processes. The airborne laser scanning (ALS) approach to these research problems was the best fit, and in the scope of the project, we utilized data from three very different laser scanning surveys to ensure proper coverage of the research area. This paper will present the preliminary results of our first ground surveys and LiDAR data interpretations, with a special focus on the prehistoric sites which are in the focus of the Trans Rivers project.

**Martin Bažoka<sup>1</sup>, Filomena Sirovica<sup>2</sup>, Mario Bodružić<sup>3</sup> & Lujana Paraman<sup>4</sup>**

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### **Field survey methodology and lithic scatters in Dinaric karst landscapes – a case study from Bristivica in the Trogir hinterland**

**T**he Dinaric karst landscapes present challenging conditions for the implementation of standard field survey methods. The ubiquitous practices of intensive field clearance and a high level of parcellation of arable land resulted in various types of drystone walls and stone cairns at the edges of fields. In the Dalmatian hinterland, this practice was the main agency of intensive transformation of the landscape and thus the cause of alteration of the surface archaeological record. These factors resulted in a landscape fragmented in small drystone-bounded fields that are mostly unconnected and thus do not form continuous surfaces favourable for field survey practices. On the other hand, the recent general abandonment of agricultural activities, as a consequence of the continuous deruralisation of the Dalmatian hinterland, resulted in an increase in dense vegetation on abandoned fields, significantly reducing the surface soil's availability and visibility.

For these reasons, the authors present an artefact-based field survey approach, adapted to the described conditions, simultaneously aimed at recording types of surveyed units (drystone wall, stone cairn, field, ground, etc.) and their visibility rate. The procedure was carried out in the area of Bristivica village, located in the hinterland of Trogir, where different types of surface archaeological material were recorded. As the collected assemblage is marked by the significant presence of lithic artefacts and chert raw materials, the objective is to present the potential of the employed approach for detecting lithic scatters in a Dinaric karst landscape, as well as the difficulties that arise in evaluating the spatial context of their appearance and a more specific chronological frame to which they could be determined.

**Nikolina Nikolova**

Prehistory Department, National Institute of Archaeology & Museum, Bulgarian Academy of Sciences, Bulgaria

### **Identifying phases of construction, maintaining and refilling of ditch enclosures. Case studies from the Early Neolithic of Upper Thrace**

**E**nclosures are a widespread feature in European prehistory that first appeared in Southeast Europe at the beginning of the neolithization. There, it seems that the early Neolithic settlements were preferably enclosed by ditches even though the evidence is limited, as a very small area



of the sites has usually been excavated. Ditch enclosures are a popular research topic in the latest archaeological work in said region, however, the character of their backfills is a rarely discussed matter. Attention has mostly been paid to the presence of various finds and/or human skeletal remains but not to the nature and the formation processes of the fills themselves.

This presentation will focus on the ditch construction that was revealed at several Neolithic sites in Bulgarian Thrace. Most of them seem to have been in use for a long time, and the communities took special care to maintain them. This is visible in the cross sections of their fills as multiple cleanings and recuts. The “repair activities” may be partial as only sections of various lengths were affected. Sometimes, however, the entire course of the ditch was renovated and thus a new cut was dug, following the exact outlines of the former, slightly, or completely deviating from them. An argument can be made that the episodes of ditch digging, re-filling, re-cutting, and digging new, larger ditches, were an intentional and well-organized communal effort to create and maintain social identity over a long period of time.

### Saša Kovačević

Institute of Archaeology, Zagreb, Croatia

### Building materials and the constructional sequence of the burial mound Gomila in Jalžabet

In the lecture, I will analyze the use of different kinds of building materials during the construction of the burial mound Gomila, in Jalžabet east of Varaždin (NW Croatia). My objective is to identify their source and present the construction sequence which is inextricably intertwined with the burial rite. The complex burial monument from the middle of the 6th century BC was one of the focal points of the Early Iron Age cultural landscape and - without a doubt - a symbol of the whole Eastern Hallstatt community in the region. Between 2017 and 2021 rescue excavations of the burial mound 1 – Gomila in Jalžabet have been conducted by the Institute of Archaeology in Zagreb. The research was financed by the Ministry of Culture and Media of the Republic of Croatia. One of the largest burial monuments of its kind in Central Europe is 65 m in diameter, with a current height of 8 m. Around the burial mound, there was a circular ditch about 100 m in diameter. During the field research, we found a burial chamber with dromos made of wood and different kinds of stones placed in the center of the stone-paved plateau – crepidoma. The sourcing and extensive use of different kinds of materials was a huge undertaking for the community involved in construction. Placing the building sequence in the proper context of the burial rite has left us with numerous unanswered questions, some of which will be addressed in the presentation.

**Luka Gruškovnjak<sup>1,2</sup>, Agni Prijatelj<sup>2,3</sup>, Petra Vojaković<sup>2,4</sup>, Jaka Burja<sup>5</sup>, Barbara Šetina Batič<sup>5</sup>, Manca Vinazza<sup>1,2</sup>, Borut Toškan<sup>6</sup>, Tjaša Tolar<sup>6</sup>, Rok Brajkovič<sup>7</sup>, Helena Grčman<sup>3</sup> & Matija Črešnar<sup>1,2</sup>**

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<sup>7</sup> Geological Survey of Slovenia, Ljubljana, Slovenia

## The floor of a smithy under the microscope

**A**t the proto-urban hillfort of Pungrt above Ig, located in the vicinity of the Slovenian capital of Ljubljana, we are employing various geoarchaeological and micro-archaeological analytical techniques to study the lifeways and technologies in the Iron Age. Micro-refuse analysis in one of the buildings under investigation, Building 24, has revealed a blacksmith's workshop dating to the Late Hallstatt Period. Since our first presentation of these preliminary results at the 10th MetArh, we have further studied the smithys' floor deposits, and micro-debris trampled into the floor at the microscopic level. The micromorphological, petrographic, metallographic and scanning electron microscope analyses have provided detailed insights into various technologies and practices in the Hallstatt Period, some previously unknown. These include the first clear evidence for the use of flux in iron welding during the Early Iron Age, and the use of lime technology recognised for the first time in the Hallstatt Period in Slovenia. They also provide insights into floor maintenance practices, grease rendering, bread baking and numerous other activities. The combined data allows for a detailed reconstruction of activities in the Early Iron Age smithy that could never be garnered through excavation data alone.

### Selena Vitezović

Institute of Archaeology, Belgrade, Serbia

## Rabbit holes of bone technology: production and the use wear of perforations on bones, shells and teeth

**A**nimal bones, teeth and mollusc shells were widely used for the production of diverse artefacts, including ornaments. Some of the everyday tools, as well as some of the ornaments, needed to be suspended or attached to something, and usually perforations, were made. Technology of making perforations through rather thick and resilient materials such as animal hard tissues without breaking them was rather demanding, and several technological procedures were used in prehistoric times. These included incising, drilling with a chipped stone artefact, drilling with a bow drill, usually with sand added, while larger holes were made by larger, hollow instruments and with sand added. Sometimes, unfinished perforations served as an ornament. There are also examples of naturally pierced mollusc shells that were collected and subsequently used as ornaments.

Use wear on perforations may provide information on how long the item was in use, and whether it was suspended, or it was attached to something, for example, some ornaments were most likely attached to the clothes. On ornaments worn for a very long time, for example, may be noticed that after the perforation was broken, another one was made. Bracelets made from mollusc shells were occasionally recycled into pendants, by adding a perforation and other modifications. In this paper will be presented major techniques for the production of perforations used in the Neolithic and Chalcolithic periods in the Balkans, as well as some of the interesting examples of the intensive use wear traces.



## Predrag Đerković

Department of Archaeology, Faculty of Philosophy, University of Belgrade, Serbia

### The use of 3D photogrammetry in analysing the Roman epigraphic monuments: a case study from Kremna village, southwestern Serbia

**W**ith the rapid development of digital photogrammetry in the last decade, the construction of 3D models for archaeological purposes is becoming more common. Recent research has shown that software processing of 3D models of various artefacts makes it possible to detect even the smallest irregularities on their surfaces. Thus, in recent years, a small number of papers, which are based on the use of different software visualizations for the purpose of reading damaged and unrecognizable inscriptions on epigraphic monuments, were published. This work was carried out with the aim of examining the possibilities of applying different open-source software tools in the analysis of photogrammetric 3D models of Roman epigraphic monuments. The research was conducted on 4 Roman monuments from today's village of Kremna, in southwestern Serbia. Each of the monuments was photographed twice: using a DSLR camera and mobile phone, with the desire to compare the results and simultaneously determine the possibilities for the wider use of this method. The results of this research show that reliefs on all monuments are much more noticeable, and some of those that are not visible today using traditional epigraphic methods, are also recognizable. On each of the analyzed monuments, a part of the present-day invisible or partially visible inscription was observed, and the high success of the method is best illustrated in the case of recording 27 new letters on one of the analyzed altars from Kremna. The quality of the results obtained by the used methodology leads to a significantly better archaeological interpretation of epigraphic monuments. If one takes into account the very poor state of preservation and the lack of protection of a large number of monuments, creating 3D models can also ensure their permanent recording and protection in virtual space.

## Domagoj Perkić<sup>1</sup> & Miroslav Vuković<sup>2</sup>

<sup>1</sup> Archaeological museum Dubrovnik, Dubrovnik Museums, Croatia

<sup>2</sup> Department of Archaeology, Faculty of Humanities and Social Sciences, University of Zagreb, Croatia

### Image-based 3D models of late medieval tombstones – Stećci

**S**hallow reliefs and lightly carved motifs or inscriptions have always presented a unique problem in research dealing with late medieval tombstones locally known as Stećci. The tombstones are usually found in situ or slightly removed from their original location but in most cases still completely exposed to the weather conditions which gradually erode the stone surface of the monuments. Documenting and surveying these tombstones usually included clearing them from surrounding vegetation, waiting for the proper light conditions to expose the shadows, photographing and drawing the monument. In recent years 3D laser scanning has also proven to be an effective way to document these types of monuments. Without diminishing the previous documentation practices, utilizing image-based modelling opens up a new range of possibilities in research and survey of Stećci. This paper will present the advantages and methods used in the documentation process as well as some new approaches in utilizing the created 3D models of tombstones to conduct further research. Using different visualization techniques various small changes in the microrelief of the tombstones revealed new details and previously unseen carvings in the stone. It



quickly became apparent that documenting these monuments in three dimensions is important not only as a recording of the state they are in but that due to the slow degradation of the stone surface, we could lose a part of the historically significant information that past societies tried to preserve and convey to us.

**Andrej Bašić<sup>1</sup>, Tina Bareša<sup>2</sup>, Ana Curić<sup>3</sup>, Željana Bašić<sup>2</sup>, Ivan Jerković<sup>2</sup> & Ivana Kružić<sup>2</sup>**

<sup>1</sup> Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, University of Split, Croatia

<sup>2</sup> University Department of Forensic Sciences, University of Split, Croatia

<sup>3</sup> Museum of Croatian Archaeological Monuments, Split, Croatia

### **Creating a physical 3D atlas of cranial morphological traits: a pilot study**

**E**stablishing the sex of unknown skeletal remains is one of the first steps in the identification and reconstruction of demography of past populations. A common approach to estimating sex is visually examining bone morphology differences based on scores, anatomical descriptions, and referent depictions. However, it is challenging for scientists with less experience to compare 3D specimens with 2D displays. Thus, we selected skeletal element with highly expressed three-dimensionality, the mastoid process, and bony protrusion behind the ear on the temporal bone. It is an important anatomical feature, and its size and shape can be used to differentiate male from female skulls. We decided to create exact 3D models of mastoid processes representative of each degree of the trait expression. Expression of mastoid processes was scored on 200 patients' MSCT scans from the University Hospital centres in Split and Zagreb. Twenty specimens of each grade (1 - 5) were randomly selected and evaluated by two experienced researchers. We selected one of each grade from specimens with full agreement as representative. The mastoid models were created using a 3D surface rendering tool in Osirix MD and exported as OBJ files. The models were refined through CAD software in preparation for 3D printing. A simplification eliminated extraneous details while simultaneously addressing errors and deformations, yielding the creation of refined and contoured 3D models. The subsequent phase involved printing optimized models using a Masked Stereolithography Apparatus (MSLA). The choice of the Anycubic Photon M3 resin 3D printer for the MSLA printing ensured precision and accuracy in replicating the mastoid processes. As previous studies showed that casts of skeletal elements for age estimation could be more beneficial than descriptions and 2D depictions, we tested if a similar approach could be applied using 3D-printed skeletal elements for sex assessment.

**Predrag Novaković**

Department of Archaeology, Faculty of Arts, University of Ljubljana, Slovenia

### **On Epistemic Relationship between Academia and Practice**

**T**raditionally, epistemological research in archaeology was primarily concerned with the ways one can obtain knowledge about past humans and their activities from material remains. In doing this, epistemological questions included, in the first place, detailed analyses of theoretical frameworks, their conceptual apparatus and categories, and thought processes involved in making the archaeological interpretation. Later, with the onset of post-processual archaeology and gender archaeology, another set of questions was added to epistemological research in archaeology,



that of the role of the subject and its social milieu in the production of archaeological knowledge.

The paper discusses the epistemic outcomes of the recent division in Slovene archaeology, between academic archaeology and field professionals, two distinctive groups of researchers each working in a particular social and economic context in archaeological practice. These changes produced new circumstances and determinants which greatly affected the knowledge-producing process which we observe from a standpoint of social epistemology. The topics of the nature of research, research freedom, organization of research work, and associated epistemic asymmetry and dependence are discussed in more detail.

**Dijana Škorić<sup>1</sup>, Renata Šoštarić<sup>1</sup>, Olivera Maksimović Carvalho Ferreira<sup>2</sup>, Lana Vogrinec<sup>2</sup>, Jurica Bezak<sup>3</sup> & Denis Kutnjak<sup>2</sup>**

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<sup>3</sup>Department for Underwater Archaeology, Croatian Conservation Institute, Zagreb, Croatia

### **Do antique olives have antique viruses and how do we investigate that?**

**O**live (*Olea europaea* L.) or its wild relatives have been a part of the Mediterranean diet and they have been valuable goods for trading since antiquity. The shallow Pupak off the island of Palagruža was part of the ancient trans-Adriatic waterway. It is the site of a Roman shipwreck where a large number of olive stones and well-preserved fruits were found in two amphorae in 2018. The biological material was carbon-dated and confirmed to be 2200 years old. Modern olives can be infected with viruses and some of these viruses can be transmitted by seeds. We set out to investigate whether we could find viruses in the seeds of the antique olives from the shipwreck. Total nucleic acids were extracted from olive embryos found in some of the olive pits after opening and used to perform shotgun high-throughput sequencing (HTS) starting from RNA, as most known plant viruses have RNA-genomes. In-house developed bioinformatic pipeline was used for the detection of viruses. Near-complete genomic sequence of a putative yet unknown alphacarmovirus was obtained from the data. Phylogenetic analysis confirmed that the virus belongs to the genus Alphacarmovirus, family Tombusviridae. Specific RT-PCR primers were constructed and DNA amplicons were obtained from different samples to confirm the HTS findings through wet-lab experiments. Further wet- and dry-lab (in silico) tests are being performed to ascertain the ancient origin of viral RNA. Hurdles and pitfalls of the methodologies used will also be discussed. If confirmed, this finding represents unprecedented insight into the sanitary status of olives in antiquity and possible olive viruses over the span of two millennia.

## Petra Petković<sup>1</sup>, Sara Essert<sup>2</sup> & Mladen Pešić<sup>3</sup>

<sup>1</sup>Independent researcher, Zagreb, Croatia

<sup>2</sup>Division of Botany, Department of Biology, Faculty of Science, University of Zagreb, Croatia

<sup>3</sup>International Centre for Underwater Archaeology, Zadar, Croatia

### Archaeobotanical research of the Roman port Barbir in Sukošan, Croatia

In this research, an archaeobotanical analysis of plant remains collected from the Roman age port of Barbir in Sukošan was conducted. Previous research indicates that the harbour was used between the 1st and 5th centuries. A total of 13 samples were collected in 2019 and 2020 and then processed, yielding 525.25 non-carbonized macrofossils of plants. A total of 24 plant taxa were identified. The most abundant ones were common fig (*Ficus carica* L.), domesticated olive (*Olea europaea* L.), Mediterranean seagrass (*Cymodocea nodosa* (Ucria) Asch.), grapevine (*Vitis vinifera* ssp. *vinifera* L./*sylvestris* (C. C. Gmel.) Hegi), common blackberry (*Rubus fruticosus* L. agg.), and stone pine (*Pinus pinea* L.). These account for 93.29% of all plant material that was found, while all other taxa constitute only 6.71% of the identified plant remains. Ecological-ethnobotanical analysis shows that cultivated and useful woody plants were the most abundant in macrofossils, accounting for 78.98% of the analyzed plant remains, while weeds and ruderal plants were most abundant in taxa but with very few individual plant remains. A comparison with some other research of ancient sites on the Croatian Adriatic coast and elsewhere in the Mediterranean region reveals that the plants found in Barbir are representative of Mediterranean useful woody and herbaceous plant species and can be expected on ancient Mediterranean sites. This suggests that the inhabitants of Barbir in antiquity cultivated and utilized typical Mediterranean plants.

## Ilaria Calgaro<sup>1</sup>, Miljana Radivojević<sup>1</sup>, Mark Altaweel<sup>1</sup>, Paula Doumani-Dupuy<sup>2</sup> & Antonina Yermolayeva<sup>3</sup>

<sup>1</sup>UCL Institute of Archaeology, UK

<sup>2</sup>School of Sciences and Humanities, Nazarbayev University, Astana, Kazakhstan

<sup>3</sup>A.Kh. Institute of Archaeology, Almaty, Kazakhstan

### Metal production in the Eurasian Steppe Bronze Age Case studies from the 2<sup>nd</sup> millennium BC sites of Taldysai, Myrzhyk and Koken (Kazakhstan)

The 2<sup>nd</sup> millennium BC Eurasian Steppe witnesses a surge in metal circulation and exploitation. Nevertheless, this is yet paired by scarce data on local metal production across this area, which is crucial for interpreting the role metal making played in the Bronze Age Eurasian Steppe communities. We present new data on smelting technology from three 2<sup>nd</sup> millennium BC sites from Kazakhstan, which span the regional Middle to Late Bronze Age: Taldysai and Myrzhyk (Central Kazakhstan), two workshops, and Koken (East Kazakhstan), workshop and burial site. The analysed collection includes ores, archaeological and experimental smelting debris, crucibles and metal artefacts.

At Taldysai (MBA-LBA), we identified two metal production lines transmitted over 400 years: copper and arsenical copper. Copper metal was obtained by co-smelting local copper oxides and sulfides in a single step. Experimental smelting conducted in a replica of the archaeological pit furnaces by using local copper oxides with low sulfur supports this interpretation. Arsenical copper production is exhibited through co-smelting of copper and arsenic-rich ores in two steps: (i) desulfurisation, (ii) iron removal. Myrzhyk (LBA) provided evidence for local production of arsenical copper. Copper



oxides with moderate arsenic content were documented alongside slag materials, although their origin is still contentious. Most interestingly, this site yielded pit furnaces comparable to those in Taldysai. Materials from Koken (LBA) showed in-situ production of copper metal again from copper oxides. Here, local copper production is paired by numerous tin bronze grave goods, which infer contacts with the Altai mountains.

Site-scale level analyses of metal production debris allow to distinguish centres that shared and transmitted technological models and traditions (Taldysai and Myrzhik) and connector sites at the crossroad between the steppes and their margins (Koken). In a broader perspective, this enables to better pinpoint the dynamics of technology and economy of the Bronze Age Eurasian Steppe communities.

### István Fórizs<sup>1</sup>, Kata Dévai<sup>2</sup> & Friderika Horváth<sup>3</sup>

<sup>1</sup>Institute for Geological and Geochemical Research, HUN-REN Research Centre for Astronomy and Earth Sciences, Budapest, Hungary

<sup>2</sup>HUN-REN-ELTE Research Group for Interdisciplinary Archaeology, Budapest, Hungary

<sup>3</sup>Institute of Archaeology, HUN-REN Research Centre for the Humanities, Budapest, Hungary

### Glass vessels from the fortress of Ságvár (Pannonia): Preliminary results

**S**ágvár was built as a fortress in Transdanubia (Pannonia Prima, Valeria) in the 4<sup>th</sup> century AD. A succession of barbarian attacks, from the end of the 2<sup>nd</sup> century AD, exposed the weakness of the boundary-based defence system. The 4<sup>th</sup> century AD military reorganization fundamentally changed the organization of this defence. The construction of fortresses under military supervision and through public works in Transdanubia, such as Ságvár, was linked to stricter enforcement of annona collection and storage.

More than 200 glass fragments have been recovered from Ságvár, most belonging to glass vessels, and window glass but polychrome mosaic tesserae have also been found. Typical late Roman vessels were olive green, semi-spherical, conical and ovoid beakers, with several rim and body fragments of beakers with blue blobs. The chemical analysis was carried out to determine whether the base glass of the late Roman fortress is HIMT (High Iron Manganese Titanium) glass, or not. Were the windowpanes also HIMT glass or not? Which region does the analysis of the blue blobs of conical, and hemispherical cups resemble?

The archaeometric analyses of 78 fragments answered some questions, left open others, and raised new ones. We did not identify classic (strong) HIMT composition, but weak HIMT among both vessels and windowpanes. The chemistry of the whole set of analysed fragments reflects well the picture of what we know about the transition which took place in the 4<sup>th</sup> century in Roman glass making. In the previous centuries, the Sb decolourant dominated while it was gradually replaced by manganese in the fourth century. Accordingly, the application of Mn decolouriser dominates, while the Sb- or mixed Sb, Mn-decoloured fragments are rare. A special character of this set of glass findings in Ságvár that while the far majority of the published Mn-decoloured glass has lower Na<sub>2</sub>O and higher CaO content than the Sb-decoloured glass, the Mn-decoloured glass shows the characteristics of higher Na<sub>2</sub>O and lower CaO content. It seems that the flux/sand ratio used previously for the Sb-decoloured glass was applied for the Ságvár Mn-decoloured glass, which is a rare phenomenon.

## Jurica Bezak<sup>1</sup> & Stefano Nisi<sup>2</sup>

<sup>1</sup>Department for Underwater Archaeology, Croatian Conservation Institute, Zagreb, Croatia

<sup>2</sup>Istituto Nazionale di Fisica Nucleare, Laboratori Nazionali del Gran Sasso, L'Aquila, Italy

### The provenance of the Roman lead ingots cargo from the Pupak shallows shipwreck site in the Adriatic Sea

The remains of a Roman shipwreck from the 1st century BC were discovered in the Eastern Adriatic Sea, at the Pupak shallows, near the island of Palagruža. Twenty-five lead ingots have been discovered among the remains of the commercial cargo in the course of the research. Three lead samples were taken from the ingots, and subjected to lead isotope analysis, aiming to precisely determine their geographical origin. The isotopic ratios of lead were measured by Thermal Ionization Mass Spectrometry at the Laboratorio Nazionale del Gran Sasso-INFN. The results were processed and compared with the LIMS Database consisting of about 1800 reference samples related to mining districts mainly active in the Mediterranean basin in ancient times. The origin of the lead from the Cartagena-Mazarrón mining district in south-eastern Spain was confirmed both by the graphic cluster and by the punctual analysis with the probability of belonging between 90% and 100%.

## Mirja Jarak<sup>1</sup> & Andreja Sironić<sup>2</sup>

<sup>1</sup>Department of Archaeology, Faculty of Humanities and Social Sciences, University of Zagreb, Croatia

<sup>2</sup>Laboratory for Measurements of Low-level Radioactivity, Ruđer Bošković Institute, Zagreb, Croatia

### Building phases of the triconch church complex at Bilice with regard to mortar dating

The paper contains data on the building phases of the early Christian church complex at Bilice near Šibenik. Different chronological phases were already recognised during the first excavations of the complex at the beginning of the 20th century. In the new revision research, the existence of earlier and later structures has been confirmed by the position of walls and their connections. Regarding the first phase, the triconch church, its dating could be supported by the dating of the furniture from the site. The additional parts of the complex must have been built after the church, probably in two building periods.

The determination of the phases is provided by radiocarbon mortar dating. It is based on mortar absorption of atmospheric CO<sub>2</sub>, containing natural <sup>14</sup>C, during mortar hardening. However, the binder generated by CO<sub>2</sub> absorption is the same as the aggregate, CaCO<sub>3</sub> in the form of calcite, making it difficult to extract only the pure binder.

In order to extract binder carbonate, the difference in morphology between binder and aggregate, making binder reacts quicker in reaction with acid, was used. The initial CO<sub>2</sub> portions generated during hydrolysis of samples were collected and their extrapolated <sup>14</sup>C result was used to calculate the age of mortar hardening.

Three samples from Bilice were radiocarbon dated. The samples originate from different parts of the church complex, two of them from additional structures and one sample from the wall of triconch church. The paper brings a detailed account of the achieved results of radiocarbon mortar dating of the Bilice samples and their meaning in the context of similar early Christian localities in Dalmatia.



**Andreja Sironić<sup>1</sup>, Alexander Cherkinsky<sup>2</sup>, Damir Borković<sup>1</sup>, Jadranka Barešić<sup>1</sup>, Anita Rajtarić<sup>1</sup>  
& Ines Krajar Bronić<sup>1</sup>**

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**Experience of the Zagreb Radiocarbon Laboratory in mortar dating**

**A**lthough the Zagreb Radiocarbon Laboratory of the Ruđer Bošković Institute exists since 1970, the radiocarbon mortar dating has started performing only recently, with the introduction of the Accelerator Mass Spectrometry, reflecting the overall trend in the wider Radiocarbon community. The radiocarbon dating of mortar was considered as something on the edge of science due to many possible sources of contamination and due to heterogeneity of the analytical matrix. The quality of the mortar is often influenced by surrounding geology, source of the building material, historical period and skill of craftsmen.

In support of the Center for Applied Isotope Studies, Georgia, we made our first attempts to date mortar in 2017, by selecting lime lumps and extracting water suspended particle fractions of mortar and deciding to use the lime lump principle in laboratory practice. Further analysis showed that in some cases lime lumps are under the influence of delayed hardening, so sequential dissolution of 32-63 µm particle fraction and extrapolation was developed. Since not all mortar is datable, we introduced extra pre-testing of samples: laboratory petrographical and X-ray analysis.

The focus of this presentation is on our 7-year experience in radiocarbon mortar dating with all the difficulties, errors and solutions we found on the way.



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**Valentina Lončarić<sup>1</sup>, Mafalda Costa<sup>1</sup>, Hrvoje Potrebica<sup>2</sup> & Degryse Patrick<sup>3</sup>**

<sup>1</sup>HERCULES Laboratory, University of Évora, Portugal

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**Archaeometric investigations of Iron Age amphora-shaped glass beads from Gradac near Pleternica (Croatia)**

This poster presents the first results of a multi-analytical archaeometric investigation of Iron Age amphora-shaped glass beads from Croatia. Amphora-shaped Iron Age beads made of glass or coral are known from a wide area of the Carpathian Basin, the Balkans, and the Adriatic during the 5<sup>th</sup> and 4<sup>th</sup> centuries BCE. The distribution of amphora-shaped beads has been the subject of prior studies, which interpreted them as evidence of trade between Mediterranean civilisations and social elites of Prehistoric Europe. Compositional data on this type of beads is so far rather limited, but suggestive of their origin in Eastern Mediterranean workshops. A set of amphora-shaped beads from Gradac near Pleternica (Požega county) was studied by Optical Microscopy (OM), scanning electron microscopy coupled with energy dispersive X-ray spectrometry (VP-SEM-EDS), micro X-ray diffraction ( $\mu$ -XRD) and laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) to document manufacture and use traces, and to obtain their chemical (including trace elements) and mineralogical composition. The results of analyses are discussed within the framework of technological and raw materials provenance studies of Iron Age glass.

**Sara Igljić<sup>1</sup> & Šime Vrkić<sup>2</sup>**

<sup>1</sup>Department of Archaeology, University of Zadar, Croatia

<sup>2</sup>Independent Researcher, Zadar, Croatia

**The fortified site of Babin grad, Croatia**

The karst region of Croatia prominently displays material traces of its rich past. Using landscape archaeology methods, primarily field surveys, aerial photographs and satellite imagery analysis, the anthropogenic structures of the landscape are documented. In 2021 and 2022, as part of a project, surveys were conducted along the canyons of the Zrmanja and Krupa rivers. A fortified site Babin grad was documented on a highly inaccessible ridge deep in the river Krupa near the settlement of Ravni Golubić. Although the site's archaeological history is not well established, it holds significant cultural importance in local oral tradition. Exploring different narratives related to the site provided a fresh outlook. After conducting surveys, it has been confirmed that the fortified site dates back to the Middle Ages, dispelling the previous scarce archaeological mention of a prehistoric hillfort. Our surveys provided new insights and information regarding the site by taking into account the perspectives of local communities toward the archaeological remains. There are various noteworthy observations that can be drawn with respect to the understanding of the site. This has enabled us to comprehend how the landscape is formed over time.



## Petra Nikšić<sup>1</sup> & Jana Škrgulja<sup>2</sup>

<sup>1</sup>Independent researcher, Zagreb, Croatia

<sup>2</sup>Department of Archaeology, Faculty of Humanities and Social Sciences, University of Zagreb, Croatia

### **Interpretation of the northern part of the late antique hilltop settlement in Lobar, northwestern Croatia, based on the spatial distribution of pottery finds**

Archaeological research of the multi-layered site Lobar - Majka Božja Gorska in northwestern Croatia was mostly concentrated on the church complex and its cemetery, which damaged earlier prehistoric, antique and late antique structures. Excavations were also carried out in several areas on the northern plateau outside the church complex. During the excavation, large quantities of late antique pottery were found, which can be dated from the second half of the 3rd to the first half of the 6th century. Although late antique pottery is very fragmented, several sherd clusters were documented on the northern plateau of the late antique hilltop settlement, between the church complex and the northern rampart. Considering that the architectural remains are few and poorly preserved due to the mentioned damaging, during the late antique pottery research, quantitative analysis of sherds, analysis of spatial distribution and comparative analysis with the contemporary sites of the Noric-Pannonian border area, were used in order to interpret the appearance of the northern side of the late antique settlement, which was less destroyed by construction and erosion. The results of this research provide insight into the degree of destruction of the site due to the burial of medieval and post-medieval graves and the spread of late antique pottery, as well as how well the clusters of late antique pottery finds match the few remains of late antique architecture. Certain clusters point to the existence of completely destroyed structures, which indicate different construction techniques within the late antique settlement. The final interpretation of the possible appearance of the northern part of the late antique settlement in Lobar based on the pottery finds shows similarities with other hilltop settlements of the Noric-Pannonian border area and probably indicates the integration of the settlement into the mentioned area.

## Gil Vilarinho

Laboratório de Arqueologia Pinho Monteiro, University of Évora, Portugal

### **Seeing the Unseen: Assessing the scope and limitations of remote sensing data for the study of Iron Age hillforts in northern Portugal**

The use of remote sensing techniques in Portuguese archaeology has, thus far, been rather limited. Nevertheless, the increasing awareness and availability of equipment and open-source data, namely airborne LiDAR and satellite imagery datasets, is changing this picture. With these techniques to study archaeological landscapes and, particularly, Iron Age hillforts, it is possible not only to identify sites that were, until then, unknown but also to obtain new information on known sites that, in some cases, have already been investigated in the past. Focusing on the northern area of modern-day Portugal and using several case study sites, this study aims to explore the different remote sensing tools that are currently publicly available, particularly airborne LiDAR and aerial photography, and discuss the potential and limitations these techniques present for the study of Iron Age fortified settlements. This paper will thus discuss the different techniques and particular visualisation techniques, as well as new archaeological sites and new data on the extension, morphology and defensive systems of other, previously known sites. Ultimately, it will hopefully provide a contribution to a better understanding not only of the Iron Age sites in this region of the Iberian Peninsula but also, by extension, of the use of remote sensing to study hillforts across Europe.

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*PUBLICATIONS*



Papers from the 1<sup>st</sup> and 2<sup>nd</sup> conference *Methodology and Archaeometry* are published in the Journal *Opuscula Archaeologica* 39/40, Department of Archaeology, Faculty of Humanities and Social Sciences of the University of Zagreb, Zagreb, 2018.

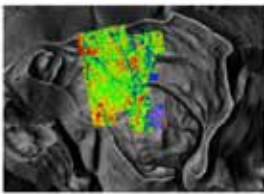
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Papers from the 3<sup>rd</sup> and 4<sup>th</sup> conference *Methodology and Archaeometry* are published in a book *Recent Developments in Archaeometry and Archaeological Methodology in Southeastern Europe*, Cambridge Scholars Publishing, Cambridge, 2020.

[https://www.cambridgescholars.com/recent-developments-in-archaeometry-and-archaeological-methodology-in-south-eastern-europe?fbclid=iwar0nmmpb4m\\_uizm6gsxwiqdi422ursres9oy-0owlrp9gyjm3r316dghchas](https://www.cambridgescholars.com/recent-developments-in-archaeometry-and-archaeological-methodology-in-south-eastern-europe?fbclid=iwar0nmmpb4m_uizm6gsxwiqdi422ursres9oy-0owlrp9gyjm3r316dghchas)

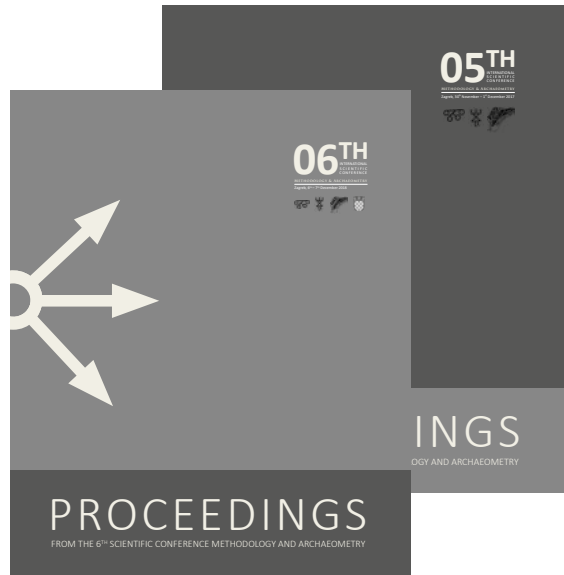
OPUSCULA  
ARCHAEOLOGICA

2018



**Recent Developments in  
Archaeometry and  
Archaeological Methodology  
in South-Eastern Europe**

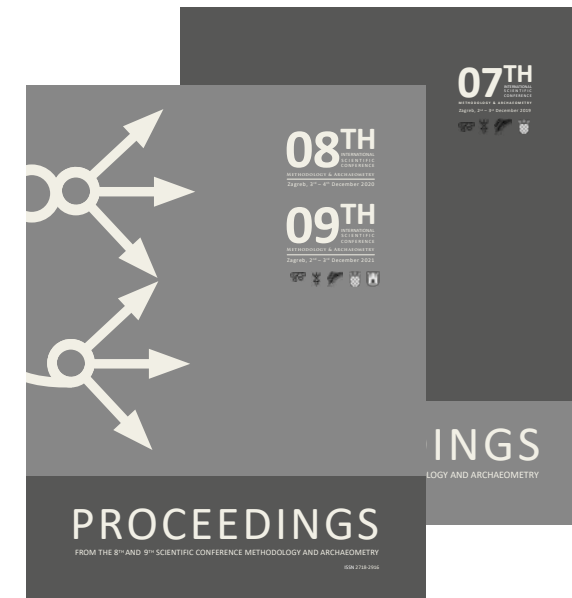
Edited by Ina Miloglav



Since 2019 papers from the conference are published in the *Proceedings from the scientific conference Methodology and Archaeometry* on a platform for open access books from the Faculty of Humanities and Social Sciences of the University of Zagreb (FF Open Press).

Proceedings from the 5<sup>th</sup>, 6<sup>th</sup>, 7<sup>th</sup>, 8<sup>th</sup> and 9<sup>th</sup> conference are available on:

<https://openbooks.ffzg.unizg.hr/index.php/FFpress/catalog/series/MetArh>

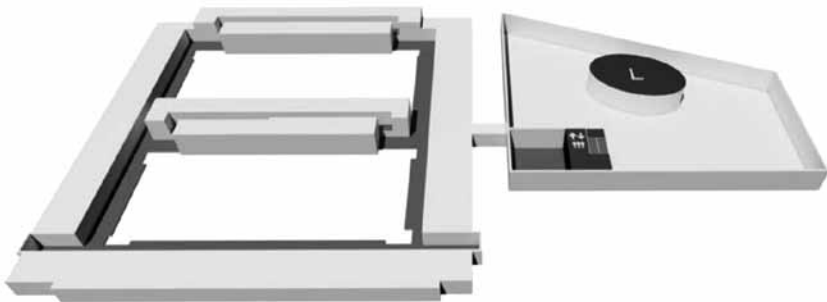


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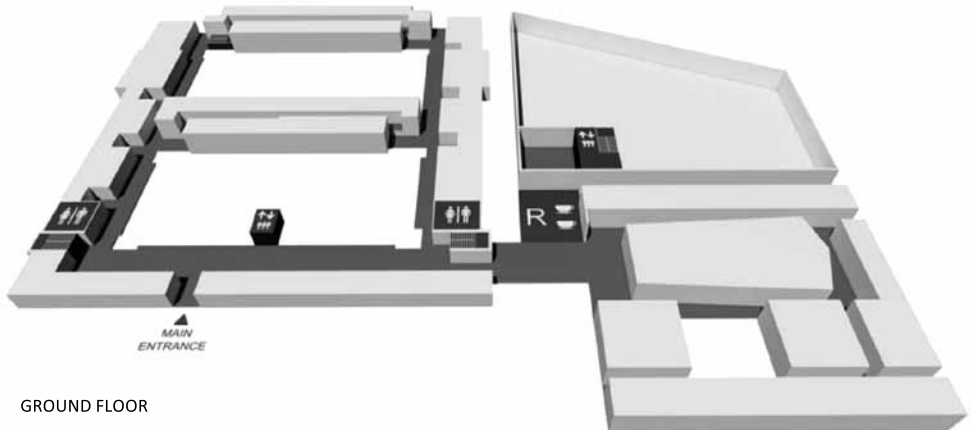
NAVIGATION



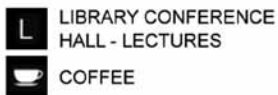
## Faculty of Humanities and Social Sciences of the University of Zagreb GROUND PLAN



2ND FLOOR



GROUND FLOOR



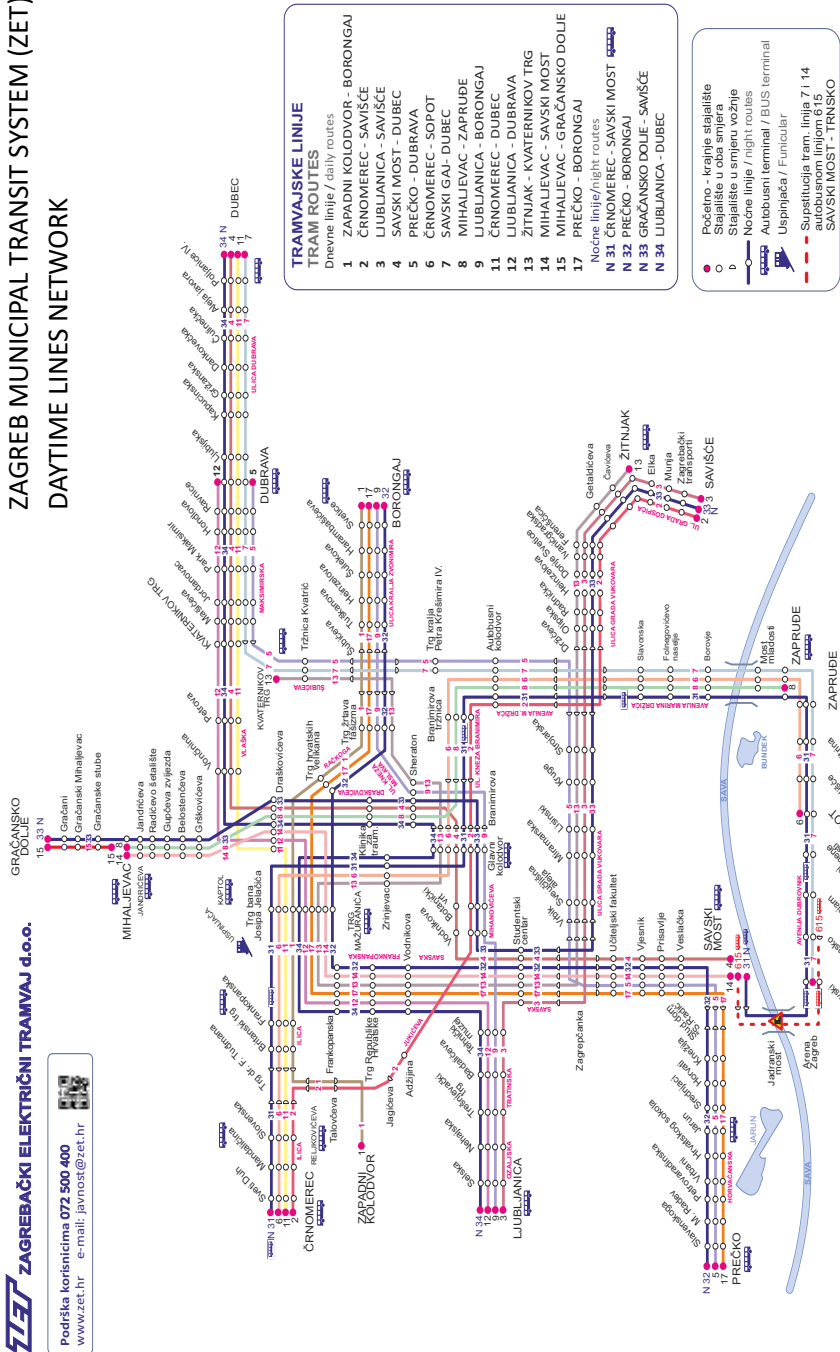
The lectures will be held at the Conference hall on the 2<sup>nd</sup> floor of the Faculty Library (on the right of the main entrance of the Faculty building)



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