MET ARH

08TH INTERNATIONAL SCIENTIFIC CONFERENCE

METHODOLOGY & ARCHAEOMETRY

Zagreb, 3rd – 4th December 2020

Book of abstracts

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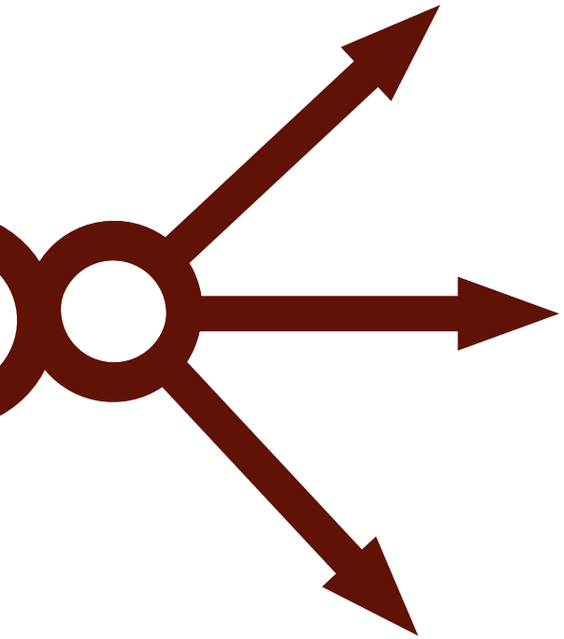

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CONFERENCE *METHODOLOGY & ARCHAEOMETRY*

The 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.

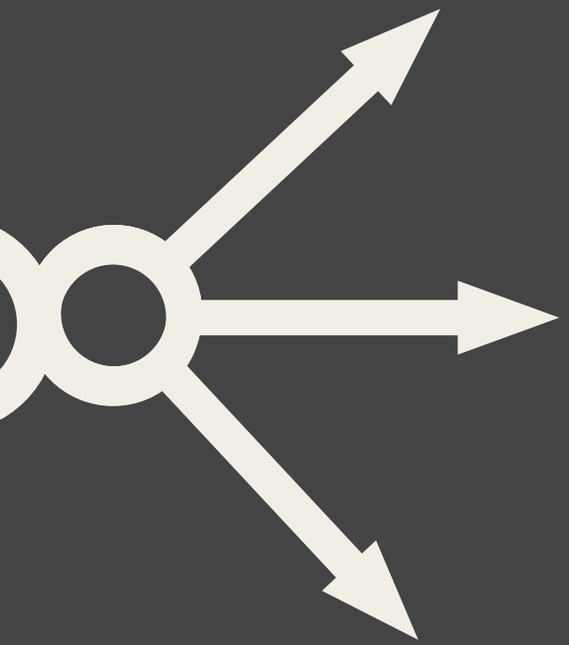
Section Methodology

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 the past processes and to give more objective and comprehensive picture of the past. Contemporary interpretation tools alleviate and speed the data collection and also provide us with countless possibilities of interpretation, protection and presentation of archaeological sites and the landscapes encompassing them.

Section Archaeometry

Having in mind limited information we obtain from archaeological excavations and the classification of archaeological material, cooperation with other scientific disciplines becomes unnecessary, to obtain as much information as possible on the conditions and the way in which the 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 arhaeometrical 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 a continuous cooperation of a specific expert and an archaeologist from sample collection to the final interpretation.

Due to the COVID-19 pandemic, this year's conference was held on online platform for virtual events: **https://hopin.to/events/metarh-2020**



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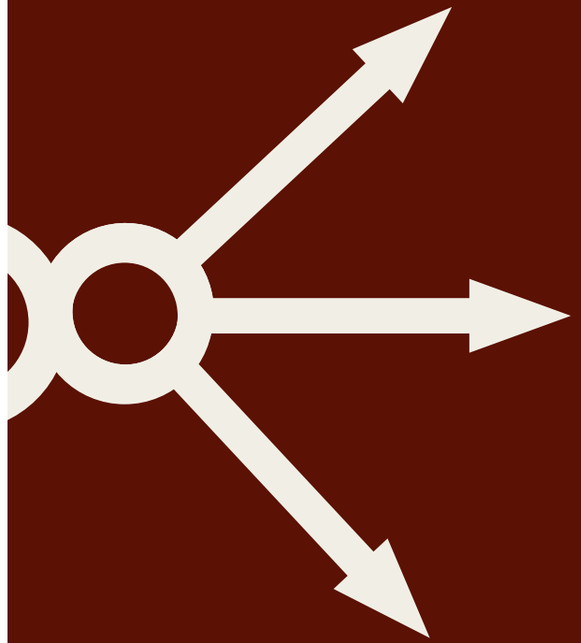

PROGRAMME

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Thursday, 3rd of December

10:00 – 10:15
Conference opening

Ina Miloglav – organizer, Department of Archaeology
Domagoj Tončinić – Head of the Department of Archaeology
Jacqueline Balen – president of Croatian Archaeological Society

Keynote lectures:

Chair: Ina Miloglav

10:20 – 10:50
Sarah McClure
Exploring stable isotope analysis in archaeology: a case from Neolithic Dalmatia

10:55 – 11:25
Daniel Albero Santacreu
Ethnoarchaeometry in action: New strategies to old challenges

11:30 – 11:45
Break

Chair: Rajna Šošić Klindžić

11:45 – 12:00
Tena Karavidović, Dinko Tresić Pavičić, Tajana Sekelj Ivančan
Methods of documenting iron production waste finds: the role of digital photogrammetry

12:05 – 12:20
Rory Becker, Ivor Janković, James Ahern, Darko Komšo, Ivor Karavanić
Modeling Sediment Depth through High Resolution Earth Resistance Tomography

12:25 – 12:40
Toni Ljubić
Optical Character Recognition (OCR) and Artificial Intelligence in Digital Epigraphy

12:45 – 13:00
Manuel Reimann
Information Systems for Documenting Archaeological Excavations

13:05 – 13:50
Break

Chair: Staša Babić

13:50 – 14:05
Rajna Šošić Klindžić
That's not the shape of my site

14:10 – 14:25
Predrag Novaković
Reflections on empathy as a method in archaeology

14:30 – 14:45
Boris Kavur, Martina Blečić Kavur
To everything there is a season and a time to every purpose…

14:50 – 15:05
Break

Chair: Jacqueline Balen

15:05 – 15:20
Boris Kavur
Being (almost) a Neanderthal

15:25 – 15:40
Mykhailo Klymovych
Few experiments of log-boats making based on archeological artifacts founded on the land of southwestern Rus' 10th – 13th century

15:45 – 16:00
Goran Tomac
Animal exploitation in the Đakovo area during Neolithic

16:05 – 16:20
Andreja Sironić, Jadranka Barešić, Damir Borković, Anita Rajtarić, Ines Krajcar Bronić
Radiocarbon dating of textile in the Zagreb Radiocarbon Laboratory

Friday, 4th of December

Chair: Jasna Vuković

10:00 – 10:15
Maja Miše
The post-depositional alteration and contaminations in amphorae from shipwrecks

10:20 – 10:35
Sergios Menelaou, Fotis Georgiadis, Stella Katsarou, Anastasios Siros, Andreas Darlas
New Light on Prehistoric Aegean Cave Use and Pottery Production: Preliminary Petrographic Results and Provenance of a Ceramic Assemblage from Samos Island, Greece

10:40 – 10:55
Kristina Heath, Maja Miše, Patrick S. Quinn
Provenance and Technology of Kitchenware from a Roman Roadside Station at Žuta Lokva, Croatia

11:00 – 11:15
Courtney Allardice, Patrick S. Quinn, Maja Miše
Provenance and Technology of Large Storage Jars from the Iron Age settlement Nadin, Croatia

11:20-11:35
Break

Chair: Andreja Kudelić

11:35 – 11:50
Michela Spataro, Tihomila Težak-Gregl, Marcel Burić
Pottery technology and the Korenovo enigma

11:55 – 12.10
Esmeralda Agolli
Innovation and Technology: An Attempt to Measure the Rate of Transformation in the Late Prehistoric Pottery from Albania

12:15 – 12:30
Petra Nikšić
Volume density and spatial analysis of a Late Antique settlement - preliminary results

12:35 – 13:00
Break

Chair: Domagoj Tončinić

13:00 – 13:15
Katarina Šprem, Uroš Barudžija
I yabba-dabba do! Limitations of petrographic analysis in determining the stone raw material sources

13:20 – 13:35
Branko Mušič, Matija Črešnar, Bryan Hanks, Barbara Horn, Petra Basar
Identification of Early Iron Age iron-smelting complexes on the territory of Dolenjska region in Slovenia on the basis of geophysical and geochemical research. The case study of Cvinger near Dolenjske Toplice hillfort

13:40 – 13:55
Martin Hristov, Svetla Tsaneva
Technological observations on an EBA gold dagger from Dubene, South Bulgaria

14:00 – 14:10
Break

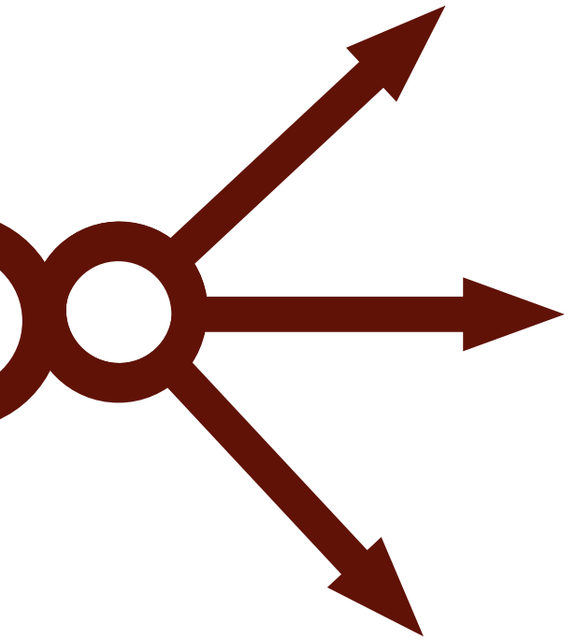
Chair: Jacqueline Balen

14:10 – 14:25
Ivor Karavanić, Ines Krajcar Bronić, Slobodan Miko, Rory Becker, Nikola Vukosavljević, Natalija Čondić, Marko Banda, Fred H. Smith
Last Neandertals at the Crossroads of Central Europe and the Mediterranean: Project presentation

14:30 – 14:45
Domagoj Tončinić, Mirjana Sanader, Joško Zaninović, Ina Miloglav, Miroslav Vuković, Vinka Matijević, Mirna Vukov, Domagoj Bužanić
Choosing the right spot. ALS and field survey in the AdriaRom project

14:50 – 15:05
Staša Babić, Predrag Novaković, Rajna Šošić Klindžić, Jasna Vuković
The HERISTEM (STEM In Heritage Sciences) Project: The First Year of Experience

15:15
Closing



ABSTRACTS

ABSTRACTS

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Exploring stable isotope analysis in archaeology: a case from Neolithic Dalmatia

Stable isotope analyses have become more common in recent years to address diverse issues such as human and animal diets, movement and mobility, climate and ecology. However, like any method, the ability to interpret the results of stable isotope analyses is tightly linked with the specific research questions, sample quality, and sample size. In this presentation I describe stable isotope work we have conducted as part of an international project on Neolithic domestic animal management practices in Dalmatia.

The ultimate goal of the project was to create multiple lines of evidence that would link with one another to create a mosaic of information of Neolithic subsistence and land use practices through time. We worked on several different isotopic systems in bone, teeth, and seeds, including carbon, nitrogen, oxygen, strontium, and sulpher. Here I discuss results that are changing the ways we understand human-animal interactions during this period, along with those that remain inconclusive or where our original project design was flawed.

Daniel Albero Santacreu

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Ethnoarchaeometry in action: New strategies to old challenges

The application of techniques and methods from the Natural Sciences (e.g. Physics, Chemistry, Geology, Biology, etc.) to the characterization of the material culture and raw materials related to current societies has given birth to a new field of study known as “ethnoarchaeometry”. The combination of both disciplines, i.e. archaeometry and ethnoarchaeology, has promoted a deeper understanding of the ways in which the technological choices made by artisans throughout the diverse stages involved in the production are embedded in the multiple dimensions of materiality. On the one side, archaeometry provides effective analytical routines that allow us to obtain a large amount of data related to the technology associated with archaeological materials. On the other side, ethnography provides us with interpretative frames that are useful to approach the social and cultural dynamics underlying this rich corpus of data.

In this lecture, we are going to address the synergies between archaeometry and ethnoarchaeology. Through various case studies related to different types of analysis, we will see how this discipline has been used, on the one hand, to test and improve the archaeological methodologies applied in the study of the materiality associated with past societies. On the other hand, we will show how it has been also used to improve the theoretical frameworks and our interpretations of such materiality in order to address its social and cultural dimensions. The main objective of this talk is, therefore, to provide a general overview of the role that ethnoarchaeometry has been playing since it was first implemented in archaeological studies fifty years ago.

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Methods of documenting iron production waste finds: the role of digital photogrammetry

The process of direct (bloomery) iron production, which was used from prehistory till the Middle Ages, often produces a large amount of waste. Dependent on the production process and the procedures used, several categories of waste are likely to be present on the archaeological sites. The general categories of waste can be iron slag from different procedures of the production process, such as iron ore smelting or primary/secondary smithing, and the remains of technical ceramics from smelting furnaces and/or smithing installations. The methodological approach to primary documentation of these finds must be organized concerning the character of standard, mainly destructive procedures used for further analysis and interpretation, as well as a cost-effective way of meaningfully documenting large amounts of metallurgical waste that often occurs on sites with the iron production remains.

The authors will present the primary documentation methods used in the treatment of *in situ* smelting furnaces and other metallurgical waste from several sites that can be regarded as iron production and processing workshops. All of the sites are situated in the Podravina region and are dated to late antiquity and early middle ages (4 – 8/9th century AD). The main objective for the selection of documenting procedures was to gain an optimal level of output information while securing a low level of data loss. The chosen approach allows the further application of various analytical methods, reconstructive modelling and visualizations. Authors will elaborate on the methods used, analysis employed and information gained, with an emphasis on photographic documentation and further digital processing such as image-based 3d modelling.

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Modeling Sediment Depth through High Resolution Earth Resistance Tomography

Earth Resistance Tomography (ERT) has the capacity to model sediment depths to bedrock. However, its use at archaeology cave site investigations has been limited though it has the potential to inform the archaeological excavation planning process by producing sediment depth estimates. A GeoScan RM85 earth resistance meter was utilized for all surveys in this study which is significant given it is an instrument common to near-surface archaeological investigations as opposed to the dedicated ERT systems typical of geology remote sensing surveys or groundwater testing. A pole-pole array was used in each of these surveys after early testing at the Bukovac Cave site near Lokve proved the data collection for this array worked well in caves as compared to the more common Wenner and Schlumberger arrays with a GeoScan instrument. Development of the pole-pole ERT survey methodology at cave sites in Croatia continued in 2014 and 2015 at the Velika Pećina near Kličevica and Romuald's Cave sites.

Though these surveys proved unsuccessful concerning the reliability of the sediment depth estimates as compared to the ground-truthing from traditional excavations, much information was gained in about field methodology. In 2017, the Romuald's Cave site in Istria was again surveyed though field methodology was modified to a very high density survey design (using 0.1 m probe spacing instead of the 0.5 m probe spacing from earlier surveys). The high data density survey produced reliable results as compared to observed sediment depth from excavations within the cave. The authors present the development of their field methodology with the ERT technique using common archaeological geophysics equipment which has produced reliable results in recent years. Primarily, the method employed with the ERT technique involves very high-density surveys within the (often) limited space available inside Paleolithic cave sites.

Toni Ljubić

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Optical Character Recognition (OCR) and Artificial Intelligence in Digital Epigraphy

Optical Character Recognition (OCR) and Artificial Intelligence (AI) are information technologies which started their life in the 1980s and have since then been applied for the digitalization of printed texts, as well as their editing, analysis, storage, and prediction. Today they are applied, along with the Computer Vision (CV) algorithms, for real-time text detection and trans-

lation. These technological breakthroughs were only recently introduced in the field of archaeology, and consequentially, epigraphy, thus replacing the text-bearing medium from paper to stone and clay. The vast improvement in technology (i.e., smartphones, tablets, digital cameras, etc.) provided researchers, as well as everybody else in the archaeological ecosystem, with the tools to access information at any given time in a matter of seconds. For example, OCR, AI, and CV enable the utilization of the photosensors of a smartphone as an input to the algorithm, whose goal is to match the photograph of an object made by the user, with the previously stored photographs and the information of the same object in the database.

This alleviates the need for setting up physical info-points about epigraphs and inscriptions, which can sometimes be seen as an invasion of the archaeological site itself. Along with that, these technologies have also been used to analyze the text from epigraphs, as well as to reconstruct the inscriptions in the case of missing or damaged characters of whole parts of the inscription. This presentation will show current possibilities and features of OCR and AI methods, their application in various scenarios, such as visiting a museum or an archaeological site, but also in the inscription research and non-destructive reconstruction scenarios. As these technologies are being developed with a rapid pace, their future possibilities and usage in digital epigraphy will also be presented.

Manuel Reimann

Inari Software GmbH, Graz, Austria

Information Systems for Documenting Archaeological Excavations

Internationality and Interdisciplinary research have become focal points in archaeology. As positive as these trends are in general, they also present new problems for projects and the (regional) management of research. Since the standards of documentation differ in different countries and even regions, internationality can cause problems, for example if researchers with different backgrounds shall document according to the standards of a national or regional authority. One solution can be the use of IT-Systems which provide the correct guidelines by default. With an interface adapted to the respective guidelines and an export-function for the completed documentation all the needed documentation can be created in one system. The benefits are obvious: the standard and quality of the documentation will rise, because archaeology, not the documentation itself, is the focus. Also the time needed for creating the documentation is reduced, which leaves the archaeologists to spend more time with the interpretation and research work.

In this context, the paper shows how modern information systems can be used for quality assurance and raising standards and how they can help with simplifying international projects. It shows how an AIS (Archaeological Information System) enables different people to use their experience and working methods as effectively as possible. The example in this study is the AIS-System developed by Inari Software, which covers precisely these requirements and can be flexibly adapted to new standards and guidelines.

Rajna Šošić Klindžić

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

That's not the shape of my site

This presentation will be refection on 5-year work on Neolithic site Gorjani Kremenjača and changes in the perception and interpretation that the site underwent during this period. The research questions at the beginning were significantly different than those right now. The major change in research trajectory was not the results of an elaborate research plan but more a matter of circumstances.

Most of the research activities, especially on a single site, is deeply embedded in the standard archaeological practices and rely heavily on poorly formulated, yet rarely challenged theoretical background. In archaeological practice, theoretical background frequently transforms into dominant, yet unconscious assumptions on scale and type of prehistoric societies and settlements. The underlying and conjoining "common ground" is simplicity. When it comes to defining habitational spaces, scales shrink significantly, and features are rarely observed through space needed for everyday life through analogy with modern villages, but instead forming some imaginary "concentrated" spaces, more resembling videogames scenery like Age of Empires. One of the reason is that archaeological trenches are usually small in size. Adding to that is another embedded assumption, that of the simple primordial society that started to evolve right around the Neolithic period. Emerging evidence of complexity vs usual evidence of simplicity urge archaeology to move from those traditional explanatory models where we created prehistoric man and his life based on the image of our simple cousin and create new ones. In this presentation, I will build my arguments around work of D. Clarke, D. Graeber and D. Wengrow on the restrictions of the archaeological/anthropological method and theory and discuss alternative approaches and ideas for better interpretation of prehistoric sites using site Gorjani Kremenjača as a case study.

Predrag Novaković

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Reflections on empathy as a method in archaeology

The classical 19th century hermeneutic argued that one could not understand history without the intentions of the people making it. Traditionally, there are two intertwined channels how to reach the intentions to understand historical events, by a detailed study of historical conditions which acted upon the particular event, and by empathically immersing into the people's mind to 'rethink' or 'relive' the situations as closely as possible. The intentions in this sense transcend the action by connecting the past people with the present historian. Through time, the emphatic immersion was increasingly understood not as a technique only, but as ontological characteristic of the human existence. Immersing into other minds was the way how to make sense (for us) of the world in which we live or think about it. For Heidegger, understanding is not a form of cognition but the ontological existential which always creates necessary relationships between the There being (Dasein)

and other people and objects in-the-world. In the 20th century historiography, the major proponent of 'history of the mind' was Robin Collingwood. Crucial is his distinction between an event and an action. The event can be explained by causal chains (e.g. X produces Y), while action can be intelligible only through the reconstruction of motives, intentions, etc. He argues that historical thinking is projecting ourselves into the past to understand past actions.

In contrast, archaeologists very rarely explicitly defined empathy or 'reliving' as a way how they came to interpretations. Processual archaeology completely abolished empathy and considered it as pseudo-scientific. For processualists, it is possible to think of human reasoning only based on material evidence provided by patterns of human behaviour. The revival of empathy came with postprocessulist archaeology which in its critique of the processualist scientism turned back to some older ideas (of Collingwood and others) and revived them in new contexts. One of the best examples of such older ideas with significant impact on archaeology is William Hoskin's research of past landscapes.

Boris Kavur, Martina Blečić Kavur

Faculty of Humanities, University of Primorska, Koper, Slovenia

To everything there is a season and a time to every purpose…

In the last two decades, Slovenian archaeology benefited financially from the potential derived from large-scale infrastructure projects and increased dramatically the number of analyses performed using methods derived from natural sciences – especially increased the number of radiocarbon dates. In the same period, several research projects were conducted with the intention to supplement and interpret the opportunistically collected data. In several instances the results missed the explanatory potential of absolute dating – the results exposed the conceptual problems behind the forceful conjunction of research methods coming from natural sciences and humanities. This became dramatically evident on the epistemological level of archaeological interpretation – the use of radiocarbon dating, instead of solving several archaeological questions, created new problems.

This paper will expose several examples where deeply rooted archaeological assumptions, combined with a superficial reading of data, caused manipulation with data and influenced interpretations. Presented will be cases where a planned strategy of radiocarbon dating enabled the authors to formulate a new interpretation of archaeological data, but also cases where the authors, despite the results of dating, arranged the data to support the previous (traditional) knowledge.

Boris Kavur

Faculty of Humanities, University of Primorska, Koper, Slovenia

Being (almost) a Neanderthal

Ancient humans, especially the Neanderthals, were too often not so fastidious to relinquish with the remains of their activities also the manuals on how to read the mess they have left behind. Structuring, and explaining, the Middle Palaeolithic archaeological date became the obsession of numerous field archaeologist and masters of academic rhetoric. We could actually claim that a capital part of the archaeological theory was formed in the 20th century on the academic battlefields besprent with side-scrapers.

Parallel to the airing of modern archaeological minds, experimental archaeology, this is the production and reproduction of (almost) convincing stone tools, was developed as a desperate attempt to enable through the material action to obtain a glimpse into the ancient mind. Doing and using primitive technology boosted researchers' confidences, but the development of academic bushcrafts aided mostly to the understanding of ancient human adaptability to chaotic environmental variability. Only rarely, it triggered a retroactive re-assessment of standard methodologies of field research or helped the researchers to address the things they did not find.

More than two decades ago, we attempted to manufacture (as accurately as possible) many Middle Palaeolithic looking like stone tools. However, instead of focusing on the process, we will bring forward in this presentation, the interpretation of the debris, of the waste, produced during this process. It will not only help us to assume what we are missing with methodologically modern excavations, but it will also create a framework for the re-assessment of archaeological data from older excavations. Behaving (almost) like a Neanderthal will help us to assume what we are missing when looking at archaeological finds produced by Neanderthals, discovered, and published by generations of *Homo sapiens*.

Mykhailo Klymovych

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Few experiments of log-boats making based on archaeological artefacts founded on the land of southwestern Rus' 10th – 13th century

On the territory of Ukraine, several dozen log-boats were found, which can be dated to the medieval period. Most of these findings are not well researched and were found by accident. Over the past few years, there has been an increase in the number of finds and interest in their studying. However, the data of the discovered finds is not complete and poorly introduced into the scientific environment. The medieval written sources are fragmentary, and therefore don't give a complete picture of the features of log-boats construction in mentioned lands. The most effective method for studying the traditions of making log-boats is to carry out experiments by comparing the archaeological and ethnographic evidence.

During the 2019 and 2020, three experiments on the manufacture of log-boats based on archaeological materials were carried out in Ivano-Frankivsk. This paper will present the theoretical basis, the implementation of experiments, and obtained results. The experiments included the hollowing out of the boats and their further processing, which included a steaming of the sides and "sewing" of several rows of the borts. Different ways of turning (rotating) the logs, using human power and primitive levers were tested as well. Two methods of steaming borts, so-called "Finnish" and ethnographic will also be shown.

Goran Tomac

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Animal exploitation in the Đakovo area during Neolithic

Although the Neolithic of the eastern part of Croatia has been extensively researched since the latter part of the 19th century, relatively little is known about the subsistence strategies of the contemporary populations inhabiting the area. While the eastern Adriatic coast has yielded large quantities of data on the exploitation of animals throughout prehistory, archaeofaunal studies from Slavonian sites are rare. The analysis of animal bone assemblages from the Late Neolithic Sopot culture site Gorjani-Kremenjača may therefore begin to shed some light on the matter. The site lies in the vicinity of Đakovo and its excavation in the recent years uncovered remnants of burned rectangular structures, while geomagnetic survey indicated a complex settlement with a layout of residential features, ditches and palisades. According to pottery assemblage and ^{14}C dates, the site belongs to Sopot culture period (5016-4486 cal BP). Preliminary archaeozoological analysis reveals animal-based subsistence economy with cattle being the most abundant taxa, followed by pigs and sporadic remains of caprines, canids and wild ungulates. Additionally, this presentation will also give a basic overview of scarce faunal remains from Gorjani-Topole, a site attributed to Starčevo and Sopot culture, based on ceramic finds and the obtained ^{14}C dates. The excavation of this site began this year but was paused due to COVID-19 outbreak.

The overall aim of this study is to provide more information on the animal husbandry in Sopot culture in Croatia, raising some interesting topics, including the complexity of animal husbandry and the degree of impact of wild taxa in the Neolithic diet, while also comparing the subsistence strategies of both sites as part of the larger network in the northern Balkan Peninsula and the Pannonian Basin.

Andreja Sironić, Jadranka Barešić, Damir Borković, Anita Rajtarić, Ines Krajcar Bronić

Ruđer Bošković Institute, Zagreb, Croatia

Radiocarbon dating of textile in the Zagreb Radiocarbon Laboratory

Textile was rarely dated before the introduction of accelerator mass spectrometry (AMS) introduction since the radiocarbon method is destructive and AMS requires a much smaller amount of material than conventional radiometric methods. For the same reason, however, AMS is more susceptible to sample inhomogeneity and foreign contamination. Linen or wool textiles contain thin closely intertwined fibers, so the pretreatment should be done with extra care. The pretreatment method that effectively removes contaminants and isolates only the original carbon representative for dating, is often dictated by the condition of the artifact. For the most famous radiocarbon-dated textile, the Shroud of Turin, many different techniques had been applied: from mechanical scraping, removing organic coatings with organic solvents, using detergents and standard acid, base and acid wash.

The usual pretreatment method in the Laboratory consists of: identifying the fiber origin (by burning a thread), mechanical scraping and removal of applied coatings (like paint) by solvents, if needed, then acid, base, bleach and again acid washing. The best known artifact of linen dated in the Zagreb Radiocarbon Laboratory is the wrapping of the Zagreb mummy, called *Liber linteus Zagrabiensis*. Since the AMS has been introduced to the Laboratory, we have also dated canvases and textiles (wool and linen) from archeological, historical and mostly art historical context. Here we present types of textiles dated in the Laboratory and the methods for their pretreatment and compare the obtained radiocarbon ages with the expected ages, when data are available.

Maja Miše

University Colleague London, Institute of Archaeology, London, United Kingdom

The post-depositional alteration and contaminations in amphorae from shipwrecks

The present study sheds new light on the alterations of archaeological ceramics buried in marine environments by analysing in detail a large dataset of Hellenistic and Late Roman Republican transport amphorae from 15 sites along the well-known ancient maritime trade route of the Dalmatian coast in southern Croatia.

The analysis included amphorae from shipwrecks, kiln sites and settlements. In this multiple site investigation, the ceramic petrography and bulk geochemical analysis by Instrumental Neutron Activation Analysis have been used to directly compare, for the first time, sherds that have a common origin, but were buried in different environments, marine and terrestrial. This has permitted the identification of changes in ceramic microstructure as well as alterations of chemical elements that were either enriched or depleted in the amphorae from shipwrecks relative to those from land burials. The findings of the study are discussed in terms of the provenance determination of ceramics from submerged environments that can set a framework for reconstruction of ancient maritime trade routes.

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New Light on Prehistoric Aegean Cave Use and Pottery Production: Preliminary Petrographic Results and Provenance of a Ceramic Assemblage from Samos Island, Greece

This pilot study forms part of an interdisciplinary research project being carried out on finds from Agriomernos Cave (Seitani) in northwest Samos Island, Greece, which have produced important evidence for use during at least two different chronological episodes, the Final Neolithic (late 4th mill. BC) and the Middle Bronze Age (early 2nd mill. BC). In the framework of this wider project, this paper presents some preliminary results from the petrographic analysis of a recently discovered ceramic assemblage. Petrographic results, combined with macroscopic and typological data, have revealed a diverse ceramic assemblage in terms of clay composition and provenance. While most of the pottery was produced locally, using a range of different raw material sources, potential imports from the south coast of Samos and secure off-island imports have also been identified based on their petrological signature. The mineralogical data are compared with already established groupings from previous analysis of Final Neolithic/Chalcolithic, as well as Early and Middle Bronze Age pottery from the Heraion and Tigani settlements, located in south-central Samos. This aims at reconstructing manufacturing traditions diachronically, as well as intra-island and inter-Aegean communication and mobility during prehistory. This picture adds to already existing analytical data on the production and circulation of Neolithic pottery in caves around the Aegean, such as Euripides Cave on Salamina (Saronic Gulf), Cyclops Cave on Youra, Aghios Efstratios and Ayio Gala on Chios (northeast Aegean). The Seitani Cave constitutes a key archaeological site at an area that has largely remained unexplored and it offers a unique opportunity to evaluate a sealed and securely-dated ceramic assemblage with strong typological and stylistic parallels from the nearby islands and western Anatolian littoral.

Kristina Heath, Maja Miše, Patrick Sean Quinn

University Colleague London, Institute of Archaeology, London, United Kingdom

Provenance and Technology of Kitchenware from a Roman Roadside Station at Žuta Lokva, Croatia

Uncovered in 1996 during the building of a road, the archaeological site of Žuta Lokva, Croatia has been excavated until 2003. The remains of a building with two phases were uncovered, along with ceramic finds dating from the beginning of the 1st Century AD to the middle of the 2nd Century AD. Excavations show that the site was a permanent roadside station on one of the busiest roads from the Adriatic coast towards the inland of the Roman province Dalmatia. Most of the sherds unearthed at Žuta Lokva belong to Roman kitchenware, indicating that main activity at the roadside station was serving food and accommodation to Roman travellers.

The aim of this research is to determine the provenance of the kitchenware found at Žuta Lokva, using ceramic petrography and chemical analyses, and compare the results with neighbouring pottery workshops. This will help to answer questions, such as whether Žuta Lokva potters produced their own kitchenware, and the site functioned as an independent roadside station, or if the local community imported wares from the neighbouring workshop in Crikvenica, ancient Ad Turres on the coast. The 61 sherds, provided by the Institute of Archaeology in Zagreb for analysis, vary in terms of style, decoration and clay type. Ceramic petrography and portable X-Ray fluorescence were used to further characterise the sherds and group them by fabric. Through the integration of instrumental methods, it is possible to identify the chemical composition and microstructural components of the sherds, in turn allowing the interpretation of provenance. By using SEM-EDS, I also hope to answer technological questions, specifically paste preparation, clay recipes and firing processes.

Courtney Allardice, Patrick S. Quinn, Maja Miše

University College London, Institute of Archaeology, London, United Kingdom

Provenance and Technology of Large Storage Jars from the Iron Age settlement Nadin, Croatia

The site of Nadin is a large Liburnian hillfort settlement near Zadar, Croatia, occupied by the indigenous community of Liburnians. Intensive seafaring promoted the development of the Iron Age Liburnian culture, which in its later phase, from (4th-1st c. BCE), is characterised by a strong Hellenistic influence, reflected in the mortuary architecture and imported Hellenistic pottery. Significant numbers of large (1mx1m) storage jars known as Pithoi (Greek) or Dolia (Roman), have been excavated at Nadin and other neighbouring Liburnian Iron age settlements.

These storage jars were used predominantly for domestic storage of grains and foodstuffs in the settlements and have been found alongside kitchenware and imported Daunian Mattpainted ware from Southern Italy. In studies of ancient ceramics, it is usually assumed that such large storage vessels were produced locally due to the effort involved in their transport.

However, pithoi have been reported from several shipwrecks in the Adriatic may have been imported from production sites in Apulia, Southern Italy. In order to address if they are produced locally, the provenance of 23 Liburnian pithoi sherds excavated from Nadin is being investigated compositionally in the present project, an MSc dissertation at UCL Institute of

Archaeology, using a combination of macroscopic fabric analysis, thin section petrography and geochemistry. This presentation will present the initial findings of the study including ceramic petrography, portable X-Ray fluorescence (pXRF) and the further research planned. Data collected non-destructively via pXRF will be explored and compared to existing data on pithoi from Apulia. The project seeks to contribute to our knowledge of Iron Age trade networks within the Adriatic.

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Pottery technology and the Korenovo enigma

At two sites in northern Croatia, late Starčevo pottery was found together with sherds of a regional variant of Linearbandkeramik (LBK) pottery, known as Korenovo. Although these contexts have not been dated directly, the apparent coexistence of Starčevo and LBK motifs would indicate a date in the 54th century cal BC, roughly coinciding with the start of the Vinča culture in Serbia.

We report the first results of archaeometric analyses of Korenovo sherds from Malo Korenovo and Kaniška Iva, in the context of results from Starčevo, Vinča and early LBK pottery from the surrounding region. Although Korenovo pottery was locally made, like Starčevo pottery from the same sites, and superficially resembles LBK pottery, technologically it has more in common with early Vinča pottery, reflecting the complex dynamics of this transitional period.

Esmeralda Agolli

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Innovation and Technology: An Attempt to Measure the Rate of Transformation in the Late Prehistoric Pottery from Albania

Innovation comprises a question of particular interest in studies focused on production and technology of the archaeological material. Measuring the rate of transformation of material attributes could potentially explore a chain of important issues that regard manufacturing, production context, forms of exchange and market demand. It is indeed due to such potential that theoretical and methodological research on the matter has yielded some greatly beneficial outcome, especially in pottery studies. By taking advantage of these resources, in this paper, I focus on the measuring of the innovation degree of pottery material from late prehistoric southern Illyria (modern Albania).

The object of my analysis is the pottery from three consecutive late prehistoric periods: Late Bronze, Early and Developed Iron Age. In diachronic order, for each pottery repertoire, I seek to explore to what extent features classified as inherited, innovative, and extinct change quantitatively and how this could reflect the dynamics of production in terms of market demand and degree of exchange. I argue that the low level of innovative features, as opposed to those inherited, must be considered a robust indicator that the late prehistoric pottery technology in southern Illyria remains clogged in the domain of a household production developed within a self-subsistent economy that does not prevail in the context of a formal market exchange production.

Petra Nikšić

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Volume density and spatial analysis of a Late Antique settlement - preliminary results

The hilltop settlement at the site of Lobor - Majka Božja Gorska in Hrvatsko Zagorje has been in use since the Middle Bronze Age. The continuous building activity, as well as medieval and post-medieval burials, have disturbed the archaeological strata of the site to a great extent. Prehistoric and Antique layers suffered the most damage by later interventions. Antique and Late Antique pottery sherds are the most numerous finds but they are rarely found in an intact archaeological contexts. The comparison of the volume density of pottery finds (the number of sherds per excavated volume unit) on different parts of the site is a method used for its spatial analysis. The analysis focuses on the pottery finds from two trenches located almost at the opposite sides of the Sanctuary of Our Lady of the Mountain.

The first one, south-east of the enclosure wall, was excavated in 2010, and the second one, north of the enclosure wall, in 2014. The number of pottery sherds found in 2014 exceeds the number found in 2010 by 50%, what is, however, not reflected in the weight of those sherds. Since sherds found in 2014 were very fragmented and of more refined production, the difference in weight is only 30%. Those results prove that the quantification of pottery sherds alone cannot be used for the determination of the settlement expansion and the definition of its borders. Since area density isn't as correct, due to the lack of depth data, volume density is a more accurate method of analyzing pottery distribution in a settlement or in an area where a settlement is suspected. The exact position of the Antique and Late Antique settlement in Lobor is still unknown and will be determined by the use of this method.

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I yabba-dabba do! Limitations of petrographic analysis in determining the stone raw material sources

Determining the source of a stone raw material, for example, chert used for knapping or limestone for the building of a *villa rustica* can be very useful in enlightening the distribution networks of different types of raw material. One of the analyses that can help locate the sources is the petrographic analysis. This method, to an extent, allows us to identify the type and geological age of raw material used for an activity. This data can be a starting point in raw material provenance study, using geological maps of a potential area of procurement. However, petrographic analysis besides obvious advantages has some shortcomings, and its results are not always enough for answering specific archaeological questions. This presentation will show the advantages and limitations of the petrographic analysis in determining the archaeological raw material sources, with examples from prehistoric and Roman archaeological sites in Istria.

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Identification of Early Iron Age iron-smelting complexes on the territory of Dolenjska region in Slovenia on the basis of geophysical and geochemical research. The case study of Cvinger near Dolenjske Toplice hillfort

The Early Iron Age archaeological site of Cvinger near Dolenjske Toplice is located on a limestone hill above the Krka River valley between Dolenjske Toplice and Meniška vas. Recently it was a "test-site" within two EU projects, *ENTRANS* (HERA) and *Iron Age Danube* (*Interreg* DTP). One of the goals of both projects was to analyse the results of a multimethod geophysical survey, applied to detect iron-smelting complexes using a combination of magnetic method, magnetic susceptibility mapping, 2D resistance tomography and low-frequency electromagnetic method as well as geochemical analyses by the pXRF method.

The magnetic survey outlined the area of the iron-smelting complex, which lies approx. 200m to the south of the hillfort on a natural saddle called Branževec. Smaller areas were also detected inside the settlement, which might represent the magnetic effects of remains of blacksmith workshops. The purpose of other geophysical methods was to provide complementary data on the archaeological contexts. All these geophysical data was later supplemented by the results of geochemical analyses by the pXRF method and measurements of the magnetic susceptibility of long profile running across the entire Cvinger hill with the settlement and iron-smelting complex in its central part. The purpose of geochemical analyses was to determine the degree of spatial correlation between geophysical anomalies that indicate ironworks activities and the chemical composition of soils in these areas. This might be considered as an initiative for using geochemical surveys with portable XRF instruments for the discovery of iron-smelting complexes around Early Iron Age hillforts in the Dolenjska karst region, where accessibility for geophysical measurements is very limited due to lush vegetation and variable surface morphology.

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Technological observations on an EBA gold dagger from Dubene, South Bulgaria

The dagger was discovered in the closed complex of Structure no. 5 near the village of Dubene, Karlovo Region, South Bulgaria. It is referred chronologically to the EBA III, according to the ceramic material and the C^{14} dates. The structure consists of positioned on the ancient terrain

ceramic sherds, metal artefacts (daggers, a lidded silver box, a bronze knife, gold objects) and glass beads. All these were covered with the medium in size river stones, which made it a closed complex. Some of the discoveries find their parallels among other archaeological sites of the same period, but other – like the dagger in question – do not find exact analogues. This makes it important both from the archaeological point of view and for the technologies used during the second half of the EBA III.

Some preliminary technological observations and analyses were carried out that placed even more questions before the scholars. This paper will present some SEM images, analytical data and commentaries that give some indications concerning the composition and structure of the dagger.

Ivor Karavanić[1, 2], Ines Krajcar Bronić[3], Slobodan Miko[4], Rory Becker[5], Nikola Vukosavljević[1], Natalija Čondić[6], Marko Banda[1], Fred H. Smith[7]

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Last Neandertals at the Crossroads of Central Europe and the Mediterranean: Project presentation

A comprehensive interdisciplinary approach is proposed by this project, involving a wide range of professionals to obtain a variety of new data on the Middle and early Upper Paleolithic of Croatia. Employing both field and laboratory work, the project will shed new light on human biocultural evolution in south Central Europe and Central Mediterranean. This will involve obtaining a high-resolution chronology of the Middle/Upper Paleolithic interface in both continental and Adriatic Croatia and provide a more complete understanding of the relationships between Neandertals and early modern humans during the transitional period in Central Europe and the Mediterranean.

Furthermore, comparison of Neandertal behaviour between two different paleoecological zones (Continental and Adriatic) will contribute a unique perspective on Neandertal adaptations. The project „Last Neandertals at the Crossroads of Central Europe and the Mediterranean – NECEM" has been financed by Croatian Science Foundation, HRZZ-IP-2019-04-6649.

Domagoj Tončinić[1], Mirjana Sanader[1], Joško Zaninović[2], Ina Miloglav[1], Miroslav Vuković[1], Vinka Matijević[1], Mirna Vukov[1], Domagoj Bužanić[1]

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Choosing the right spot. ALS and field survey in the AdriaRom project

AdriaRom project aims to understand the Roman defence system on the eastern Adriatic coast conducted of two legionary fortresses (*Burnum* and *Tilurium*) and several forts between them. In scientific literature, this defence system was interpreted as a frontier and is sometimes referred to as the *Delmataean limes*. For successful implementation of reconstructing the defence system on the border zone, it is necessary to determine the positions of the assumed military sites and to formulate the structural indicators.

In order to achieve this, airborne laser scanning (ALS) on the targeted areas was conducted in the spring of 2019, followed by the systematic field survey in the spring of 2020. Although the ALS data revealed a number of structures during the field survey there was no visible material on the surface. In the case of the archaeological site near Balina glavica we had a completely contrary situation to the one above. Due to intense agricultural activity, there were no identifiable features visible on the ALS data in the fields below the hill of Balina glavica. During the field survey, large deposits of pottery and tegulae were found on the drywalls and stone mounds created as a consequence of land clearance which points us to the presence of a large archaeological site dating back to Roman times.

The common field surveying techniques of analyzing surface pottery finds did not show a result due to the fact that agricultural activities in the region have dropped significantly in recent years. For this reason, we were forced to come up with a field surveying method focusing on analyzing drywalls and clearance mounds, which could allow us to determine the approximate boundaries of the site. This paper will discuss our experience with field surveys based on ALS data where there is no identifiable material on the surface and the completely opposite situation where we have material but no other means to determine the nature or boundaries of the site.

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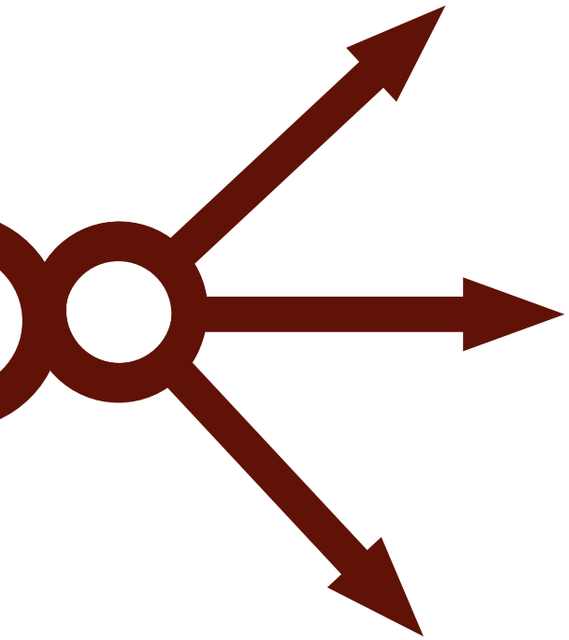
The HERISTEM (STEM In Heritage Sciences) Project: The First Year of Experience

The development in the fields of STEM (Science, Technology, Engineering, Math) in the last decades opened up a great potential for increasing of the understanding of cultural/archaeological heritage. At the same time, many social and economic transformations also affected the sector of cultural heritage protection and management.

HERISTEM is a strategic partnership project funded by the Erasmus+ Programme with the main goal of gathering high education institutions, institutions dealing with heritage preservation and protection, and small businesses in order to provide transfer of knowledge, skills, and good practices of STEM in the field of archaeology. The first activities of the Project: seminar for university teachers in online education and intensive course in remote sensing for students, both held at the University of Zagreb, have been successfully finished. However, the outbreak of COVID-19 pandemic put the activities of the Project to a challenge, resulting in new ways of implementation of STEM, both in conducting Project activities and in the Project outcomes.



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Papers from the 1st and 2nd 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 3rd and 4th conference *Methodology and Archaeometry* are published in a book *Recent Developments in Archaeometry and Archaeological Methodology in Southeastern Europe*, Cambridge Scholars Publishing, Cambridge, 2020.

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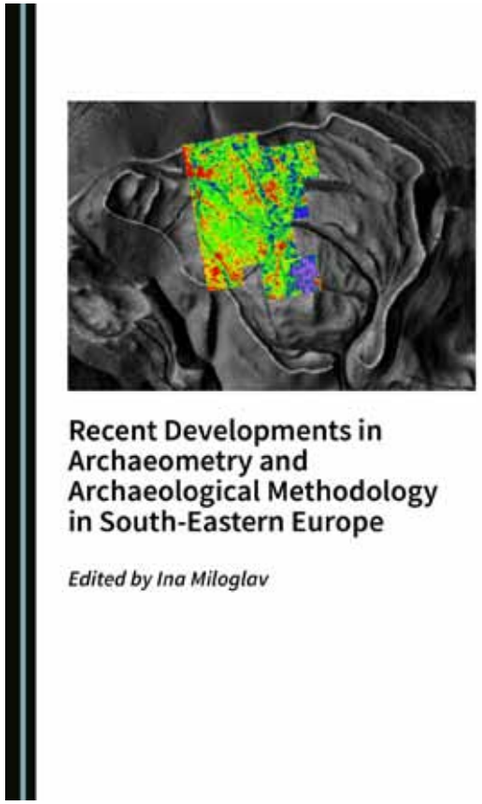

2019 papers from the conference are published in the *Proceedings from the scientific conference Methodology and Archaeometry* on a platform for open access books from the Faculty of Humanities and Social Sciences of the University of Zagreb (FF Open Press).

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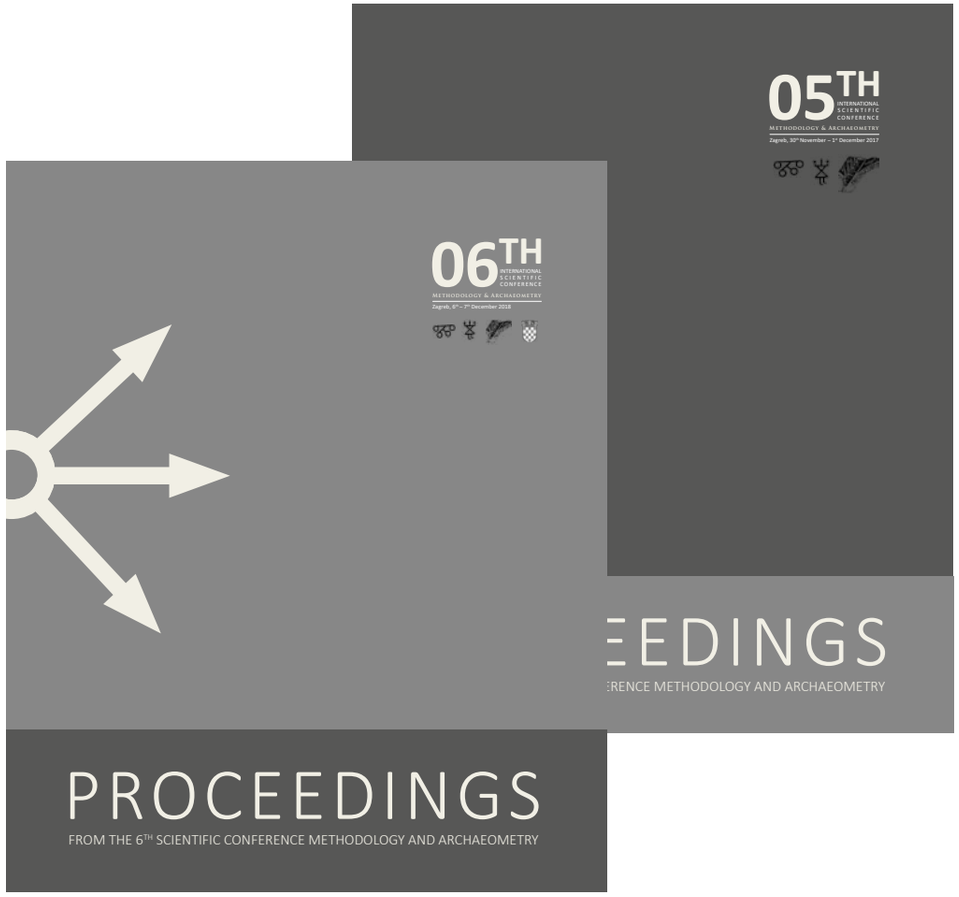

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