

METHODOLOGY AND ARCHAEOOMETRY IN FOCUS: REVIEW OF THE 13TH METARH, ZAGREB

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The thirteenth edition of the International Scientific Conference *Methodology and Archaeometry* (MetArh) was held in Zagreb on 27–28 November 2025, continuing an uninterrupted tradition established in 2013 (fig. 1). Held annually at the end of November or early December, the meeting has become a recognizable forum for interdisciplinary research – scheduled in the coldest season, yet perhaps at the ideal time for focused academic exchange. The event is organized by the Department of Archaeology at the Faculty of Humanities and Social Sciences, University of Zagreb, and is supported by both the University and the Croatian Archaeological Society. Its driving force from the very beginning has been Ina Miloglav (fig. 2), Associate Professor at the Department of Archaeology, who has consistently shaped the conference's direction and spirit.

The conference emphasizes the value of interdisciplinarity in contemporary archaeological research, encouraging critical reflection, innovative perspectives and new theoretical directions. Its broad thematic scope fosters discussions that advance key methodological questions, from data collection and documentation to the interpretation of archaeological contexts. By bringing together archaeologists and specialists from related scientific fields, the meeting highlights how collaborative work enriches the understanding of past human lifeways. The Methodology section focuses on the essential role of data acquisition, showcasing modern tools and techniques that enhance both the accuracy and efficiency of archaeological interpretation. The Archaeometry section demonstrates how analytical approaches from the natural sciences expand the information gained from excavations, while also requiring careful coordination between analysts and archaeologists. Overall, the conference underscores the importance of integrating diverse scientific expertise to build more nuanced and comprehensive reconstructions of the past.



Figure 1. Official poster of the MetArh 2025 Conference. Image Credit: Ina Miloglav.

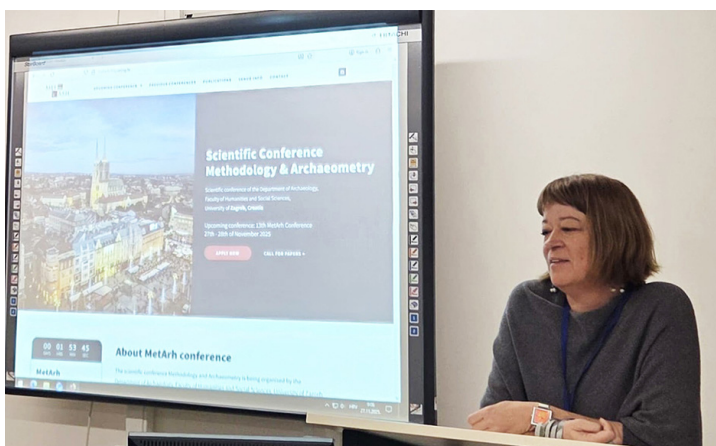


Figure 2. Ina Miloglav at the opening ceremony. Image Credit: Ina Miloglav.

Conference setting

The meeting was hosted by the Faculty of Humanities and Social Sciences of the University of Zagreb, the institution's oldest department – formerly the Faculty of Philosophy established at the founding of the university in 1669. The sessions were held in its dedicated conference hall, a venue well suited to focused presentations and discussion. Although originally conceived as a small and friendly gathering, the event continues to expand each year. This edition brought together around 110 authors and co-authors from 13 nations, with approximately half attending in person. Bulgarian participation comprised three contributions, all affiliated with the National Archaeological Institute and Museum of the Bulgarian Academy of Sciences (NAIM–BAS): one jointly presented by Atanas Tsurev and this author, and two others delivered by teams of co-authors, with Petar Minkov, Zheni Vasileva, Denitsa Sandeva, and Yana Dimitrova in attendance (fig. 3).

The Scientific Committee – Ina Miloglav, Jacqueline Balen, Rajna Šošić Klindžić, Marta Čović Mileusnić, Predrag Novaković, Dimitrij Mlekuž, Jasna Vuković, Michela Spataro, Duska Urem-Kotsou, Michael Doneus and Maja Miše – deserves recognition for ensuring the smooth organization and the consistently high academic standard of the program.



Figure 3. *Bulgarian participants in the conference. From left to right: Atanas Tsurev, Nikolina Nikolova, Petar Minkov, Yana Dimitrova, Denitsa Sandeva-Minkova, and Zheni Vasileva. Image Credit: Petar Minkov.*

The program was thoughtfully structured and deliberately kept at a manageable scale, extending over two days. In total, 25 presentations were distributed across seven sessions. One presentation had to be cancelled, while two were delivered online. Although the hybrid format is not my preferred approach, it is worth acknowledging the organizers' effort to provide remote participation for colleagues who were unable to attend in person. Each speaker was allocated fifteen minutes, followed by enough time for questions and comments. This format encouraged focused presentations and allowed for productive exchanges at the end of each session.

The sequence of sessions was interspersed with regular coffee breaks of fifteen to twenty minutes, held in the ground-floor lobby of the building. These intervals were well organized; hot drinks and pastries were readily available and the student volunteers ensured everything ran smoothly. The breaks also provided a relaxed setting for informal conversations.

The conference website (<https://metarh.ffzg.unizg.hr/>) proved very useful and user-friendly, providing clear access to the program, book of abstracts, application forms, and information from previous editions. It allowed participants to check details quickly and efficiently whenever needed. The site also offers open-access proceedings from the Methodology and Archaeometry conference series available since 2019 under the editorship of Ina Miloglav (<https://openbooks.ffzg.unizg.hr/index.php/FFpress/catalog/series/MetArh>). Contributions from two successive meetings are occasionally published together, offering researchers a comprehensive and readily accessible record of the presented work.

Program highlights

The conference opened with welcome addresses, beginning with Ina Miloglav who reflected on how the meeting began and developed over the years. Jacqueline Balen, President of the Croatian Archaeological Society, and Domagoj Tončinić, Dean of the Faculty of Humanities and Social Sciences, emphasized the significance of this gathering and shared memories from its early editions. The program then proceeded with the key-note lecture by Prof. Cristina Barrocas Dias from the Chemistry and Biochemistry Department, University of Évora, Portugal. Her presentation was both engaging and highly educational. She carefully explained key analytical methods – organic residue, isotopic, and proteomic analyses – including how lipid residues in pottery, isotopic values in human bone, and protein markers each contribute different insights into ancient diets. All terms, procedures, and their interpretive potential were presented in a way accessible even to non-specialist chemists, along with clear explanations of their limitations. Selected case studies from the Mediterranean illustrated how combining these approaches can reconcile apparently conflicting evidence and provide a more nuanced understanding of past foodways.

The conference program was well-structured and successfully balanced methodological discussions with case studies from ongoing research. One of the main the-

matic threads focused on the application of non-invasive methods, including LiDAR, magnetometry, and field surveys, often combined with spatial analyses. Several presentations highlighted the use of airborne laser scanning (ALS) and large-scale geophysical prospection, to investigate archaeological landscapes. Most studies were based in Croatia, which had recently completed a comprehensive national LiDAR survey covering the entire country. This extensive dataset, made publicly available under an open data policy (<https://dgu.gov.hr/>), allowed researchers to systematically detect, document, and interpret archaeological features across large areas, significantly expanding the scope of landscape research. In this context, Ivor Kranjec, Jelena Behaim, and Miljenko Jurković presented three case studies, offering new LiDAR-based insights into post-Roman landscape transformations in the Northern Adriatic. Tino Leleković examined how LiDAR and magnetometry revealed boundaries along the Croatian Limes, while Srđan Beck and Katarina Šprem explored the Roman centuriation of *ager Polensis* in southern Istria.

Continuing the focus on spatial analyses, several presentations demonstrated the integration of digital and quantitative approaches to archaeological survey. Kyriakos Sgouropoulos, Dushka Urem-Kotsou, and Apostolos Sarris presented a workflow from the MapFarm Project, integrating GPS-based recording of surface finds, machine learning analysis of drone imagery, and geophysical prospection for high-resolution mapping of spatial relationships. Complementing this, Boris Rozić examined Mousterian sites in Bosnia and Herzegovina, showing how site locations were shaped by the availability of primary chert, terrain morphology, and natural communication routes. Together, these studies demonstrated the value of combining advanced remote sensing, geophysical, and analytical methods to explore past landscapes.

Another aspect of the conference addressed heritage protection and public engagement. Marta Rakvin and Jacqueline Balen showcased an interdisciplinary project in the Požega Valley, using ALS data, VR visualizations, and Iron Age menu reconstructions to create trails and information boards offering immersive interpretations of cultural landscapes. Marin Buble and Lujana Paraman presented how archaeological site data from Trogir and surrounding municipalities were integrated into the Croatian Fire Association's tracking system to help fire commanders preserve heritage from wildfire damage.

A prominent theme at the conference was the application of archaeometric approaches to the study of ceramics and pigments, demonstrating how integrated analytical frameworks can illuminate technological choices and cultural practices. Andreja Kudelić and colleagues presented the first integrated archaeological–geological database in Croatia which combines archaeological, geological, and experimental materials to support interdisciplinary studies of pottery technology, provenance, and *chaînes opératoires*. Other studies applied a broad suite of complementary analytical methods – including macroscopic and microscopic observation, X-ray fluorescence (XRF), X-ray diffraction (XRD), scanning electron microscopy with energy-dispersive spectroscopy (SEM-EDS), Raman spectroscopy (Raman), Fourier-transform infrared spectroscopy (FTIR), μ Computed

Tomography (μ -CT), and hyperspectral imaging – to investigate ceramic composition, firing conditions, tempering practices, and decorative techniques. For example, Katja Kavkler and her team studied white incrustations on third millennium BC pottery from the Ljubljansko barje, Atanas Tsurev and Nikolina Nikolova analyzed Early Neolithic polychrome pottery from Chavdar, and Bogdan Manea and collaborators examined shell-tempered Chalcolithic vessels from Säveni-La Movile.

Analytical approaches were similarly applied to pigment research. Massimiliano Puntin presented a non-destructive multi-analytical protocol for Roman painted plasters, combining the same range of methods to characterize pigments, painting techniques, and traces of application.

Collectively, these studies illustrate the central role of archaeometry in reconstructing prehistoric and historic ceramic technologies across Europe, fostering interdisciplinary collaboration and data integration. This theme also sparked some of the most extensive discussions at the conference, with participants offering valuable comments and questions. Even well-established methods, applied for decades, continue to be refined, yielding increasingly detailed information and enabling more nuanced interpretations.

Another group of presentations demonstrated the application of multi-analytical archaeometry to materials beyond ceramics. Valentina Lončarić and colleagues investigated over 500 Iron Age glass beads and pendants from the Pelješac region (Croatia), revealing multiple workshops and diverse compositions. Marin Šoufek and Iva Kaić applied SEM-EDS to green chalcedony Roman gems from Sisak (Croatia) to determine their mineralogical composition and chromium content. Tena Karavidović and her team studied Iron Age ironworking in northwest Croatia with XRD and pXRF, reconstructing production processes and metallurgical organization. Selena Vitezović and Gordana Jeremić analyzed Roman-period bone pins from northern Serbia, clarifying use-wear patterns and functional aspects.

Particularly notable was the presentation by Zheni Vasileva, Petar Minkov, and colleagues on a remarkable net from Devetashka Cave (Bulgaria), which had remained largely unstudied for over 70 years in the storage of the National Archaeological Museum in Sofia. Radiocarbon dating places the net at the beginning of the Late Chalcolithic, while archaeobotanical and microscopic analyses conducted by Hanna Aleksandrova indicate that it was made from hemp or bast fibers from woody taxa. Detailed study of the knotting and weaving techniques, complemented by photomicrographs, allowed a reconstruction of the net's structure. This research provides unparalleled insights into craft and subsistence strategies of the prehistoric Balkans, offering rare information on textile technology and fishing practices. The NAIM–BAS team that initiated and led this study deserves sincere congratulations for their outstanding results.

Almost the same group of co-authors, led by Petar Minkov, presented research on the Late Bronze Age site of Kamenovo (northeast Bulgaria), using an integrated

approach that combined remote sensing, GIS mapping, geophysics, excavation, and a broad range of laboratory analyses. Their study provides new insights into subsistence, raw material use, and technological practices in the generally unexplored Ludogorsko Plateau.

Two presentations addressed past diets. Mario Novak and colleagues applied $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ stable isotope analyses to Bronze and Iron Age human and faunal remains in Croatia, revealing inland–coastal differences in millet consumption. Complementing this, Marla J. Toyne and team used fuzzy c-means clustering on isotope data from an eight–ninth century Avar cemetery at Šarengrad (Croatia), highlighting nuanced dietary variation and community structure. Together, these studies demonstrate how innovative analytical approaches can reconstruct both subsistence strategies and social dynamics.

Several presentations showcased digital and automated approaches in archaeology. Martina Naso and colleagues presented the AUTOMATA project, which integrates 3D digitization with non-destructive analyses, including hyperspectral imaging, portable XRF (pXRF), and Raman spectroscopy, for lithics and ceramics. Combining robotic handling, automated scanning, and unified workflows, the system enhances speed, precision, and reproducibility while facilitating multi-proxy integration of geometry, surface, and analytical data. Although this ‘automated pipeline’ streamlines the study of small artifacts, human supervision remains necessary to refine measurements and ensure reliable results.

Marko Porčić presented a method for quantifying ceramic vessel shapes using profile drawings, combining geometric morphometrics with numerical taxonomy. The approach enables automated analysis of large datasets and grouping of vessels with similar profile syntax, offering greater objectivity in classification. The approach is innovative and largely automated, potentially saving time, allowing rapid generation of typologies. However, there is caution regarding its application to prehistoric hand-made ceramics, which often lack symmetrical profiles. The software relies on proportions and curvature lines, which, in the case of asymmetrical vessels, may produce an excessive number of types and subtypes for essentially identical forms. This method would likely be more suitable for mass-produced, standardized pottery, such as wheel-thrown vessels of the Ancient Greek and Roman Periods.

The conference program was complemented by a poster session, strategically located in the lobby where the coffee breaks were held – an arrangement that ensured excellent visibility and made the posters both convenient to consult and practically impossible to overlook. The twelve contributions covered a broad thematic spectrum, demonstrating the diversity of current archaeological research and its engagement with questions that extend well beyond methodological concerns. Several posters addressed wider historical and analytical issues, including the archaeology of megaliths, fortification studies, ceramic production and exchange, geochemical characterization of raw materials, and interdis-

ciplinary perspectives on salt. Others focused on subsistence practices or showcased the growing role of digital and imaging technologies in heritage research. The poster session also featured more innovative thematic directions, such as prehistoric filmmaking and recent *COST Actions* centered on computational approaches and the management of artificial intelligence in archaeology.

The Archaeological Museum and Cultural Scene in Zagreb

Located in the very heart of the lower city, the Archaeological Museum occupies the elegant Vranyczany–Hafner Palace on Zrinski Square, where it has been housed since 1945. The building – and its collections – suffered extensive damage during the earthquake that struck Zagreb on 22 March 2020, the most powerful in the region in more than a century. When I first attended this conference in 2022, the museum remained closed; however, following a long process of restoration, it reopened to the public on 17 July 2024, with the permanent exhibition newly reinstalled across three levels.

For me, the highlight of the visit was the prehistoric collection on the upper level, notable for its impressive artifacts from the Neolithic, Chalcolithic, and Bronze Age. Two objects stand out: the distinctive bird-shaped vessel from Vučedol, the so-called Vučedol dove, and the ceramic anthropomorphic figurine from Dalj, each belonging to different stages of the Bronze Age in terms of the Eastern Balkan chronological framework (<https://www.amz.hr/hr/virtualni-muzej/3d-modeli-arheoloskih-predmeta/>). The museum also features a substantial Egyptian collection, and it preserves the Zagreb Mummy together with the Linen Book of Zagreb (*Liber Linteus Zagrabiensis*), the longest surviving Etruscan text and the only extant linen codex from the third century BC.

We also had the chance to explore the temporary exhibition *Archaeology and Popular Culture*, curated by Jacqueline Balen and Daniel Rafaelić. It highlights how archaeology has shaped – and been represented – across a wide range of artistic and media forms, from visual arts and literature to film, comics, and digital gaming. The exhibition shows how creators from the fifteenth century to today have drawn inspiration from archaeological discoveries and how archaeology and archaeologists continue to appear in contemporary popular culture (<https://www.amz.hr/en/exhibitions/archaeology-and-popular-culture/>).

Zagreb, Croatia's capital and largest city, functions as the nation's main political, economic, and cultural center. The city is divided between the historic Upper Town, with its medieval streets and prominent landmarks, and the more modern Lower Town, featuring a mix of nineteenth and twentieth-century architecture, museums, and public parks. Nestled along the Sava River and at the base of the Medvednica mountains, Zagreb showcases a distinctive blend of Central European and Mediterranean cultural influences, reflecting its long and varied history.

Visiting Zagreb at the very beginning of December offers a unique experience, as the city embraces the Advent season with festive celebrations across the center. The

largest and most prominent market is held at Ban Jelačić Square, complemented by events such as Fuliranje on Strossmayer Square, a live nativity scene on Kaptol, and decorative displays in the Grič Tunnel. The streets are lively with numerous smaller markets, pop-up food and drink stalls, ice skating rinks, all contributing to a bustling, joyful atmosphere. Among the highlights are the aromatic mulled wines – offered not only in the traditional red but also in white varieties – and a broad selection of warm beverages, including teas, hot chocolate, and spiced alcoholic cocktails featuring sloe gin, whisky, or rum. The combination of festive lights, decorations, and the general bustle creates a particularly enchanting pre-Christmas ambiance, making Zagreb a memorable destination during this period.