



Marmora Thracica. Recent advances in marble studies from the international project “Fingerprinting white marbles: quarries and cities of Roman Thrace (1st–3rd c. AD)”

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Marble was a material of considerable visual and social significance in antiquity, with its conspicuousness making it an effective medium for expressing identity, status and cultural affiliation. This is particularly evident during the Roman period when the widespread use of marble reflected both its increasing availability and its function as a symbol of distinction. It also served as a means of tracing the social networks embedded in its use and display. The rise in marble consumption coincided with the consolidation of elites and the reinforcement of the Roman narrative. Its presence in both public monuments and private interiors created a material continuity between state power and personal identity. Across the Roman provinces, marble functioned as a unifying medium connecting local communities and practices to the broader imperial visual culture.

The durability and symbolic complexity of stone, particularly marble, make it one of the most analytically productive material categories in archaeological research. Marble provenance studies inherently demand the continual development and refinement of methods, often generating new questions and innovative scientific approaches – a field that has undergone significant transformation over the past fifty years. The foundational work of J.B. Ward-Perkins in the 1960s and 1970s marked a pivotal moment in the integration of marble studies within Roman archaeology (Smith 2018), setting the stage for subsequent research. Seminal publications by N. Herz and M. Waelkens have played a crucial role in shaping the discourse, highlighting how the study of marble not only illuminates material culture but also provides insight into the economic and ideological frameworks of antiquity (Waelkens 1982; Herz, Waelkens 1988). Since the 1990s, the investigation of marble – encompassing both cultural-historical perspectives and scientific analyses – has become firmly established in archaeological methodology. This integrated approach is now applied to various historical periods and geographic regions where marble played both a material and symbolic role. The scale and visibility of marble in Roman architecture and sculpture have prompted sustained interest in its provenance, quality and the logistics of quarrying, transport, and long-distance trade. Furthermore, these investigations have expanded to address broader themes, such as prestige, identity and representation, both in public and private contexts. The complexity of these questions has necessitated collaboration across disciplines, including archaeology, geology, art history, and archaeometry, reinforcing the importance of interdisciplinary approaches in marble research. Marble studies, therefore, exemplify how material analysis can intersect with broader historical inquiry.

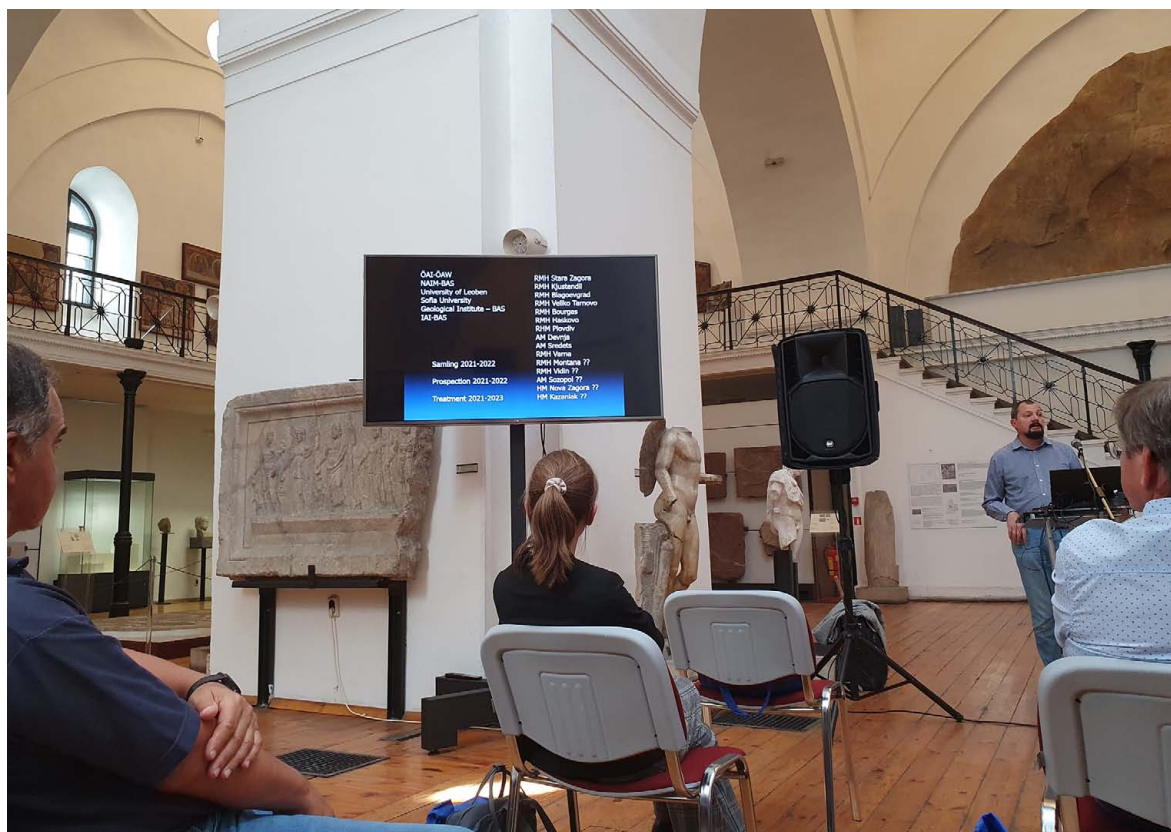


Fig. 1. Kick-off meeting for the project participants, organised at NAIM–BAS (photo B. Frerix, ÖAI/ÖAW)

Despite the abundance of marble studies and the systematic integration of marble analysis within archaeological research, the current state of the field remains, in many respects, incomplete. The dominant focus continues to rest on major quarrying centres and the research questions directly associated with them. Efforts to distinguish between different white marbles, in particular, have increasingly directed scholarly attention toward source deposits, prompting extensive survey activities in both well-known and lesser-known quarry sites. This emphasis is evident both in the supra-regional quarries – such as those at Luna/Carrara, Pentelikon, Paros, Thasos, Dokimeion, Prokonnesos, Herakleia/Miletos, and Ephesos/Göktepe – and in the numerous smaller quarries with more regional distributions. The latter have typically been studied in connection with nearby ancient settlements or specific monuments where their marble was employed. While such approaches have yielded valuable insights into extraction practices, trade networks and patterns of material use, they also highlight the need for more balanced and diversified research strategies. A broader framework that includes under-explored sources, contexts of reuse and the socio-cultural dimensions of marble consumption would deepen our understanding of the complex roles marble played across the ancient world.

Taking these aspects into account, the project “Fingerprinting White Marbles – Quarries and Cities of Roman Thrace (1st–3rd c. AD)”, conducted between 2020 and 2023 as part of a collaborative initiative between the Austrian Archaeological Institute (ÖAI) and the National Archaeological Institute with Museum – Bulgarian Academy of Sciences (NAIM–BAS), makes a significant and enduring contribution to the field of marble studies and marble networks within the Roman Empire. The project was directed by Dr Sabine Ladstätter (ÖAI), with Dr Hristo Popov (NAIM–BAS) and Dr Zdravko Dimitrov (NAIM–BAS) as co-leaders on the Bulgarian side, and Dr Petya Andreeva (NAIM–BAS) as project coordinator. The planning and implementation of the field campaigns were



Fig. 2. Archaeological sites and marble quarries relevant for the project (map by B. Frerix, ÖAI/ÖAW)

supported by the expertise of specialists from the NAIM–BAS, particularly in the fields of architecture, sculpture and epigraphy. Additionally, curators from regional museums in Bulgaria contributed to the documentation of the sampled artefacts housed in the museum collections (see below). The archaeometric analyses of the samples were conducted by Prof. Walter Prochaska (ÖAI) and Dr Vasiliki Anevlavi (ÖAI). The spatial modelling of the marble landscape in Thrace – focusing on the size and accessibility of stone quarries, as well as the transport logistics from the quarry sites to the locations of use – was developed by Benjamin Frerix (ÖAI).

The project was implemented against the backdrop of previous, highly fragmented marble studies in Thrace, which have provided only limited analysis of quarrying, processing and the use of marbles, particularly white marbles. Although significant progress has been made through excavations, a considerable gap remains in comprehensive studies, particularly in the regional analysis of quarry sites and their exploitation, as well as in the distribution of raw materials across Roman Thrace. Furthermore, the heterogeneous nature of research on marble in Thrace has often been influenced by a focus on the rarity and prestige of ancient marbles. Such analysis has been applied to the quarries, the quality of the material, and the final product, ultimately leading to economic and historical insights into the role of marble in long-distance trade, as well as its symbolic significance in representing prestige in ancient societies. The prevailing view that the provenance of marbles in Thrace is primarily traced to the major quarries of antiquity has the drawback of privileging the exceptional over the everyday. This perspective imposes significant limitations on drawing conclusions about economic models or social practices at the regional level. Therefore, this project focused on the systematic study of local patterns of marble use in relation to everyday life in Roman Thrace.

The pilot study conducted in 2018–2019 at Villa Armira near Ivaylovgrad, Bulgaria, dem-



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Fig. 3. Photos from marble sampling campaigns at archaeological sites and regional museums: 1. RHM Blagoevgrad (photo B. Frerix, ÖAI/ÖAW); 2. RHM Kyustendil (photo P. Andreeva); 3–6. Philippopolis (photo B. Frerix, ÖAI/ÖAW, P. Andreeva)

onstrated the significant potential of this approach. The results contributed substantially to a better understanding of the exploitation of local marble resources, as shown by the case study and clearly highlighted the value of conducting a broader regional investigation (Anevlavi et al. 2022). The methods employed were adapted for broader applicability, allowing for a more comprehensive analysis of the “marble economy” of Thrace.

The “Fingerprinting White Marbles” project focuses on white marbles, which were employed in a variety of contexts in Roman Thrace and offer insight into a broad spectrum of marble usage, ranging from basic construction materials to high-quality works of art. The correlation of quarry sites with urban and villa contexts within a well-defined geographical framework lays the groundwork for a systematic investigation based on micro-regional economic models. Furthermore, the project examines the relationship between imperial authority and provincial elites, as reflected in the organization and functioning of marble distribution networks across the province.

The primary objectives, research tasks and methodological framework essential for the successful implementation of the project were presented during the 2021 kick-off meeting at NAIM (fig. 1). In light of the project’s interdisciplinary approach, which incorporates archaeology, geology, archaeometry, economic history and digital archaeology, the main objectives, accompanied by a detailed schedule for systematic sampling, were defined as follows: a comprehensive survey and petrographic-geochemical characterization of the Thracian white marble quarries exploited in antiquity; an examination of the relationship between the quality of the raw material and the type of final product, particularly in the context of demand-based production; an analysis of local and regional production and imports, aimed at providing a clearer understanding of the marble landscape in Roman Thrace and the dynamics of the regional marble market.

The project employs a range of archaeological and archaeometric methods, with newly acquired samples from both quarries and artefacts forming the foundation of the study. The research examines the patterns of distribution and use of white marble in the Roman province of Thrace, covering both regional extraction and imported sources, within the broader context of urbanization in the 1st–3rd c. AD. Systematic sampling of artefacts was conducted during three field campaigns at sites where the pronounced increase in marble usage is particularly evident, including the cities of *Philippopolis*, *Augusta Traiana*, *Deultum*, *Montana*, *Nicopolis ad Nestum* and the villas at Kasnakovo and Chatalka. The sampling programme also included artefacts from *Marcianopolis* and *Nicopolis ad Istrum* – cities near large limestone quarries, where the selective use of marble can be specifically investigated. In order to broaden the comparative basis for the database of marbles in Roman Thrace, additional samples were collected from *Anchialos*, *Aquae Calidae*, *Odessos*, *Dionysopolis* and artefacts from the Middle Struma Valley (fig. 2). The analysis of the objects requires a comprehensive collection of all available information and a systematic sampling approach. To facilitate the process, a standardised classification form was developed for the project. It records key attributes of each object, including descriptions, dimensions, typological designations, chronological data, archaeological context and other relevant information. Additionally, photographic documentation was carried out for all sampled objects (fig. 3). The assemblage of objects under examination comprises a diverse range of types, including architectural fragments, sculptures (both in-the-round and in relief), sarcophagi and inscriptions. While a single sample is sufficient for smaller objects, buildings, sarcophagi, and even some sculptures, require multiple samples to ensure a systematic and comprehensive investigation. The number of samples varies between findspots, determined not only by the type and scale of the archaeological site but also by the extent of prior archaeological investigation, which directly affects the availability of a precise archaeological context for the marble pieces.

To ensure the successful implementation of the project, equal emphasis was placed on sampling both artefacts and major marble regions in Bulgaria. Inland Thrace was rich in marble deposits, particularly in the southwestern and eastern Rhodopes, the Strandzha Mountains, and regions such as Topolovgrad, Asenovgrad, and Berkovitsa (Andreeva et al. 2024). The marble formations of southwestern Bulgaria, including the regions of Ilindentsi, Pirin and Petrovo, extend into the ancient regions of Thessaly and Macedonia. A team of geologists and archaeologists was organised to carry out the field-walking surveys (fig. 4). Geodetic and photographic documentation was undertaken at

the quarries, with samples predominantly collected from surface flakes and recently exposed outcrops. The documentation also included records of ancient traces of exploitation, unfinished objects and other relevant features.

The archaeometric investigation of marble provenance, including the identification of specific quarries, involved a combination of methods, with the reliability of the results increasing as more data were gathered. W. Prochaska and V. Anevlavi employed a comprehensive analytical approach. Petrographic analysis was systematically conducted, and thin sections were prepared for detailed microscopic analysis when the sample size was sufficient. Carbon and oxygen stable isotope analysis, the most common method for marble provenance, was also conducted. However, for white marbles, as previous studies have demonstrated, this method alone does not provide conclusive results, necessitating the use of complementary analytical methods. W. Prochaska has developed a novel research approach by integrating fluid inclusion analysis, which has enabled the distinction between marbles with similar isotopic characteristics (Prochaska, Grillo 2010; Prochaska et al. 2018). Trace element chemistry provided additional variables, as elements embedded in the carbonate lattice show a relatively uniform distribution, which can be used to distinguish between different types of white marbles. The analysis of micro-inclusions was also integrated into the research approach. The various variables derived from the analytical methods were subjected to multivariate discriminant analysis for statistical evaluation, with the results presented numerically. This presents the absolute and/or relative probability of a particular artefact belonging to specific quarry samples. The data obtained provide a scientific foundation for developing discourses on the availability, exploitation and distribution of local marble resources in both synchronous and diachronous contexts. The resulting database also constitutes a critical element in drawing conclusions about marble use in the Roman Empire, particularly within the framework of provincial archaeology and advances research on Thrace's role in marble trade networks.

The concluding event of the project was the International Conference “Ex Marmore: Exploitation, Trade and Use of White Marbles in Ancient Thrace and its Neighbourhood”, held in Stara Zagora from 10 to 13 May 2023. The conference was attended by archaeologists and specialists in marble provenance studies (fig. 5). The programme covered a broad spectrum of geological, archaeological and archaeometric topics related to marble landscapes and the use of marble in Thrace. It provided a platform for productive discussions, addressing long-standing issues related to marble artefacts in Thrace, while also promoting new discourses informed by the project's results. H. Popov also put forward important considerations for enhancing the “marble map” of Thrace, emphasizing the further incorporation of conventional geographical data (both analogue and digital) and LiDAR-scan data from selected marble regions, along with the verification of the acquired data.

In January 2025, two public lectures were given as part of the Academic Seminar of the NAIM-BAS series, where the analyses and results from the marble samples collected for the “Fingerprinting White Marbles” project were shared with Bulgarian colleagues¹. W. Prochaska and V. Anevlavi provided a comprehensive summary of the data on the use of local marble resources and evidence of imported marbles in the cities of Roman Thrace, based on systematic sampling of representative artefact groups from various contexts, including cities, villas and sanctuaries in Roman Thrace. Pamela Fragnoli gave an overview of the ÖAI laboratory and the facilities employed in the archaeometric investigations supporting the integrated approach to white marble provenance analysis. Helmut Schweiger introduced the digital database developed by the Austrian Centre for Digital Humanities (ACDH) of ÖAW for managing the marble specimen collection. In addition to specimen metadata, the database includes controlled vocabularies, geographic data, image files and all relevant

1 <https://naim.bg/bg/content/news/600/857/1425/>; <https://naim.bg/bg/content/news/600/857/1426/>



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Fig. 4. Photos from field-walking surveys and sampling at marble quarries: 1. W. Prochaska and V. Anevlavi; 2. W. Prochaska, geologist; 3. I. Ivanov, geologist; 4. N. Gospodinov, geologist; 5–6. H. Popov and the field-walking survey team (photo B. Frerix, ÖAI/ÖAW)

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The successful completion of the project not only significantly expanded research on raw materials and their use in Thrace but also laid the foundation for integrating these results into future marble studies, particularly those related to Roman provincial archaeology. Marble trade routes connected the provinces of the empire, establishing a complex network of quarrying, transportation, and craftsmanship, with Thrace playing an important role in this network.



Fig. 5. Photo of the Ex Marmore conference participants (courtesy of the organisers)

Dedication

This paper is dedicated to the memory of Priv. Doz. Mag. Dr. Sabine Ladstätter, whose exceptional guidance, visionary leadership, and intellectual generosity shaped not only this project but also the field of archaeology at large. As the Director of the project, her commitment to collaborative research and her passion for advancing knowledge across disciplinary boundaries left a profound and enduring impact.

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