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From Dokimeion to Aphrodisias: A Reassessment of Marble Provenance and Workshop Relations of Roman Period Sarcophagi from Perge (Pamphylia) / Asia Minor

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From Dokimeion to Aphrodisias: A Re-assessment of Marble Provenance and Workshop Relations of Roman Period Sarcophagi from Perge (Pamphylia) / Asia Minor.

Abstract: This article presents a comprehensive re-evaluation of the marble provenance of Roman-period sarcophagi from Perge (Pamphylia), integrating the typological and archaeometric framework established by Korkut and Dirican (Korkut, Dirican 2020) with newly acquired multi-proxy analytical data generated at the Austrian Archaeological Institute (OeAW). While the earlier study questioned the long-standing attribution of Pamphylian sarcophagi to Dokimeion, limitations inherent in isotope-based discrimination and restricted reference datasets prevented a definitive reassignment of marble sources. The present study employs an expanded analytical strategy combining stable carbon and oxygen isotope analysis, high-precision ICP-MS trace element measurements, and multivariate statistical modelling based on a global database of over 5,700 geological marble samples. The results demonstrate a strong and statistically robust association of the Perge sarcophagus marbles with the Aphrodisias quarry district, while Prokonnesos emerges as a secondary source for a limited subset of samples. Dokimeion and Ephesian marble sources can be confidently excluded. Beyond provenance determination, these findings necessitate a fundamental reconsideration of workshop organisation, artisan mobility, and material procurement strategies in Roman Pamphylia. In particular, the dominance of Aphrodisias marble suggests sustained inter-regional connections between Caria and Pamphylia, challenging traditional models centred on Phrygian production and reinforcing the role of Aphrodisias as a major sculptural hub with far-reaching economic and artistic influence.

Keywords: Marble, sarcophagi, provenance, Perge-Pamphylia, Dokimeion, Aphrodisias, Asia Minor

Introduction

The terminology "Dokimeion Sarcophagi" is widely used in the literature for marble sarcophagi dating back to the Roman Period, unearthed in the Pamphylia Region[1]. Since the marble of these sarcophagi, which have specially prepared sarcophagi with certain decorative templates that repeat continuously, including garlands and friezes, is accepted to be of origin from the Dokimeion in Phrygia[2], the terminology "Dokimeion" has been adopted and used by many researchers to this day (Fig. 1). In this direction, it has been argued that the marble sarcophagi unearthed in the Pamphylia Region were either produced in Dokimeion and transported to the region or were produced on-site by traveling master's from Dokimeion in Pamphylia cities using Dokimeion marble[3]. Under the influence of this approach, it is seen that the term "Dokimeion Sarcophagi" is also used for marble sarcophagi containing similar decorative templates found in other regions[4].

Fig. 1. Location map of Aphrodisias, Dokimeion, and Perge in Roman Anatolia (This map derived from WorldGeoDemo © Dirican M.).

In parallel with this general acceptance, the thesis that Dokimeion was the third-largest sarcophagus production centre of the Roman Imperial Period, alongside Rome and Athens, was advanced[5]. However, this view is a theoretical assumption based entirely on typological and chronological evaluations, and it is debatable to what extent it reflects reality. To date, the existence of a sarcophagus production centre using similar templates in the Dokimeion has not been archaeologically determined. On the other hand, it is known that similar decorative templates were imitated using local marbles across different regions

[1] Waelkens 1982; Waelkens 2019; Waelkens et al. 2019.
[2] Waelkens et al. 2019; The concept of Dokimeion marble – Dokimites/Dokimaion – was first used by Strab. 12.8.14.
[3] Waelkens 1982, 100-123.
[4] Strocka 2017.
[5] Koch, Sichtermann 1982, 33-34.

during the Roman Period, and sarcophagi were produced accordingly[6]. This situation must be related to a fashion sense specific to the Roman Period or the Romanisation process. The limited supply of marble in the Pamphylia Region is not a sufficient argument to justify the use of the terminology "Dokimeion Sarcophagi" alone. As a matter of fact, research carried out in the Pamphylia Region reveals that marble was sourced from many regions and widely used in both monumental architecture and plastic art[7].

Studies to determine the source of the marble used in the sarcophagi of the Pamphylia Region are among the subjects that have long been neglected in archaeological research. However, evaluations carried out in recent years have shown that there is a local workshop tradition in the region and that certain decorative templates are produced within the framework of this tradition[8]. This situation necessitated examining the marbles used in the sarcophagi through scientific analysis. In this context, in 2020, marble samples were taken from five sarcophagi with different decorative templates in the ancient city of Perge, which is known to be an important sarcophagus production centre, and analysing were carried out[9]. Chemical and isotope analyses have made it clear that the marble used in these sarcophagi is not related to Dokimeion or other nearby marble quarries in Phrygia. Although some important findings have been made regarding possible connections with other regions, no precise marble sources that can be directly linked have been identified.

However, the results of this analysis clearly brought to the agenda for the first time the necessity of questioning the "Dokimeion" terminology used for the sarcophagi of the Pamphylia Region. On the other hand, the fact that the quarries to which the marbles used in the production of Pamphylian sarcophagi belong could not be determined with certainty has left the relevant research incomplete. For this reason, a new project was developed; Within the scope of the project, existing samples were re-examined in a laboratory environment with more advanced methods and richer databases, and additional analyses were carried out. In this article, the results of these analyses will be introduced in detail.

Archaeological and Historiographical Background

Marble sarcophagi from the Pamphylia Region[10] are divided into two groups based on their decorative templates. The examples evaluated in the first group are decorated with figured frieze expressions. Two long faces and one narrow façade of this sarcophagus group are filled with figurative expressions (Figures 2a, 2b and 2c). There is a door motif on the second narrow façade, whose orientation varies with the front and back applications (Figure 2c). In front of or next to the door motifs, the presentation scene depicts male and female figures, usually in front of an altar. The figurative frieze sarcophagi from the Pamphylia Region are also divided into subgroups based on their different decorative templates. The most common examples in the first subgroup are the colonnaded sarcophagi. The surface of the sarcophagi in this group is animated with columns placed at regular intervals. Different expressions are included between the columns. Some of these accounts are related to the tomb owners (Fig. 2a). Scenes of mutual dialogue or education are the most preferred narrative template among narratives related to the grave owners.

There are also sarcophagi that are the subject of mythological narratives. The scenes in which the Twelve Labours of Heracles are described are the most common group

[6] Koch, Sichtermann 1982, 476-557.
[7] Dirican et al. 2025.
[8] Işık 2007; Korkut 2016; Korkut 2019.
[9] Mansel 1949; Mansel 1963, 1978; Abbasoğlu 2001; Özdizbay 2002; Turak 2011, 2012, 2018; Korkut, Dirican 2020.
[10] For general information on marble sarcophagi in the Pamphylia region, see Korkut 2019, Korkut 2022.

among mythological subjects (Fig. 2b). Another defining feature of the columned sarcophagi, in which mythological narratives are preferred, is that the lower part of the sarcophagus is emphasised by an ornamented belt, bounded by a flat moulding at the top. In sarcophagi, where narratives about the tomb owners are preferred, this deletion arrangement is not encountered. In these sarcophagi, the figures are depicted on the pedestal at the base. This difference in décor templates is also evident in the arrangement of the columned sarcophagi on the cover.

In sarcophagi with narrations about the tomb owners, kline lids were generally preferred. On the clines, the depictions of husband and wife symbolising the grave owners are engraved in an extendable manner. In sarcophagi depicting mythological narratives, pedimented lids in the form of barrel vaults were used, as in the sarcophagus cluster with garlands. In the second subgroup of figured-frieze sarcophagi, there is a cluster of sarcophagi called the "Torre-Nova" type in the literature. In Torre-Nova-type sarcophagi, the frieze expressions are uninterrupted and are limited to carriers such as columns or pillars only at the corners (Fig. 2c). Another common feature of these sarcophagi is that the frieze belts consist of mythological narratives. The scenes in which Heracles' 12 works are given are the most popular narratives among mythological subjects. The frieze in which the childhood story of Heracles and Iphicles is told is represented by a singular example. In addition, quotations from the Trojan wars were also used in the décor templates. Among the Trojan War friezes, the Menelaos-Paris-Aphrodite scene is the most preferred subject. The lids of Torre-Nova type sarcophagi are generally arranged in the form of barrel vaults. It is also known that kline lids are used in some examples, albeit few in number. The dimensions of the sarcophagi with kline lids are smaller than the others. As in the set of sarcophagi with garlands, it is possible that these examples were used as ostotheks. The depiction of adults on kline covers must have been considered in this direction.

Fig. 2. The first group of local sarcophagi of the Pamphylia region are decorated with figured frieze expressions (© Korkut T.)

The characteristic feature of the second group of sarcophagi from the Pamphylia Region is their decoration with garland motifs (Fig. 3). The garlands, which are processed three on the long sides and one on the narrow faces, are either made of leaves alone or of a leaf-fruit mixture. Garland carriers are Nike figures in the corners, and Eros figures in the middle. The empty spaces above the garlands were often filled with Medusa heads and theatre masks. In some special cases, figurative expressions are also included. The tops of the sarcophagi of the Pamphylia Region are cut straight.

On the other hand, the lower parts of the sarcophagi are enlivened by rich frieze belts featuring geometric and ornamental motifs. The lids of the sarcophagi with garlands are arranged in the form of a barrel vault roof. In addition, a triangular pediment is included on the narrow facades. The pediment is emphasised with different motifs. Antefixes are formed on the long faces of the caps. The outer surfaces of the antefixes are emphasised with mask or palmette motifs. The tops and corners of the lids are also animated with palmette-shaped acroteria. The sarcophagus sizes of garland sarcophagi are generally arranged for adults. However, it is known that some sarcophagi are kept smaller. The number of garlands on the long faces of these specimens was also reduced from three to two. It is thought that such small sarcophagi were used as children's sarcophagi or ostotheks.

Fig. 3. The second group of sarcophagi of the Pamphylia Region is that they are decorated with garland motifs (© Korkut T.).

The funerary landscapes of Pamphylia, particularly those of Perge and Side, are characterised by an exceptional concentration of marble sarcophagi dating from the first to the third centuries CE. Since the late nineteenth century, these monuments have played a central role in discussions of regional identity, artistic production, and economic connectivity in southern Asia Minor[11].

Early scholarship interpreted Pamphylian sarcophagi primarily through stylistic comparison with Phrygian material. This approach was strongly influenced by the discovery and systematic exploitation of the Dokimeion marble quarries, which were

[11] Lanckoronski 1892; Mansel 1949; Mansel 1963, 1978; İnan 1979; Abbasoğlu 2001; Özdizbay 2002; Turak 2011, 2012, 2018.

recognised as one of the principal imperial quarry districts of the Roman Empire[12]. The assumption that Pamphylia lacked significant local marble resources further reinforced the attribution of its sarcophagi to Dokimeion.

The concept of a Dokimeion-centred production model was formalised in the late twentieth century by Koch and Sichtermann[13], who identified Dokimeion as one of three principal centres of Roman sarcophagus production alongside Rome and Athens. Waelkens[14] further elaborated this model, grouping a wide range of Anatolian sarcophagi under the label 'Dokimeion sarcophagi' on the basis of typological and stylistic criteria.

Subsequent typological research, however, began to expose the limitations of this approach. Detailed analyses revealed significant regional variation in decorative programs, carving techniques, and compositional principles, suggesting the existence of multiple production centres operating within a shared visual koine rather than a single dominant workshop tradition[15].

At the same time, the increasing application of archaeometric methods fundamentally altered the evidential basis of provenance studies. Stable isotope analyses demonstrated that many Anatolian marble sources exhibit overlapping isotopic signatures, rendering simple attribution problematic[16]. This realisation prompted calls for multi-proxy approaches combining isotopic, petrographic, and trace-element data.

Within this evolving historiographical landscape, Aphrodisias emerged as one of the most intensively studied sculptural centres of the Roman East. Archaeological, epigraphic, and archaeometric research documented a highly organised quarrying and workshop system capable of producing and exporting large quantities of marble sculpture[17]. While Aphrodisias has traditionally been associated primarily with statuary and architectural sculpture, its potential role in the production and distribution of sarcophagi has increasingly been recognised.

The first systematic archaeometric investigation of Pamphylian sarcophagi was conducted by Korkut and Dirican[18]. Combining stable carbon and oxygen isotope analysis with chemical data, the study demonstrated that the marble used for the Perge sarcophagi could not be securely attributed to Dokimeion.

While this conclusion represented a significant departure from traditional models, the authors emphasised the limitations imposed by isotopic overlap and the restricted scope of available reference datasets. The study, therefore, remained cautious in proposing alternative source attributions and explicitly called for further analyses based on expanded databases and multi-proxy methodologies.

Materials and Methods

Sampling: Within the scope of this research, samples were taken from sarcophagi belonging to two different typological groups. The first of these is the columnar sarcophagi, and in this study, two samples belonging to this group were examined (P1a and P1b). The samples in the second group are sarcophagi with whirlpools. Samples from this group are common in the ancient city of Perge (P2, P3, and P4) (Fig. 4).

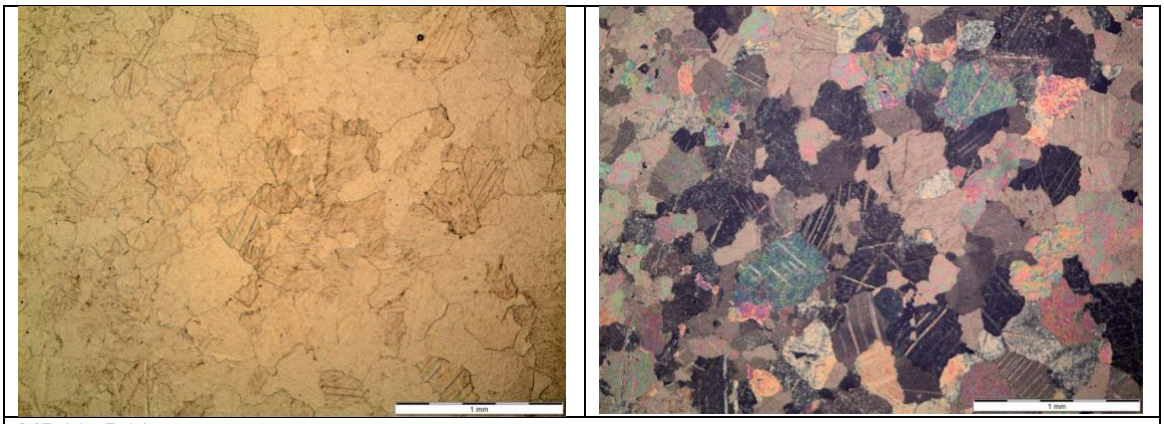
As a result of petrographic analysis, the rock type of the samples has been confirmed as marble with varying grain sizes. Accordingly, the P4 sample has a medium grain size (1.5 to 3 mm), and the others have a fine grain size (<1.5 mm). The grain-size specification

[12] Humann, Puchstein 1890.
[13] Koch, Sichtermann 1982.
[14] Waelkens 1982.
[15] Korkut 2019.
[16] Attanasio et al. 2006.
[17] Roueché 2007; Russell 2013.
[18] Korkut, Dirican 2020.

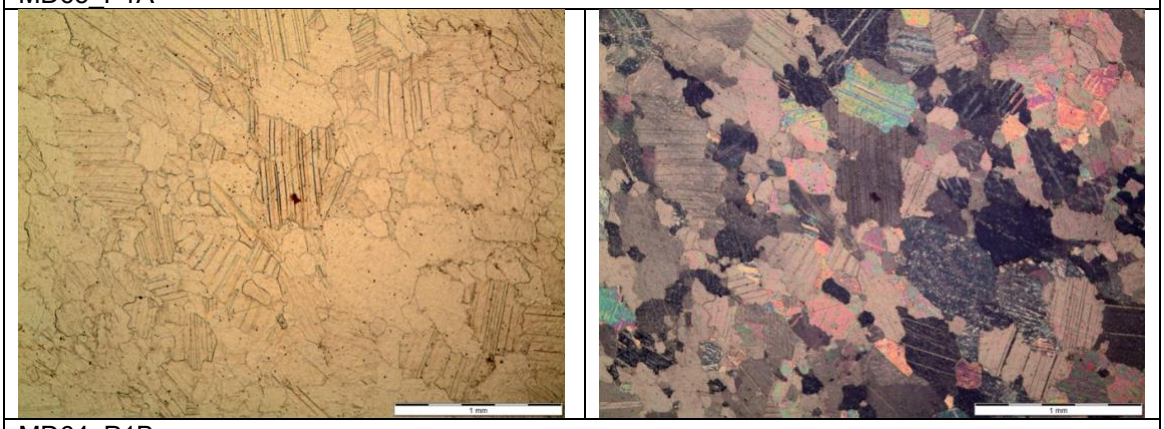
after Prochaska and Attanasio 2022[19] (Fig. 5).

Fig. 4. Fragments of marble sarcophagi subjected to archaeometric analysis from Perge (© Korkut T.).

[19] Prochaska, Attanasio 2022.



MD63_P1A



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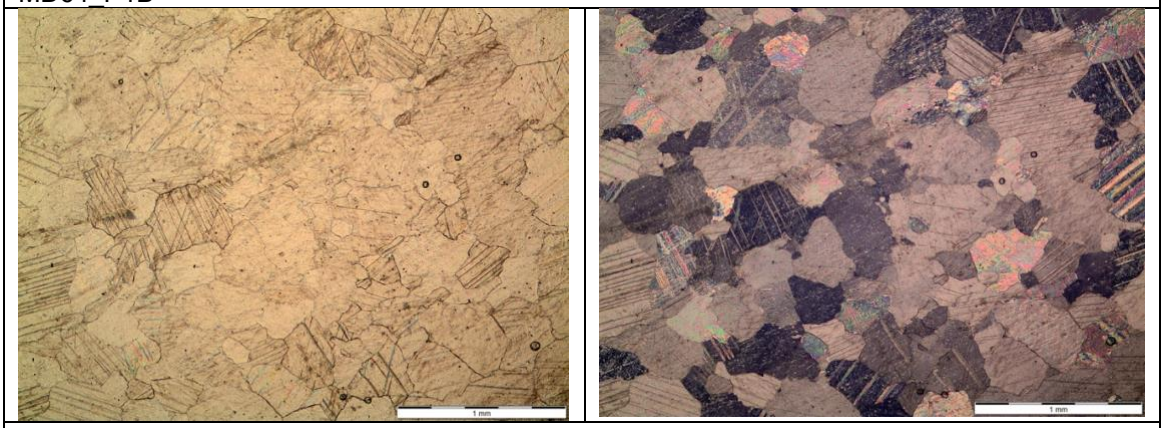
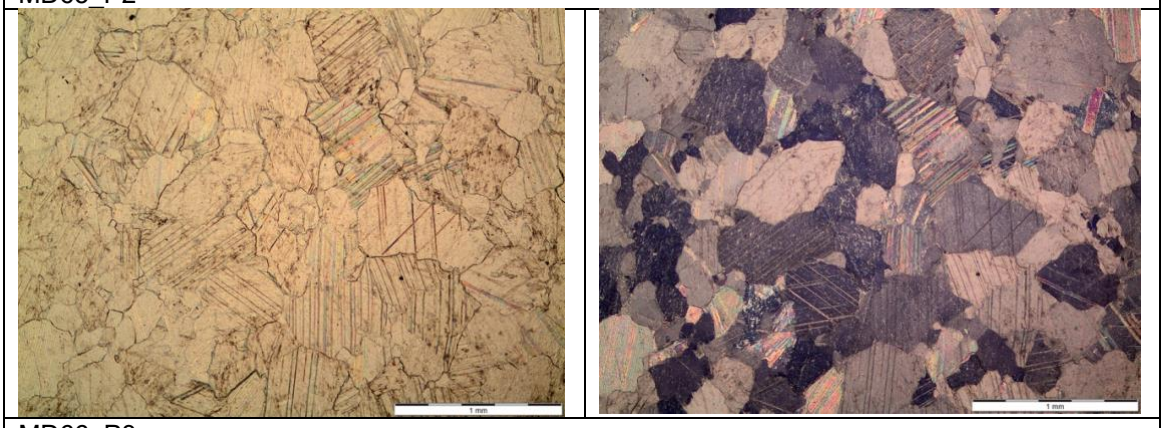


MD65_P2



MD66_P3

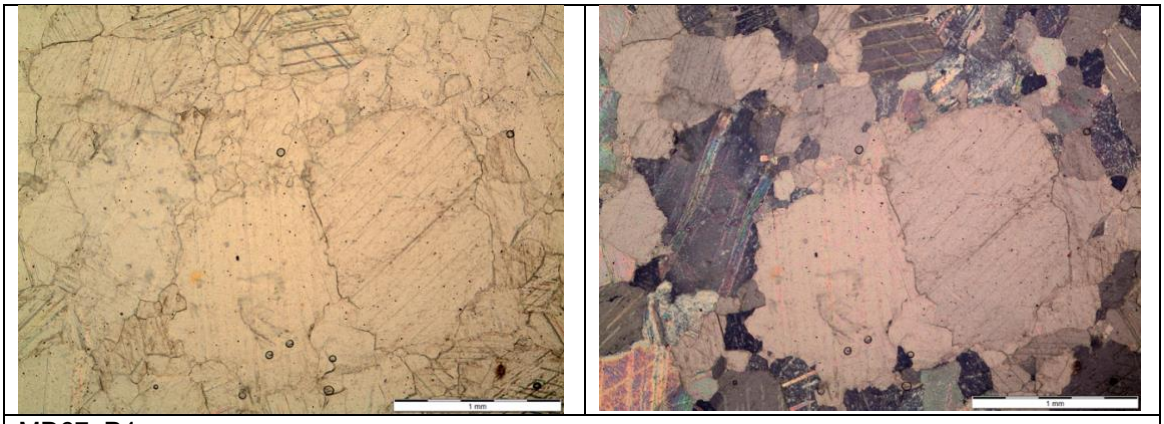


Fig. 5. Thin sections of the samples (scale 1 mm). The artefacts are carved from fine- to medium-grained white calcitic marble. The first three samples (MD63_P1A, MD64_P1B, MD65_P2, MD66_P3) show very similar petrographic properties. If we define these samples: Fine-grained (MGS <2mm), heteroblastic granoblastic calcitic marble with an interlocking mosaic texture. The calcite crystals are predominantly anhedral to subhedral in shape and display curved to embayed grain boundaries. Under crossed polars, the sample exhibits well-developed polysynthetic twinning, intracrystalline strain features, and evidence of dynamic recrystallisation. The rock is characterised by a highly recrystallised metamorphic carbonate fabric that has been affected by deformation-related tectono-metamorphic processes. The fourth sample (MD67_P4) is different from the others: Medium-grained (MGS 2mm-5mm), heteroblastic granoblastic calcitic marble characterised by an interlocking mosaic texture. The rock consists predominantly of anhedral to subhedral calcite crystals displaying well-developed polysynthetic twinning under crossed polarised light. Grain boundaries are mostly curved to locally embayed, with limited polygonal equilibrium textures. Several large calcite porphyroblasts are surrounded by finer recrystallised carbonate grains, producing a distinctly inequigranular fabric. Intracrystalline deformation features, including bent twin lamellae and strain-related extinction patterns, are locally developed and indicate deformation-assisted dynamic recrystallisation. Accessory mineral content is extremely low, and the marble exhibits a highly recrystallised tectono-metamorphic carbonate fabric. These definitions were based on Antonelli & Lazzarini 2015 (©Dirican M.).

These samples correspond exactly to those examined in the 2020 study and were re-analysed using refined analytical protocols.

The analysis of the stable isotopes of O and C is a standard method in marble provenance analysis, and several laboratories offer this service. The method is relatively robust but must be applied cautiously when sampling weathered or contaminated surfaces. Stable carbon and oxygen isotope ratios were measured on carefully prepared, fresh fracture surfaces to minimise the effects of weathering and surface contamination[20]. Stable carbon and oxygen isotope analyses were performed at the Bayerische Staatssammlung für Paläontologie (Munich, Germany). Carbon dioxide was extracted from carbonates using phosphoric acid at 72 °C with a Finnigan Gasbench II automated device coupled to a Finnigan DeltaPlusXP mass spectrometer operated in continuous He flow mode. NBS-19 served as the reference material and AK-5 as the running standard.

In this study, many trace elements were determined by ICP-MS after dissolution of the carbonate phase using only hot HNO_3. As many significant trace elements in the marbles (e.g., Mn, Mg, Fe, Sr, Y, V, Cd, Ba, La, Ce, Yb, and U) occur only in the sub-ppm range, extreme diligence has to be exercised in the sample preparation and the execution of the analyses in general. Under no circumstances should these trace element data be compared or mixed up with data obtained by bulk analytical methods (e.g., HF dissolution, XRF analysis, etc.), in accordance with protocols outlined by Prochaska and Attanasio[21]. Trace element analyses were conducted by ICP-MS at the Technical University of Vienna using a Thermo Fisher Scientific iCAP Qc ICP-MS system equipped with a concentric nebuliser and quartz cyclonic spray chamber.

[20] Attanasio et al. 2006.
[21] Prochaska, Attanasio 2021, 2022.

Data evaluation employed multivariate discriminant analysis using STATISTICA 13.5 and SPSS 28. Detection limits and analytical reproducibility followed the laboratory standards and protocols established in previous archaeometric marble provenance studies[22].

The archaeological sample was compared with an extensive database containing 5,700 geological samples collected from marble quarries and outcrops across the ancient world. This comprehensive database included notable locations such as Aphrodisias, Carrara, Prokonnesos, Dokimeion, Penteli, Paros, Thasos, Heraklea/Miletos, Ephesos, Göktepe and various other sites[23]. Additionally, quarries located near each relevant group were also considered[24]. The resulting diagrams illustrate the final selection of quarries that matched the examined archaeological specimens in terms of grain size, colour, and the closest chemical and petrographic similarities.

Results

Stable isotope ratios alone display extensive overlap with several Anatolian and Aegean marble sources, confirming the limitations of single-proxy approaches observed in earlier studies[25].

The study utilised stable isotope analysis and ICP-MS to generate numerical data for the sampled objects, offering comprehensive insights into their composition and characteristics. These advanced analytical techniques enabled a detailed investigation of the samples' isotopic signals and elemental composition, significantly enhancing the precision and depth of the findings.

Samp. #	Lab Nr	$\delta^{18}O$ (PDB)	$\delta^{13}C$ (PDB)	Fe (ppm)	Mg %	V (ppm)	Cr (ppm)	Mn (ppm)	Sr (ppm)	Y (ppm)	Cd (ppm)	Ba (ppm)	La (ppm)	Ce (ppm)	Yb (ppm)	U (ppm)
P1-a	MD 63	-4.5	1.8	82.654	0.99	1.24	0.48	15.91	111.31	0.183	0.191	1.609	0.139	0.183	0.009	0.01
P1-b	MD 64	-4.4	1.6	81.811	0.87	1.23	0.44	17.08	97.05	0.139	0.191	1.650	0.094	0.126	0.007	0.02
P2	MD 65	-4.7	1.1	43.304	0.47	1.24	0.43	11.22	81.97	0.367	0.171	1.628	0.120	0.134	0.019	0.02
P3	MD 66	-4.6	1.2	93.934	0.89	1.37	0.48	31.94	85.00	0.378	0.190	2.097	0.141	0.176	0.021	0.02
P4	MD 67	-6.1	2.8	19.812	1.18	1.23	0.90	6.67	186.74	1.477	0.367	2.870	0.400	0.221	0.051	0.01

Table 1: The archaeometric data of the sampled artefacts (© Dirican M., Anevlavi V.).

The results are presented alongside the laboratory and sample numbers, including stable isotopic values of carbon and oxygen, as well as chemical data from ICP-MS analysis. The chemical data encompass concentrations of magnesium (in per cent), manganese, iron, strontium, chromium, vanadium, yttrium, cadmium, boron, lanthanum, cerium, ytterbium, and uranium (in ppm) (Table 1)[26].

The results confirmed Aphrodisias and Prokonnesos as the marble sources through discriminant analysis. The following variables were used for the multivariate diagram and numerical statistical approach (STATISTICA and SPSS): $\delta^{18}O‰$, $\delta^{13}C‰$, Mn, Fe, Sr, La, Ce, U, Yb, V, Cd, Y and Ba (Table 2) (Figures 6 and 7).

As the analysed artefacts consist exclusively of calcitic marble, dolomitic sources (most notably Thasos Vathi and Sivec) were ruled out at an early stage of the investigation. The identification of suitable quarry candidates relied on an integrated assessment of macroscopic features, including grain size, together with geochemical

[22] Prochaska 2021; Prochaska, Attanasio 2021; 2022; Prochaska, Ladstätter, Anevlavi 2024.
[23] Attanasio et al.2006; Prochaska 2021; Prochaska, Attanasio 2021; 2022; Prochaska, Ladstätter, Anevlavi 2024.
[24] Anevlavi et al. 2025.
[25] Korkut, Dirican 2020.
[26] The analytical uncertainty of the ICP-MS measurements is estimated to be within ±5% for major trace elements, based on repeated measurements of reference materials and laboratory standards.

criteria. Particular weight was given to trace element distributions, with special attention to yttrium (Y) concentrations within the broader Rare Earth Element (REE) suite. The quarries illustrated in the diagrams correspond to the final group of candidate sources, all of which display comparatively elevated yttrium values compatible with the geochemical signature of the artefacts. Although Dokimeion exhibits certain overlapping characteristics, the systematically high yttrium concentrations measured in the samples are inconsistent with this source and therefore exclude it from further consideration. Ephesian quarry districts were likewise evaluated; however, clear discrepancies in both isotopic data and trace element patterns preclude any meaningful correlation with the artefact assemblage.

The stable isotope diagram ($\delta^{13}C$ vs. $\delta^{18}O$) illustrates the isotopic relationship between the analysed artefacts and a range of reference quarry datasets. Although several artefact samples plot within or near the isotopic fields of known marble sources, substantial overlap is evident among quarry groups, particularly those from Prokonnesos, Aphrodisias, and Heraklea/Miletos. This overlap significantly limits the discriminatory power of isotopic data alone, as similar isotopic signatures may correspond to distinct geological sources (Fig. 6).

The multivariate diagram, based on the combined use of stable isotope ratios and trace element concentrations, demonstrates improved separation between the artefact samples and several reference quarry groups compared with the isotope-only plot (Fig. 6). The inclusion of multiple variables enhances the overall discriminatory power and allows for a more refined assessment of potential provenance. Nevertheless, despite this improvement, the two-dimensional projection of the multivariate space still yields partial overlap among certain quarry fields, reflecting the inherent limitations of visual interpretation in reduced dimensions. Consequently, although the diagram provides valuable qualitative insight into the relationships between samples and reference datasets, it cannot, by itself, provide an unequivocal attribution. For this reason, the numerical probability values presented in Table 2 are essential, as they quantify sample–source affinities across the full multivariate space and provide a clearer, more robust basis for provenance determination.

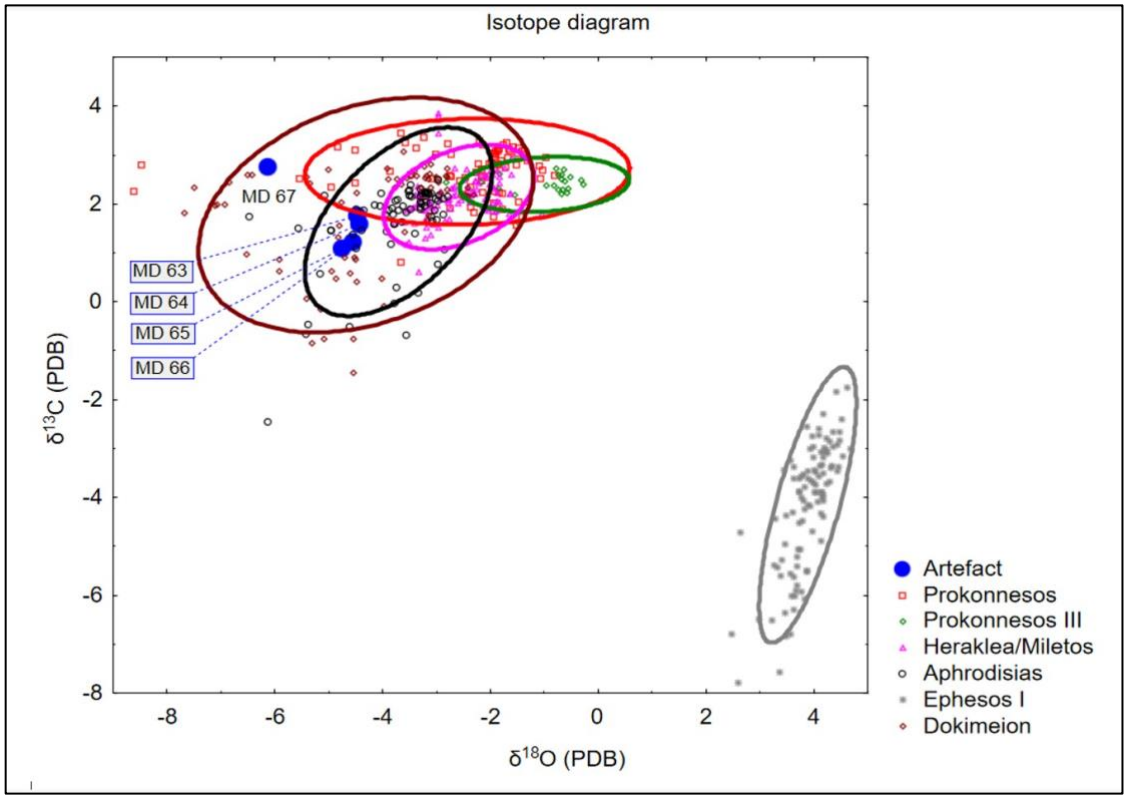


Fig. 6. Stable isotope diagram ($\delta^{13}C$ vs. $\delta^{18}O$, PDB) comparing artefact samples with reference datasets from selected marble quarries. The quarry groups are illustrated using 90% probability ellipses (© Anevlavi V.).

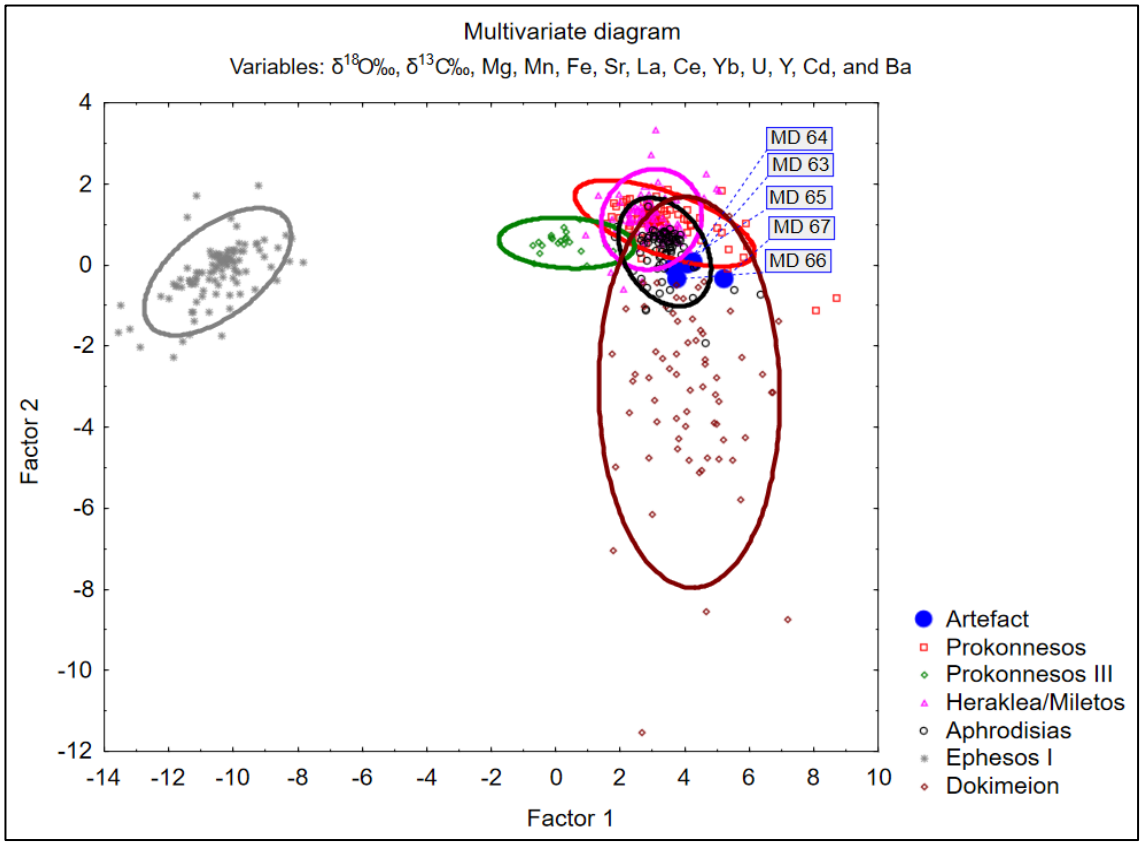


Fig. 7. Multivariate diagram showing the distribution of artefact samples and reference marble quarries based on δ¹⁸O‰, δ¹³C‰, Mg, Mn, Fe, Sr, La, Ce, Yb, U, Y, Cd, and Ba. The quarry groups are illustrated using 90% probability ellipses (© Anevlavi V.).

Artefacts		Distance	Abs. probab.	Rel. probab.	Provenance	Rel. probab.	Provenance
		1. choice				2. choice	
P1-a	MD 63	1.1	94.6	83.2	**Aphrodisias**	8.5	Prokonnesos
P1-b	MD 64	1.1	94.9	83.1	**Aphrodisias**	8.1	Heraklea/Miletos
P2	MD 65	1.7	88.2	91.6	**Aphrodisias**	6.6	Heraklea/Miletos
P3	MD 66	1.4	91.8	88.6	**Aphrodisias**	8.2	Heraklea/Miletos
P4	MD 67	7.3	19.3	97.2	**Aphrodisias**	1.4	Heraklea/Miletos

Table 2: The calculated statistical parameters of the samples investigated. The variables δ¹⁸O‰, δ¹³C‰, Mg, Mn, Fe, Sr, La, Ce, Yb, U, Y, Cd, and Ba were used to calculate the provenance result (© Anevlavi V., Dirican M.).

The explanation of these tables is given below:
• Distance: Distance of the sample under consideration from the centre of the ellipse. This centre is the average value of the quarry probability field.
• Relative (posterior) probability: Probability is the degree of likelihood of a sample belonging to a given group (within the selected number of groups). Results below 60 % indicate that the sample probably cannot be assigned with certainty, and a second choice has to be considered.
• Absolute (typical) probability: This is the measure of the probability that a sample belongs to a given population. Samples in the centre of the probability ellipse have a high absolute probability. The threshold is

10 %, corresponding to samples on the edge of the 90 % probability ellipse. Low values indicate anomalous samples (outliers) or samples possibly not belonging to any group in the selection.

However, when combined with trace element concentrations and multivariate statistical modelling, a clear and statistically robust pattern emerges. All Perge samples exhibit the highest relative and absolute probabilities for the Aphrodisias quarry district.

Prokonnesos appears as a secondary source for a limited subset of samples, while Dokimeion and Ephesian marbles can be excluded with high confidence due to incompatible trace element signatures, particularly with regard to yttrium and rare earth element distributions[27].

Discussion: Production Strategies and Inter-Regional Workshop Networks

The identification of Aphrodisias as the dominant marble source for the Perge sarcophagi has far-reaching implications for our understanding of production strategies and workshop organisation in Roman Pamphylia. Rather than viewing the region as a passive recipient of Phrygian products, the evidence points to sustained and structured connections with Caria and the Aphrodisian sculptural milieu.

The predominance of Aphrodisias marble in the sarcophagi of the Pamphylia Region raises several possibilities regarding the production and distribution processes of these artefacts. In this context, it can be evaluated that the sarcophagi were either completed in Aphrodisias and exported to Pamphylia or sent as semi-processed sarcophagi and completed in Pamphylia by Aphrodisian masters. However, the fact that the sarcophagi of the two regions show significant differences in decorative templates and compositional understanding suggests that these scenarios are unlikely to have occurred through a direct, widespread transfer of production. In addition, no examples of semi-processed sarcophagi of Carian origin or belonging to Aphrodisias workshops have been found in Pamphylia so far. On the other hand, no traces of semi-processing were found on the completed sarcophagi of Pamphylia, which may indicate the production of Caria or Aphrodisias. All these data show that the sarcophagus production process cannot be explained by a simple centre-periphery relationship; rather, it should be evaluated within the framework of a multi-actor, flexible, and multi-layered organisational model.

The earliest examples of Aphrodisias sarcophagi began to be produced in the Early Roman Period under the influence of Ephesus and the Ionia Region in general[28], from the 2nd century AD, the workshops of Aphrodisias developed their own typological and compositional templates, and within this unique repertoire, production continued uninterrupted until the second half of the 3rd century AD. Sarcophagus production in the Pamphylia Region dates back to the Hellenistic Period, with local limestone as the primary material in this early phase. With the spread of marble sarcophagi throughout the Roman Empire, the use of marble increased in Pamphylia. However, due to the limited quality of local marble quarries, marble was imported from abroad for sarcophagus production as well as for sculpture. As the results of this research show, Aphrodisias marble has been the most preferred material. The widespread appreciation of the decorative templates developed by Pamphylian masters shows that this repertoire was carried beyond the region. As a matter of fact, it has been determined that the mobile masters go to Konya, Denizli and Manisa in line with special orders and produce in line with their own typological schemes[29]. It is noteworthy that this type of production activity also took place in Aphrodisias. The garland arrangement of a sarcophagus found at Aphrodisias reflects features of the Pamphylia region as a whole rather than the local Aphrodisias scheme. The

[27] Anevlavi et al. 2025.
[28] Işık 2007.
[29] Korkut 2019, 642-644.

fact that the marble of the work in question is of Aphrodisias origin indicates that this sarcophagus may have been produced on site by a travelling Pamphylian master[30].

Extensive re-evaluations of the Roman marble economy in recent years largely coincide with the findings on sarcophagus production and trade. These studies reveal that production is organised within the framework of flexible and multi-layered systems rather than a single-centred and hierarchical model, artisan mobility is a common practice, and multiple supply routes operate simultaneously within regional networks[31]. In this context, the processes of extraction, processing and transformation of marble into final products can be shared among different geographical centres, and the circulation of raw materials and the transfer of technical knowledge exhibit an integrated structure within the same economic network. Therefore, sarcophagus production should be considered not only as the output of certain workshops but also as part of a dynamic, inter-interacting economic system operating on a Mediterranean scale.

Conclusion

This expanded study transforms earlier regional observations into a robust international synthesis on the marble provenance and production networks of Roman sarcophagi from Perge.

By integrating new multi-proxy analytical data with a critical reassessment of previous research, this study demonstrates that Aphrodisias, not Dokimeion, was the primary marble source for the Perge assemblage.

The results underscore the necessity of combining archaeometric, typological, and historiographical approaches and provide a framework for future comparative studies of Pamphylian and Pisidian sarcophagi within the wider context of Roman marble economies.

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[30] Öğüş 2016, 325-331.

[31] Russell 2013; Prochaska, Ladstätter, Anevlavi 2024.

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