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https://doi.org/10.1038/s40494-025-01975-6

An interdisciplinary study of an unknown Roman matron's sculpture portrait from Chersonesos Taurica

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This study will examine the marble sculpture portrait of an unidentified Roman matron from Chersonesos Taurica through an interdisciplinary approach. Identifying Roman portraits, especially those found in remote provinces or outside the Roman Empire with limited written sources, poses a significant challenge. By employing interdisciplinary methods in the study of ancient sculpture, it is possible not only to determine the date and origin of the material, but also to associate it with a specific historical individual. The authors of this paper employed a multifaceted analytical approach, combining historical methods and art historical analysis with spectral-isotopic and traceological techniques, which enabled the identification of the person memorialised in the sculpture uncovered at Chersonesos Taurica.

The subject of the research is the sculpture portrait of a matron uncovered in a dwelling house in the western part of Chersonesos Taurica (coordinates 44°36′42″ N 33°29′36″ E) located in the south-western part of the Crimean Peninsula, in modern Sevastopol; and was a key city in the Black Sea region for political and economic reasons (Fig. 1).

The Dorian Greek city was founded in 422/421 BC in the place of an earlier Greek settlement from the late sixth century BC[1]. In the last quarter of the second century BC, Rome's geopolitical interests focused on Chersonesos as a convenient strategic transit point for transferring the Roman army to Asia Minor. Later, Rome granted the city a special political status, known as *eleutheria*. Accordingly, Chersonesos became a free Grecian city, an ally of the Roman Empire. The real power belonged to wealthy and influential families connected with Rome[2]. The activity of the municipal authorities brought a political, economic, and military dependence on Rome, which may also be inferred from the citizens' daily routine. Moreover, these contacts affected the cultural and spiritual spheres of life as well.

The earliest description of the mysterious ruins of Chersonesos comes from Marcin Broniewski, an envoy of King Stephen Báthory of Poland. His notes taken during a diplomatic mission to Mehmed II Giray in 1578 constitute the earliest and highly valuable account of Crimea and the northern coast of the Black Sea in modern Europe. Nevertheless, the first archaeological excavations were carried out in 1827 and aimed at finding relics of early Christianity. Lieutenant Karl Kruse, the immediate supervisor of these works, excavated three early Christian churches. Later, from 1888 to 1907, Karl Kostsyushko-Valyuzhinichhe, a member of the Russian Imperial Archaeological Commission, conducted large-scale excavations exposing the city's defensive walls, residential areas, basilicas, *thermae*, and other structures outside the city walls. Since 1924, the research has been carried out by the staff of the Chersonesos Museum in cooperation with the leading scientific institutions of the USSR, the Ukrainian SSR, and, from 1991 onward, Ukraine. Subsequent field projects included the investigation of the temple of Jupiter Dolichenus (managed by the National Preserve of Chersonesos Taurica and the University of Warsaw), a southern residential quarter (managed by the National Preserve of Chersonesos Taurica and the University of Texas at Austin and directed by Larisa Sedikova and Joseph C Carter)[3], and the more recent *Topography of Chersonesos Taurica* Project 1998–2013 (a collaboration between the Adam Mickiewicz University and the National Preserve Chersonesos Taurica)[4]. The subject of our research is the unique sculpture portrait of a matron uncovered in a dwelling house in Chersonesos as part of the latter project.

Although Chersonesos has been explored for about 200 years now, studying the portrait sculpture has not been a priority for objective reasons – the considerable fragmentation of the ancient sculpture presents numerous difficulties. In addition, most sculptures come from archaeological contexts with a broad chronology, and quite often are entirely devoid of context. Only five fragments of the marble sculpture portraits have been discovered at Chersonesos until now[5]. However, their chronological attribution and the determination of their cultural and historical significance were impossible due to the artefacts' state of preservation and the complicated archaeological context. The marble sculpture portrait in question was initially unearthed in an immaculate state of preservation, the first find of this type firmly embedded within a clear archaeological context for the first time.

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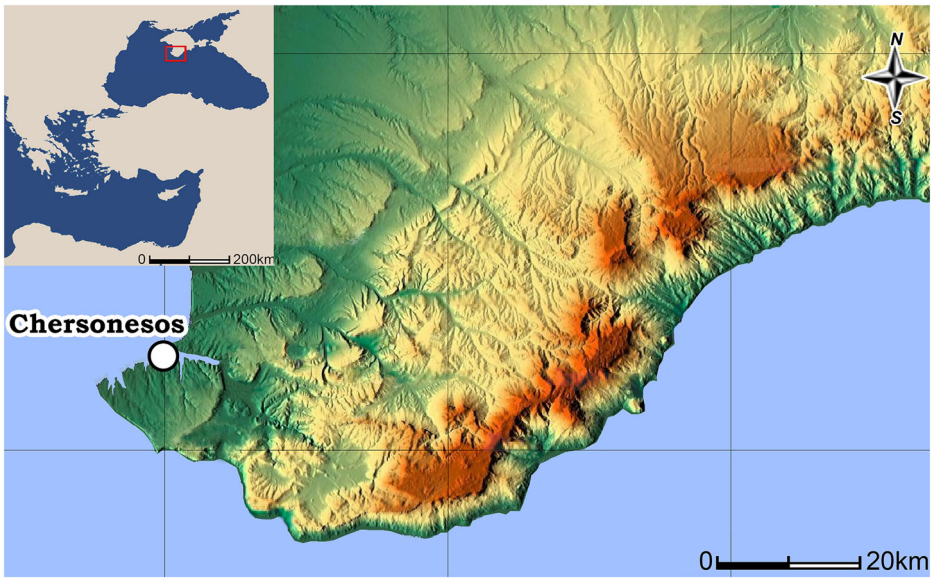

Fig. 1 | Map of the Eastern Mediterranean. The geographical location of Chersonesos in the south-western part of Crimea (created by E. Klenina based on Google Maps).

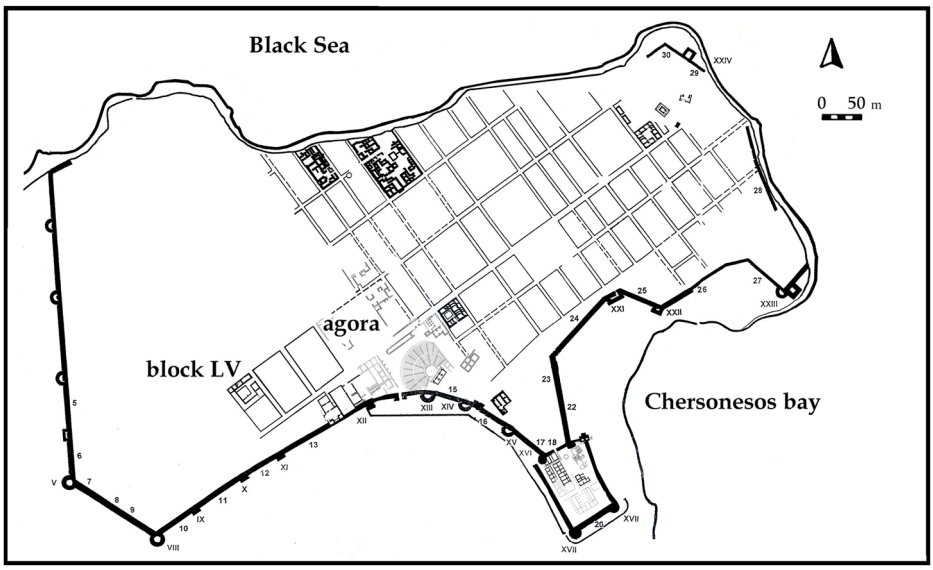

Fig. 2 | Plan of Chersonesos (drawn by E. Klenina).

In 2003, the Ukrainian-Polish archaeological expedition led by Elena Klenina and Andrzej B. Biernacki excavated an ancient residential house in block LV, in the western part of Chersonesos (Fig. 2).

This is the largest dwelling house (718 m^2) discovered until now located in the area of the theatre and the agora, adjacent to the main axis of the city, where public and other residential buildings with peristylar courtyards have been identified (Fig. 3A, B).

The residence was erected at the turn of the fourth century BC and existed until the third century AD. Unfortunately, the overground structure of the house was destroyed when a Byzantine church complex was built at its site. The basement floors and auxiliary utility rooms have mostly been preserved.

Of particular interest is room 16 (22.68 m^2) in the western corner of the residence (Fig. 3C). In the second half of the second century AD, the semi-cellar was partly filled to raise the floor level. Within this yellow-brown compact levelling layer with fine limestone rubble, a Chersonesos coin dated to the third–second century BC, a ceramic altar depicting Artemis and Apollo from the same period, and a considerable amount of ceramics dated to between the fourth century BC and the second century AD were discovered. A valuable object found in the filling was the head of a marble statue of a woman (NRChT inv. No. 1/37390) (Fig. 3D).

The female head is preserved to the lower part of the neck (Fig. 4A). The left half is broken off.

The edge of the right side of the neck shows a setting at a dihedral angle to be inserted into the torso of a sculpture, which indicates that this head was sculpted separately to be placed on a full-body sculpture or – less likely – on a bust, judging by the hollowed-out orifice inside the neck (Fig. 4C), which must have served to ensure that the piece remained in place. Also broken off are the tip of the nose, the outer edge of the eyebrow, the brow ridge and the socket of the right eye, and the outer V of both eyes. This damage had been done before the head was buried, as some affected spots, including the tip of the nose and the right eyebrow, can be seen to be broken in photographs taken during the excavation.

Furthermore, the edges of these breaks are rounded, rather than sharp. The chromatic patina of their surface is of the same light ochre colour that covers the rest of the statue – all of which indicates that this patina was formed after this deterioration occurred and at the same time when the patina of the rest of the surface of the head developed. Based on its

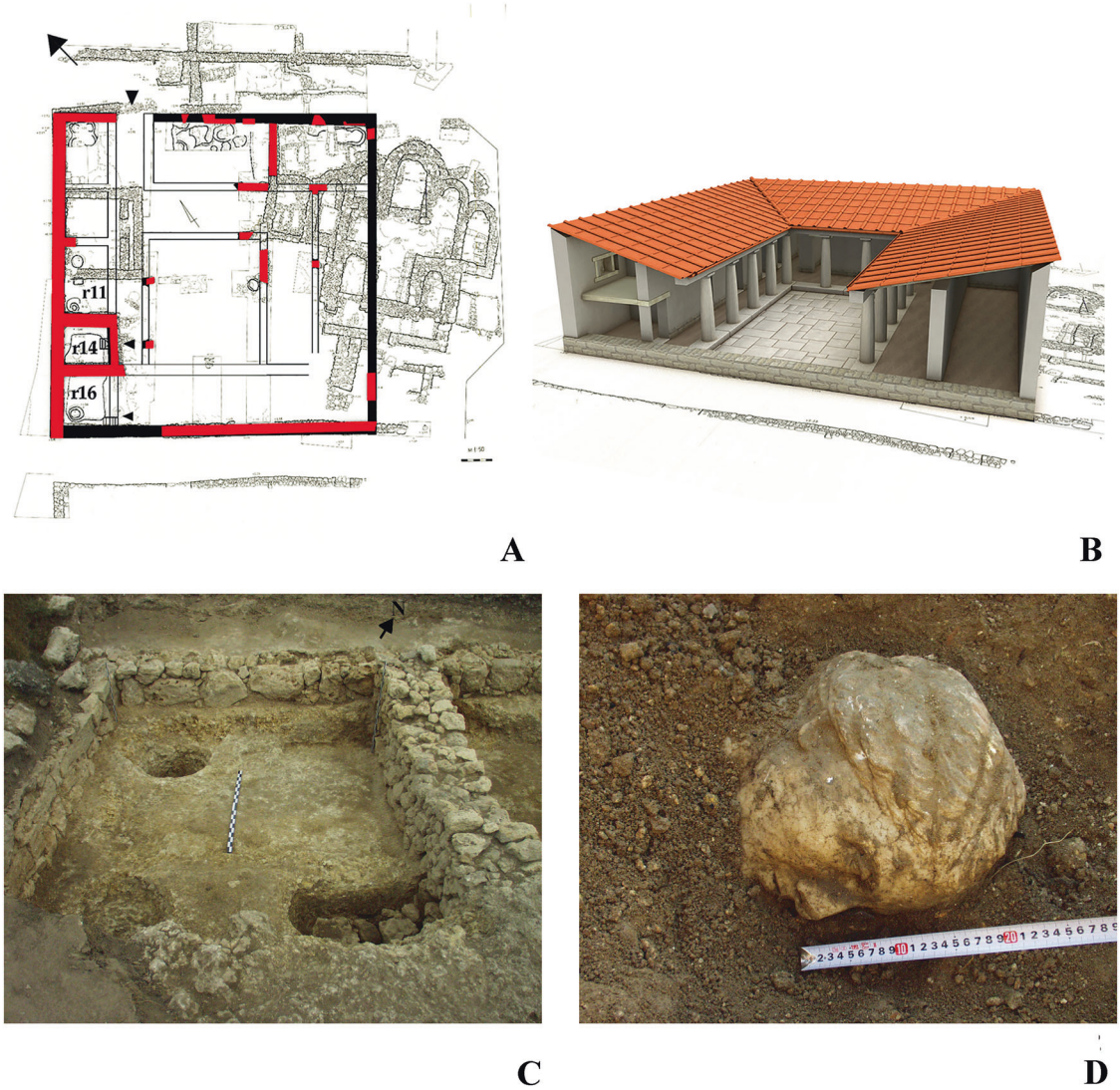

Fig. 3 | Chersonesos, the block LV (created by E. Klenina). A The special plan of the residence in block LV (drawn by E. Klenina and P. Peresvetov). **B** The 3D reconstruction of the residence (created by M. Markgraf). **C** A semi-cellar of room No. 16. **D** The marble head at the stratigraphic level during the moment of uncovering, the view from the southeast (photograph by A. B. Biernacki).

characteristics, the most logical explanation is that this chromatic change resulted from deterioration factors typical of the terrestrial archaeological context where the piece was preserved for a long time, such as oxalates formed by ruderal flora in contact with the calcium present in the marble and the calcareous and earthy concretions that can adhere to marmoreal surfaces as a result of the crystallization of salts[6].

At the back of the head, the upper part of the parietal area is flat, cut diagonally downward and sculpted on the surface with an unevenly roughed-down surface (Fig. 4B, E). The carving in this area predates the piece being deposited in the archaeological context where it was found, given that it can be seen in photographs from the excavation and its patina is of the same colour as the rest of the surface of the piece. Since the Archaic Greek period, it has been observed that two different parts of a figure were joined together by the processing of similar surfaces, the unevenness of the surfaces to be joined being conducive to glueing[7].

The sculptural portrait described above is of significant scientific interest. In the Black Sea basin, discoveries of this kind within an archaeological context are extremely rare and therefore require comprehensive, multidisciplinary investigation. Radiocarbon (^{14}C) dating of the relevant archaeological layer will be used to establish a more precise chronology.

A primary research goal is to identify the individual depicted and her role within the historical developments of the city or the wider region. To achieve this, the portrait must undergo detailed material analysis, including spectral and isotopic testing, to determine the composition and possible origin of the raw material. Microchemical, microcrystalline, and X-ray fluorescence (XRF) analyses of the patina layers in the occipital region and on the neck fracture may provide insights into the adhesive substances used and potentially indicate the workshop or region of production. Traceological studies will also evaluate the technical skill involved in the craftsmanship.

Equally essential are historical, art-historical, iconographical, and epigraphical analyses. The stylistic features of the sculpture – such as the hair, facial characteristics, and expression – should be compared with established artistic typologies and trends of the period to determine a relative date and cultural affiliation. Iconographical interpretation may shed light on the social or political status of the individual represented. A key component of this research will be the examination of epigraphic material from Chersonesos – these inscriptions could help identify the subject of the portrait and clarify the reason for her commemoration, whether it was due to her public significance or a private initiative.

Fig. 4 | Illustrations of the sculpture of the head of a woman (photographs by A.B. Biernacki). **A** Front side. **B** Back side. **C** Bottom part. **D** Left side. **E** Right side.

Table 1 | The analysed samples with archaeological context

Sample name	Material	Localisation
P01/03 pr	Charcoal	Room 22, prospect hole 4, NW profile, upper layer
P02/03 pr	Charcoal	Room 22, prospect hole 4, NW profile, lower layer
P03/03 pr	Charcoal	Room 11, under the wall 32; +0.15 m from PC-384
P04/03 pr	Charcoal	Room 11, under the wall 32; –0.35 m from PC-384

^{14}C dates were established by N. Kovaluch in the Kiev Radiocarbon Laboratory of the Institute of Environmental Geochemistry, National Academy of Sciences of Ukraine, in 2003, using an Accelerator Mass Spectrometer (14C-AMS).

Taken together, these approaches aim to construct a holistic understanding of the portrait's significance within its historical and cultural context.

Methods

Radiocarbon dating analysis

To determine the age of the building complex in block LV, four samples from two rooms of the structure were subjected to radiocarbon (^{14}C) analysis. Two samples (P01/03 pr; P02/03 pr) were taken from the stratigraphic layers of room 22, while the other two (P03/03 pr; P04/03 pr) were collected from room 11, located near room 16. The samples were deliberately chosen from four stratigraphic levels at varying depths: two originated from beneath the Byzantine wall 32 erected after the destruction of the ancient house, and the remaining two were taken from the south-western profile of the prospect hole in room 22 (Table 1).

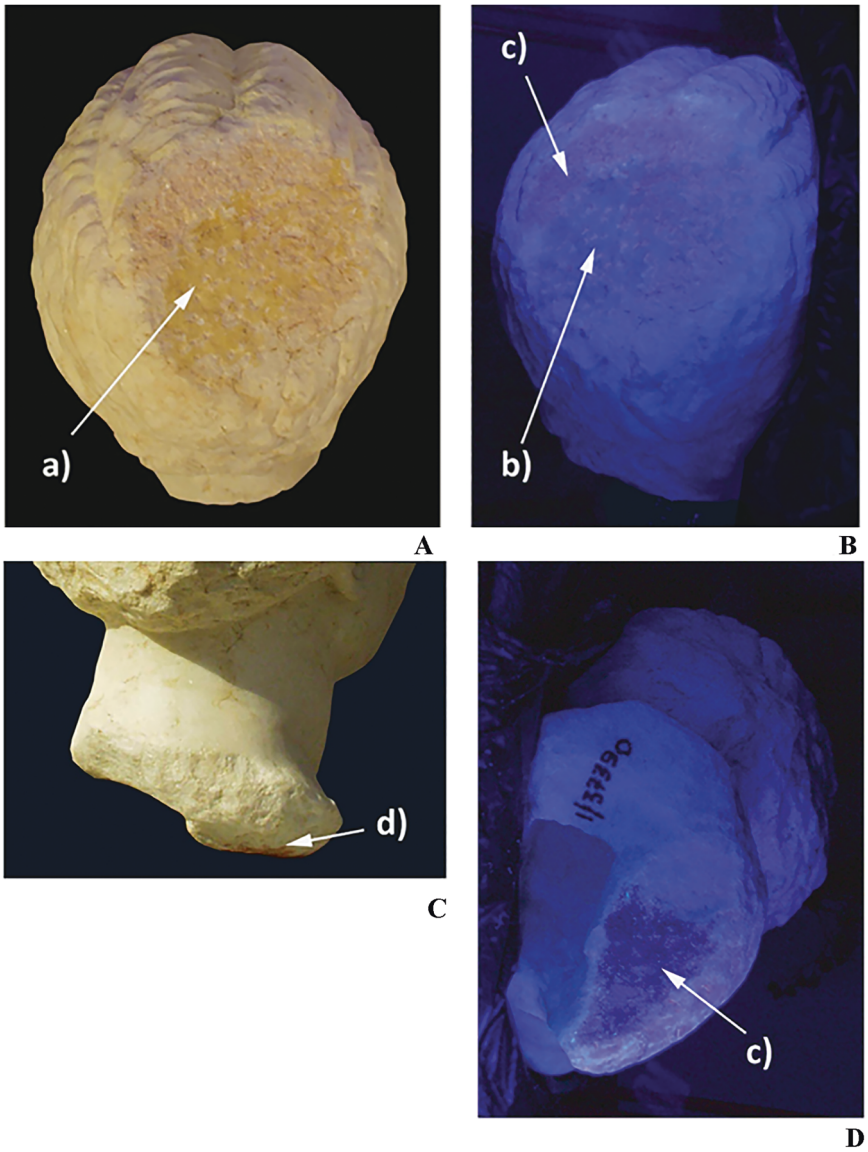

Fig. 5 | Photographs of selected parts of the sculpture with traces of layering. A The occipital part of the head, VIS image (a). **B** The occipital part of the head, an ultraviolet-induced luminescence image: coating of carbonate (b) and ferruginous layer (c). **C** The neck fracture, VIS image (d). **D** The neck fracture, an ultraviolet-induced luminescence image (c) (created by P. Zambrzycki).

Stable isotope analysis

A fragment of the marble head was sampled for carbon ($\delta\ ^{13}C$) and oxygen ($\delta\ ^{18}O$) to provide information regarding the provenance of the marble. Stable isotope signatures were measured using a mass spectrometer, a device that determines the ratios of various isotopic masses of several chemical elements in samples of very small weights. The exact isotope ratios of $^{18}O/^{16}O$ and $^{13}C/^{12}C$ in marble are measured following a chemical treatment that separates these elements as gaseous CO_2 from calcium carbonate. The result of the measurement is expressed as the deviation from the accepted reference standard, which is Pee Dee belemnite (PDB), a carbonate fossil from South Carolina; the deviation δ is expressed as $\delta\ ^{13}C$ or $\delta\ ^{18}O$, reported in parts per thousand (per mil, ‰) and calculated as in Pollini et al. 1998 and Gorgoni et al. 2002. The stable isotope analysis was conducted at the Institute of Physics of the Maria Curie-Skłodowska University of Lublin, Poland by Professor Stanisław Hałas in 2005.

Microchemical, microcrystal and XRF analysis

Three samples (Nos. 1–3) of the patina layer were taken in order to determine the composition of the bonding binder or adhesive at the joints.

Material samples taken for examination were analysed using microscopic methods, employing microchemical and microcrystal tests with the use of an M-st 130 stereoscopic microscope (max. magnification 100×) and a Nikon biological microscope (magnification up to 680×).

Sample No. 1 was taken from the occipital part of the head (Fig. 5A).

Macroscopic description: A very thin layer present on calcite crystals.

Microscopic description: Calcite crystals are visible. In addition, a red substance, charcoal, and a cream-coloured substance were observed.

Microchemical reactions: No visible reactions in water. A smear could not be performed because the observed substances adhere strongly to the calcite grains. After treatment with 3MHCl, the calcite dissolves. A microcrystalline substance, charcoal, and red pigment remain. No recrystallization of gypsum was observed. A clear positive reaction for iron ions was confirmed using potassium ferrocyanide ($K_4Fe(CN)_6$). A clear reaction for silicate ions was confirmed using ammonium molybdate.

Sample No. 2 was taken from the occipital part of the head (Fig. 5B).

Macroscopic description: The sample is compact, although it appears in fragments. The outer surface is yellowish-cream, while the underside is white.

Microscopic description: Calcite crystals are visible. In the depressions, a microcrystalline yellowish-cream substance is present.

Microchemical reactions: Calcite grains dissolve in 3MHCl. A small amount of microcrystalline substance remains. No gypsum was detected.

Charcoal is visible. Positive reactions were observed for the presence of iron ions and silicates.

Sample No. 3 was taken from the neck fracture (Fig. 5C, D).

Macroscopic description: The sample is in powder form and has an orange-yellow colour.

Microscopic description: Calcite crystals are present, covered with an orange-yellow substance.

Microchemical reactions: In 3MHCl, calcite dissolves, while the yellow substance remains in the form of flakes. A significant amount of iron compounds is present (more than in samples Nos. 1–2). A slight reaction was observed for the presence of silicate ions.

Negative reactions were found with the following:

Acetic anhydride; no presence of organic resins

Lugol's solution; no presence of starch or dextrin

Toluene, ethyl alcohol; no solubility indicating resinous or oily substances

Biuret test; no presence of proteins

4N NaOH (saponification reaction); no indication of oils or waxes

Instrumental analyses were also conducted:

XRF (X-ray fluorescence) analysis of solid samples using an energy-dispersive X-ray spectrometer MINIPAL model (PW4025) by Panalytical.

Mass spectrometry using a Micromass LTC spectrometer with electrospray ionization and a time-of-flight (TOF) analyser (TOF – Time of Flight).

Preliminary XRF analysis of the binder sample in solid state was performed using an energy-dispersive X-ray spectrometer, MINIPAL type (PW4025) by Panalytical.

The analyses were carried out at the Department of Specialist Research and Documentation Techniques at the Faculty of Conservation and Restoration of Works of Art, Academy of Fine Arts in Warsaw, in 2005.

Table 2 | Radiocarbon dating results in numerical form

sample name	Laboratory number	Age ^{14}C	
		BP	BC/AD
P01/03pr	Ki-10821	1840 ± 70	1σ 83–105 AD 115–245 AD 305–315 AD 2σ 25–43 AD 49–343 AD 369–381 AD
P02/03pr	Ki-10822	1980 ± 70	1σ 49 BC–85 AD 101–123 AD 2σ 169 BC–135 AD 149–175 AD 193–213 AD
P03/03pr	Ki-10823	1880 ± 70	1σ 69–225 AD 227–231 AD 2σ 39–29 BC 23–11 BC 1 BC–259 AD 279–291 AD 297–321 AD
P04/03pr	Ki-10824	1910 ± 70	1σ 5–9 AD 23–135 AD 147–177 AD 191–213 AD 2σ 47 BC–255 AD 303–317 AD

Table 3 | δ ^{13}C, δ ^{18}O stable isotope ratios

δ ^{13}C	+5.33‰
δ ^{18}O	–3.27‰

The values of δ are specified relative to the standard V-PDB with the accuracy of 2 σ = 0.12‰.

The traceological analysis

During the research, a continuous light lamp with a colour temperature of 5500 K, a Nikon D90 camera with a Nikkor AF Micro 60/2.8 lens, and a ruler with a millimetre scale were used.

In traceological studies carried out on the marble surface of the sculpture, information is sought regarding the artefact's individual features and the possible identification of its manufacturing method.

In the case of the examined sculptural composition, identifying the tools and the method of execution can indicate the level of the creator's technical skills. The collected data – in the form of typological classifications and measurements of stone chisels – can, when compared with other databases, be used in further comparative analyses to determine the location of the workshop itself or, in certain exceptional cases, to confirm the authorship of the creator. Systematically collected traceological data may, in the future, enable the generation of statistical results that allow for general conclusions about the evolution of manufacturing methods in art and crafts.

For the examined composition, macroscopic observations were carried out using oblique lighting, which helped reveal the stone surface morphology and, in particular, its texture. Due to the crystalline structure of marble, microscopic examination of the traces (commonly used for recording marks on materials with fine-grained or compact structures, as in studies of bone material) was not deemed advantageous.

Based on comparative studies of marks made with modern reproductions of ancient stone chisels, it is possible with a high degree of probability to identify the types and dimensional variants of chisels used in the production of the examined ancient sculpture. Some information regarding the way stone carving tools were handled is quite universal, as these tools are still in use today and form the basis of training for contemporary stonemasons and sculptors.

During in situ observations, photographic documentation was carried out while simultaneously measuring the width of the traces in millimetres and recording the direction in which the tool was applied during the stone-working process.

Results and discussion

Chronological context and provenance

The radiocarbon dating of the charcoals from the residence indicates three distinct time intervals, with the oldest represented by P02/03pr, while the slightly younger phase is indicated by sample P04/03pr. The age of the two samples (P01/03pr, P03/03pr) corresponds to the time of the reconstruction of the semi-circular space of room 16, where the marble sculpture was discovered (Table 2).

Radiocarbon analysis indicates that between 180 and 240 AD (Ki-10823: AD 60–240 at 95%) and 1910 ± 70 BP (Ki-10824: AD 20–180 at 95%)[8], the house underwent structural modifications that required the removal of the semi-basement rooms, which were subsequently filled in. The portrait under study was discovered within this fill material, which enabled a much more precise chronological determination.

Following rigorous analysis of the stone's spectral and isotopic characteristics, the provenance of the material used to craft the sculptural portrait was successfully determined (Table 3).

The two diagrams used in the analysis are those most frequently quoted in recent studies of similar spectroscopic and isotopic analyses. Our purpose in applying two diagrams was to provide maximum confirmation of the identified locations of the quarries.

Diagram 1 (Fig. 6) was specially created for fine-grained marble with MGS < 2 mm[9]. This diagram limits the number of quarries supplying fine-grained marble to four showing that the analysed sample is lychnite marble from the quarry Paros 1.

Diagram 2 (Fig. 7), used in the analysis, summarises the results of several relevant research projects[9–12]. The ranges of the quarries' isotopic fields overlap to varying degrees, making it difficult to reliably identify

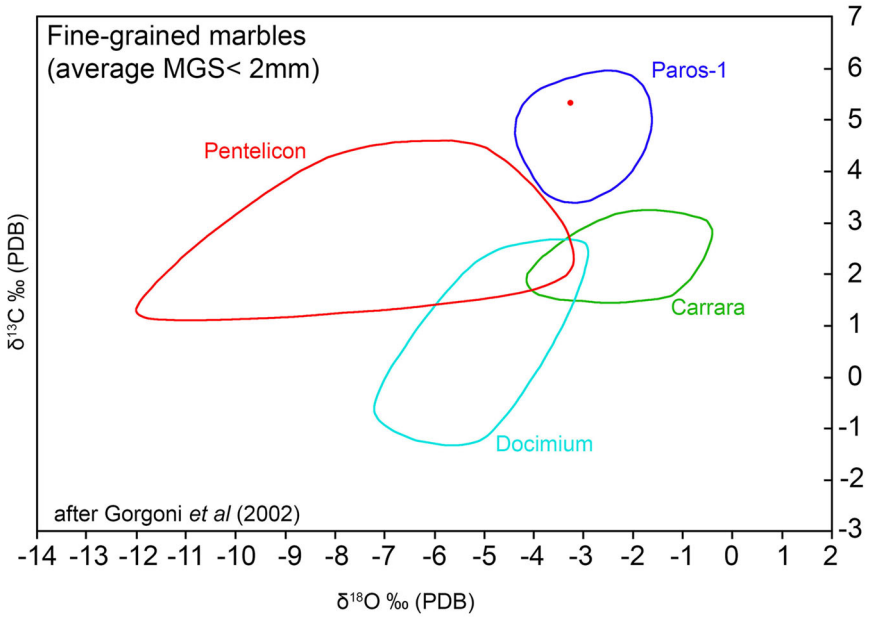

Fig. 6 | The analysed sample result is graphically plotted in the diagram as the carbon isotope ratio $\delta^{13}C$ versus the oxygen isotope $\delta^{18}O$ within the selected ellipses of isotopic signatures obtained from the quarry data (created by A.B. Biernacki).

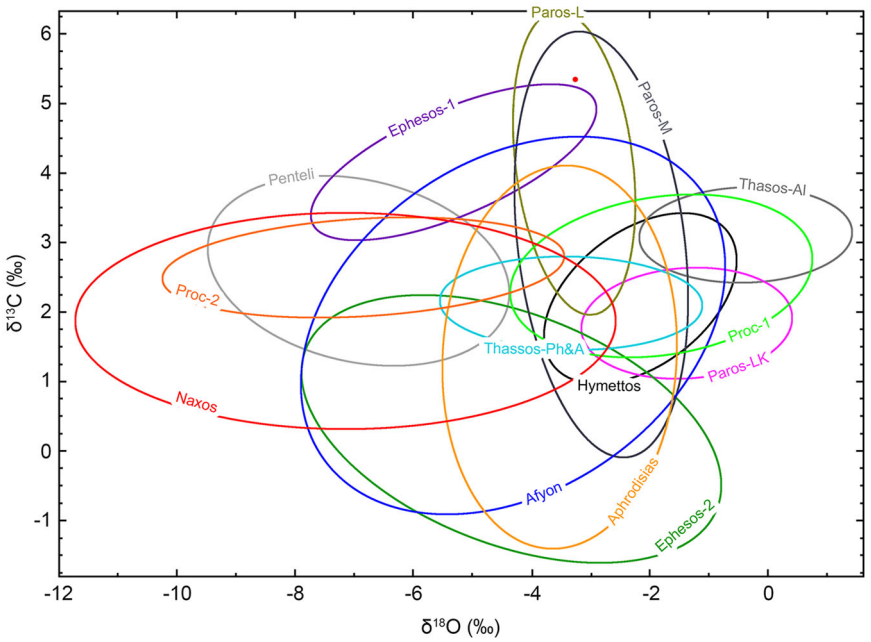

Fig. 7 | The analysed sample result is graphically plotted in the diagram as the carbon isotope ratio $\delta^{13}C$ versus the oxygen isotope $\delta^{18}O$ within the selected ellipses of isotopic signatures obtained from the quarry data (created by A.B. Biernacki).

marble samples. Despite this, the result, as in the case of the first diagram, allows us to conclude that the material came from the quarry Paros 1.

The result of the highly specialised analysis of samples Nos. 1–2 taken from the occipital part of the head showed that the examined colour coating forms a very thin layer on calcite grains ($CaCO_3$). After dissolving the calcite grains, a microcrystalline substance, charcoal and clusters of red remain. No gypsum was found. The presence of iron compounds in the form of a red substance, which may be a pigment – iron red – was detected. The clear presence of charcoal can be linked to the presence of mortar, of which it may have been a component, or, for example, to the proximity of a fire. The presence of silicate ions should be associated with the presence of clayey substances. However, some of the substances may originate from the environment in which the object was located. In the samples provided so far, it is not possible to specify the origin of the individual components.

The presence of Ca^{2+} calcium ions and Fe^{3+} iron ions was detected in sample No. 3. A preliminary MS test was performed on the sample of binder dissolved in a 1 : 1 ACN/water system with the addition of formic acid. The test was conducted using a Micromas LCT mass spectrometer with electrospray ionisation and a time-of-flight (TOF) analyser.

Analysis of positive ions showed the presence of molecular peaks in the range of 50–400 u (Fig. 8).

Analysis of negative ions also showed the presence of peaks in the mass range of 50–400 u. (Fig. 9)

During the examination of the sample No. 3, which came from the substance connecting the neck to the torso, despite a large number of chemical reactions, it was not possible to determine its chemical composition. The presence of calcite crystals as the main component of marble and a significant content of iron compounds was clearly

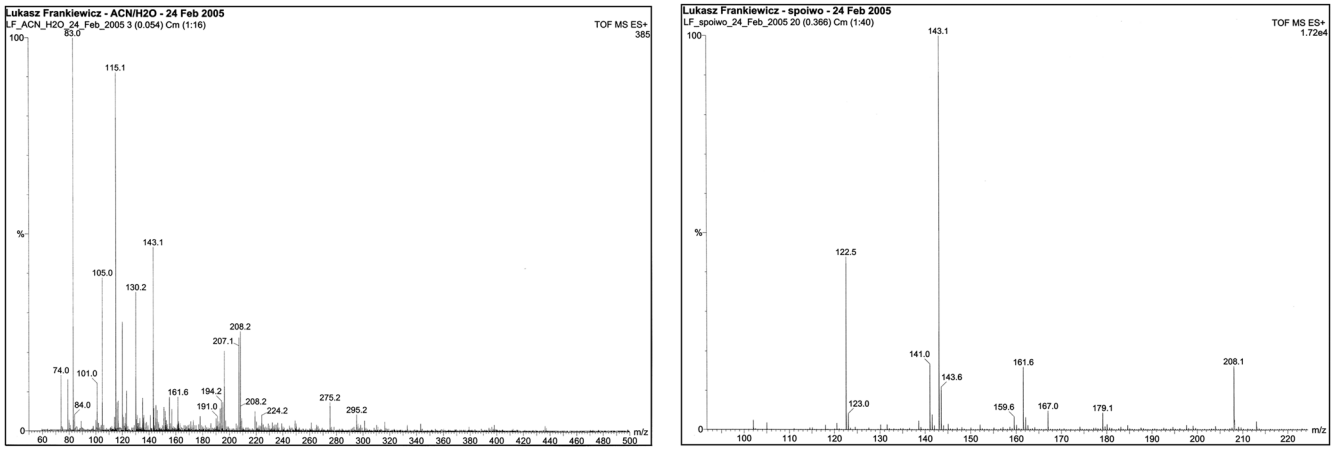

Fig. 8 | Analysis of positive ions showed the presence of molecular peaks in the range of 50–400 u (created by E. Klenina).

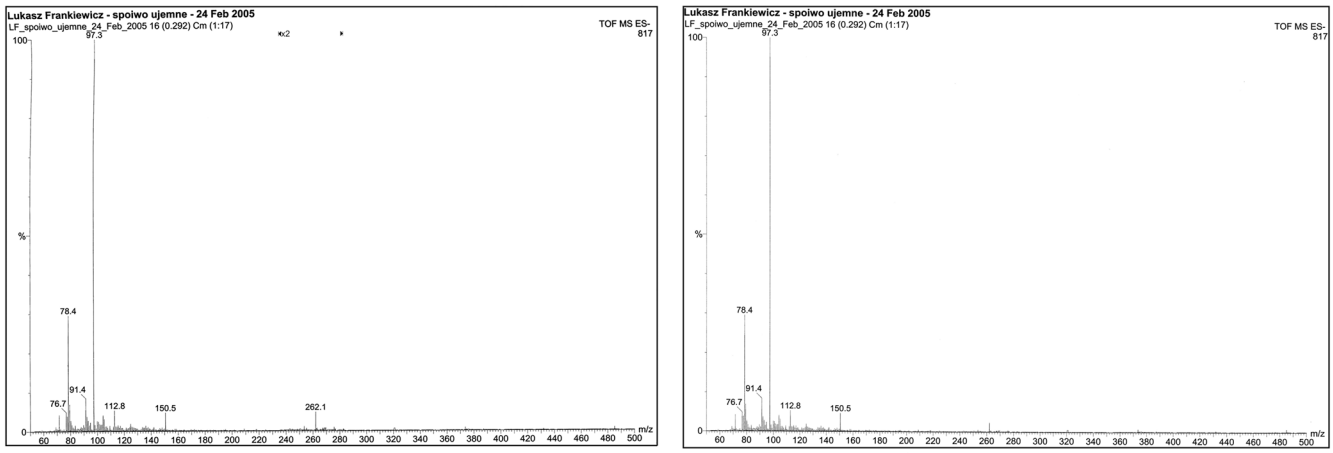

Fig. 9 | Analysis of negative ions showed the presence of peaks in the mass range of 50–400 u (created by E. Klenina).

Table 4 | Types of stonecutting tools used for the sculpture

Item	Tool	Location of traces
1.	Point chisel	The neck (the socket for the dowel), the flat area at the occiput, the hair (the roughly executed back)
2.	Punch or flat chisel app. 5 mm wide	The edge of the socket for the dowel, the hair (the strand behind the ear on the left)
3.	Flat chisel app. 7 mm wide	The hair on the left
4.	Flat chisel app. 12 mm wide	The roughly executed hair at the back at the base of the chignon and above the forehead on the left
5.	Roundel app. 6 mm wide	The hair above the neck on the left and the bottom strand; the hair above the right temple
6.	Roundel app. 8 mm wide	The hair at the back on the left above the chignon and on the right over the ear
7.	Roundel app. 15 mm wide	The hair behind both ears
8.	Rounded claw app. 15 mm wide and with 10 teeth	The roughly executed hair above the chignon
9.	Rasp and scraper	Wrinkles: at the left ear, transversal ones on the neck, at the corners of the eyes, on the right cheek; traces at the hairline on the forehead
10.	Abrasive material: sandstone, pumice	Smooth surfaces of the neck and the face
11.	Hammer, mallet	For striking the chisels

identified. The tested substance occurs in the form of small plates. It did not show any dissolution or swelling in acidic or alkaline environments, in polar organic solvents (ethyl alcohol) or non-polar solvents (toluene). It showed negative reactions to starch, dextrin, protein substances, oils and waxes. Highly specialised instrumental tests revealed the presence of organic groups in the sample.

Tool use traces on the sculpture surface

A traceological analysis of tool marks on the sculptural portrait revealed the use of eleven distinct tools by the sculptor (Table 4).

The analysis identified several stages of the sculpting process of the woman's marble head. The first one was rough cutting by means of a point chisel[13]; traces of its use for sketching the edge of the hair at the back are

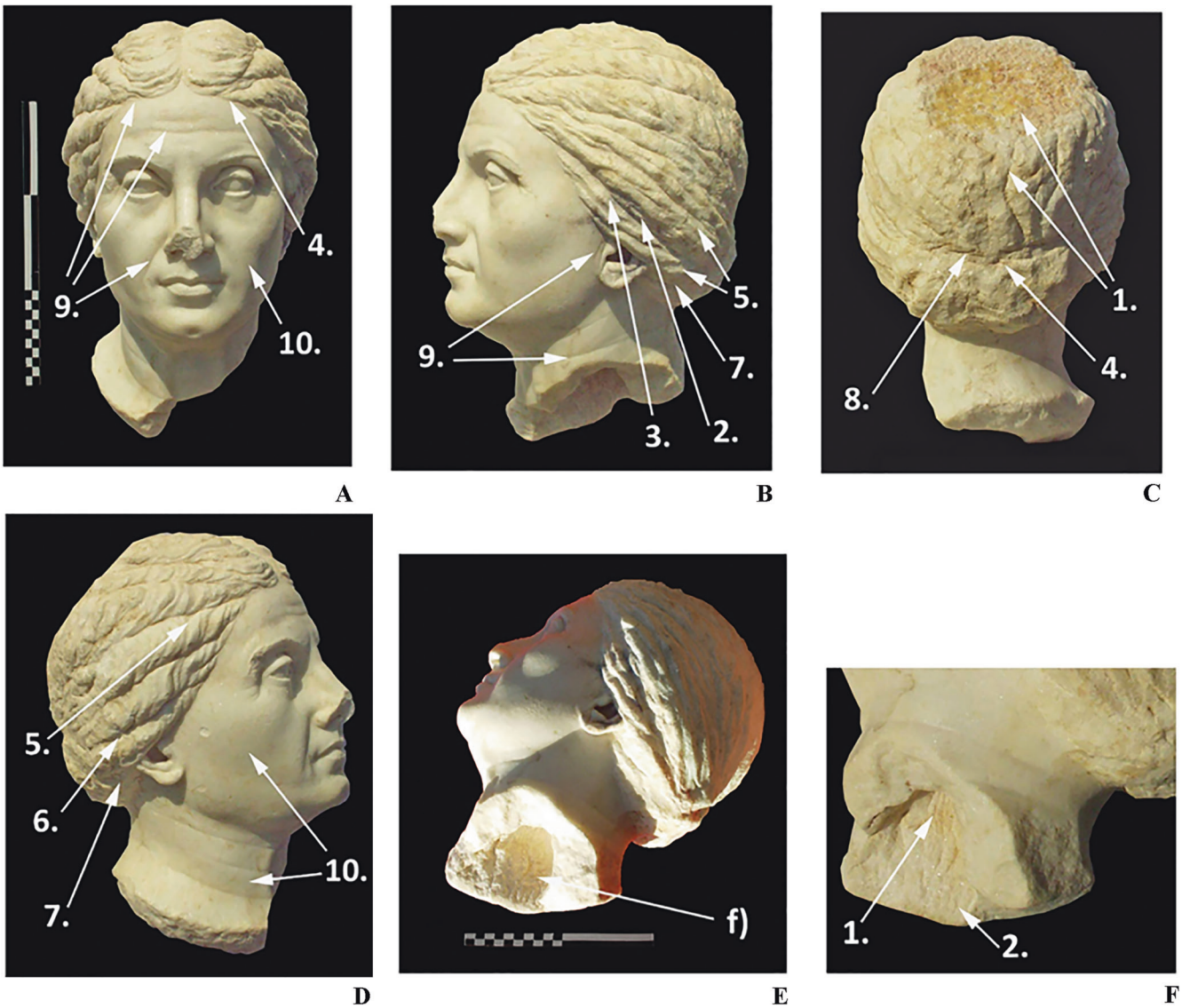

Fig. 10 | The visible traces of stonecutting tools. Numbers after Table 4 (created by P. Zambrzycki). **A** Front side. **B** Left side. **C** Backside. **D** Right side. **E** Bottom part. **F** Head fastener hole.

visible. In the next stage, flat chisels of various widths were used. For sculpting the hair, round-headed chisels (roundels) were also applied. Such chisels of various widths were commonly used for prefatory cutting of surfaces; their traces usually appeared at the backs of sculptures, which were left roughly finished. Instances of this practice are numerous Greek portrait sculptures and Roman ones patterned after the former[14]. In the described piece, traces of a rounded claw[15] are also evident. This was a chisel with very fine teeth-spaced app. 1.5 mm from one another, in this case, ten, although more typical were tools with fewer. The same rounded claw may also have been applied to other areas of the sculpture, but its traces were obliterated during the subsequent cutting and fine smoothing. In the last stage, the rough surfaces were finished with a rasp, a scraper and abrasive material (sandstone and pumice).

The flat area at the top of the head was produced by a gently stricken point chisel, which produced hollows of depths of between 1 mm and 3 mm. The resulting flat area is oblique, slanting to the right of the sculpture (Fig. 10). It is axially symmetrical. Accordingly, this rather may not have been intended for supporting a headdress or another sculpted item but instead resulted from the artist's attempt at repairing damage to or flaw of the stone.

Most probably, during the sculpting, the artist noticed a crack in the material and filled it with a flake of stone (now lost). The rough-textured surface produced with a point chisel was meant to be coated with gluing mortar. A similar area occurs in the portrait sculpture of Lucilla, the wife of emperor Lucius Verus, dated to AD 170 (the Archaeological Museum of İzmir). The same method of repairing damage to sculptures was known as early as in the archaic period: The archaic Kore 687 (the Acropolis Museum) was repaired after suffering damage to the top of her head – the damaged area was cleanly sliced off at an angle toward her left ear, and the surface was carefully prepared for a replacement piece by means of anathyrosis, using a dowel and glue[16]. The extinct section of the sculpture from Chersonesos may have featured more such areas. They occur quite frequently in other ancient pieces[14]. Also, the artist applied a similar technique in the section where the head was connected with the torso – both in the flat area at the top of the head and at the bottom of the neck, traces of iron oxide red have been detected.

The flat area at the back of the head, with a diameter of ~130 mm (Fig. 5A), was designed and produced with a point chisel; it was subsequently used to glue a flake of stone, of a maximum thickness of ~35 mm, in order to repair a flaw of the main stone block. There are also traces of red pigment on the surface of the flat area. Ultraviolet-induced luminescence revealed a ferruginous colouration with occasional coating of carbonate (Fig. 5B). The socket for the assembly dowel at the

bottom of the neck of the sculpture, with a diameter of ~45 mm and a depth of ~90 mm, was produced with a point chisel[17]. Its slightly rounded edges and bottom testify that the Ancients applied metal dowels wrapped with lead (Fig. 10E).

The coloration must have been related to the joining of stone elements, as there is a similar (although much more condensed) coating at the bottom of the neck. The coloration may also have resulted from a conflagration which oxidized the original ochre pigment in the binding material; circumstantial evidence of the latter theory is the extant black burning mark on the stone at the left ear and temple of the sculpture (Fig. 10B). Chemical tests detected iron compounds, while they failed to identify the binding material. Furthermore, occasional light-yellow layers of carbonate (confirmed by chemical tests) occur on the surface of the flat area; these result from recrystallization of calcium carbonate during the long time that the sculpture spent buried in the ground. Similar small clusters of carbonate appear in the hollows in the hair at the back of the sculpture. The rounded section at the bottom of the neck with a finished lower surface is the junction with the extant torso of the statue: The head was apparently sculpted separately and subsequently joined with the rest of the piece by means of a socket and a dowel. The tip of the nose, the edge of the right eye, and the left side of the neck (Fig. 10A) were damaged when the statue was being disassembled; the location of the latter missing fragment evidences that the head was being removed by being pulled backward and to the left. A small chipping at the back of the edge of the neck suggests that the head may have been pried off with a hard tool (Fig. 10B, C).

Stylistic analysis of the sculpture

An art history analysis showed that the head depicts an elderly woman. There are noticeable signs of old age on both sides of the face, particularly on the left side (Fig. 4D), where the skin adheres to the nose and the cheekbone, creating effects of flaccidity in the cheek area and the depression sculpted next to the eye and the wrinkle of the nasolabial fold. The visible part of the ears is somewhat decrepit (Fig. 4D, E), the chin is flaccid, and the neck is lined with the horizontal folds known as Venus rings and with vertical indentations in the middle. By contrast, the portrait's countenance, seen from the front (Fig. 4A), is elegant and serene, favoured by the dimple in the chin. The wrinkles of the forehead and the nasolabial folds are softened, and the outlines of the eyebrows and the mouth are well-defined. The difference in how age is shown on the front and sides of the face indicates the combination of two different Roman portrait traditions. On the one hand, the realism characteristic of the private portrait tradition that was well-established in Italy and the Western provinces can be seen in this piece. On the other, it can be observed that this realism was softened by the Greek female portrait tradition, which was similar to the manner of executing sculpture of divine of figures and tended to use generalized features – the "non-portrait"[18] style of female portraiture that was widespread in the Eastern Roman provinces, derived from well-known Hellenistic precedents. One such precedent is the statue of Aristonoe from Rhamnus[18–20]. Although it depicts a more youthful woman, its realism shows a somewhat similar approach to that seen in this portrait from Chersonesos.

This combination of different traditions can also be seen in how the figure's hair is arranged, which is characterized by the well-known *melonenfrisur*[18,21]. The distinctive wedge-shaped sections of this hairstyle can be clearly identified starting at the temporal region of the face (Fig. 4A), and especially in how the hair is distributed on both sides of the head (Fig. 4DE), where fine wedge-shaped sections follow one another until they are gathered in a bun in the lower occipital area. On the back side of the portrait, the hairstyle is barely outlined with a chisel (Fig. 4B).

The melon hairstyle began to be depicted beginning in the middle of the fourth century BC in Greek female figures, some of which were divine. Particularly noteworthy are the figures of Artemis, while others portrayed women on funerary reliefs[18,19]. This hairstyle, which was spread during the Hellenistic period by statues of Ptolemaic royalty and of female citizens of high social status[18,19,22–24], denoted elegance and distinction. In the Roman era, it was recurrently used over a long period in the Greek East for statues of young women and influential matrons that were erected at key sites of transit and exhibition, as is exemplified by a portrait of a woman from the local elite – or, possibly, the imperial family – that belongs to a statue displayed in one of the lower niches of the *scaenae frons* of the theatre of ancient Buthrotum (Butrint, Albania)[25]; the figure of the so-called Aelia Briseis from the Sanctuary of Artemis Polo in Thasos[18]; the statue of Flavia Vibia Sabina in front of the Arch of Caracalla, in the same city[18]; and the figure of Graphis on a funerary stela from Athens[25]. All of these examples date from the first to the third centuries AD.

This hairstyle also spread to the Roman West. The famous statue of the Small Herculaneum Woman shows that it was introduced in the second half of the first century BC[19,24,26,27]. Its use spread especially in the second century AD[28], when it was depicted in the earliest portrait types of Faustina the Younger, Crispina and Lucilla, which enhanced it with hairstyles that were fashionable at the time. It was also worn by private women – particularly those who were young and unmarried women, though it can also be seen in portraits of married and middle-aged ones – following the examples of these imperial ladies, or in its original form, as Plautilla wore it in her first portraits in the early third century.

The head from Chersonesos does not have a pure melon coiffure, but rather combines this style with the arrangement of the hair on each side of the centre part into two wide sections that form two flat waves over the forehead and are gathered toward the back. Below each of these two sections, the rest of the hairstyle follows the *melonenfrisur* style. This arrangement of two wavy sections at the centre of the forehead was fashionable during different imperial periods. In the earliest of these periods, hairstyles relating to the style worn by Agrippina the Elder were popular[28–30], but the piece discussed here does not share other characteristic features of the portraits of this period, such as distinctive large round eyes and a facial shape with an angular chin. However, it bears more similarities to portraits linked to the styles popularized by Faustina the Elder and the first portrait type of Faustina the Younger, both of whom brought back the style of waves over the centre of the forehead, combining them with the "tower" hairstyle in the first case, and with the melon coiffure in the latter. The head from Chersonesos also shares an oval face shape, elongated eyes with wide and visible eyelids, noticeable eye bags and a serenely serious expression with these two empresses and the portraits of their era[28]. It is noteworthy that the portrait discussed here shows no signs of carved lines in the iris and the pupil, in contrast to what had become usual by this period. However, K. Fittschen demonstrated that this technique, which was already common during the Hadrianic period, was not used in several early Antonine portraits[28,31]. This exception to the smooth chiselling of the eyes has not been documented beyond this particular period, which is an important argument against associating this head with portraits relating to the earliest portrait type of Lucilla, which is also characterized by the melon hairstyle and waves over the forehead[28,30].

Historical context of the portrait

The analysis of the epigraphic sources suggests that throughout the second century AD, the members of several aristocratic families took high positions in the city government and maintained traditional connections with the eastern Roman provinces[2]. The sculptural portrait under study depicts one of such members of a wealthy and influential family. As only one matron was rewarded by erecting a statue in her honour in this period, recent studies allow the identification of the person to whom the portrait may have belonged[32]:

ὁ δᾶμος
Λαο[δ]ί[κ]ην θυγατέρα Ἡρο-
ξέ[ν]ου, [γυ]ναῖκα δὲ Τ[ί]του
Φλαο[υίου] Π[α]ρθενοκ[λέ]ους
υἱοῦ Φλαουίου Παρθενοκλέους

According to the inscription on the statue's pedestal (dimensions: height – 0.26 m, width – 0.57 m, thickness preserved – 0.20 m), her name was Laodice, a daughter of Heroxenos (Fig. 11). The monument is dated to

Fig. 11 | The marble pedestal of a statue with an inscription in Greek (collection of the Archaeological Museum in Odessa, Ukraine) (created by E. Klenina).

the second quarter of the second century AD. Laodice's husband was Titus Flavius Parthenokles, son of Flavius Parthenokles. He was a member of one of the most influential families of Chersonesos, to which a number of statesmen belonged. Titus Flavius held various positions of responsibility in the state structure of Chersonesos, including being a member of the boule and first archon. The founder of this dynasty received the right of Roman citizenship under Vespasian, so members of his family used the Roman *praenomen* and *nomen* Titus Flavius, adding their Greek names as *congnomens* to them. In the era of Hadrian and the Antonines, the Flavius family belonged to the highest aristocratic circles of Chersonesos.

Laodice was not the first woman to deserve such honours in Chersonesos' history. Constantine VII Porphyrogenitus mentions that Chersonesites erected two bronze statues in honour of Gykia, who lived in the late-first century BC, as a payment for her service and for saving the city from capture by the Bosporan troops. However, what Laodice did to deserve such honours remains unclear. The erection of an honorary statue testified to the outstanding services of this person to the city. Like Roman matrons, local women were probably expected to participate in social and political activities. It can be assumed that this was related to the city's efforts to obtain the status of a liberty city during this period.

The critical event of the history of Chersonesos of the second quarter of the second century was the acquisition of the city's *eleutheria*. Between AD 135 and 138, Aristo, son of Attinas, went on a diplomatic mission to Rome to obtain *eleutheria*, as indirectly evidences by the honorary decree on the pedestal of the statue in his honour, erected around AD 138[32]. After the failed attempt to obtain a free city status, the Chersonesites returned to their metropolis, Heraclea Pontica. The next mission, taken by Heracleans to Antoninus Pius, was more successful, as evidences by the decree in the ambassador's honour[32]. It can be supposed that the city was awarded *eleutheria* no later than in the 140s AD, since it was at this time that the minting of coins with the legend "ΧΕΡΣΟΝΗΣΟΥ ΕΛΕΥΘΕΡΑΣ" began[2]. The authors can cautiously assume that Laodice's participation in the activity leading to obtaining the desired status was the reason for erecting the statue with an honorary inscription on the pedestal.

In the middle of the second century AD, two brothers, Titus Flavius Aristo and Titus Flavius Attinas, sons of Titus Flavius Apollonius, the latter son of Titus Flavius Aristo, erected a tombstone for Laodice, their sister, at their own expense[32]. She also belonged to the Titus Flavius family but came from another branch, seemingly another Laodice from Chersonesos. She may have been the daughter of the elder Laodice's husband's cousin and received the name of her famous relative. The portrait under study is unlikely to represent this youngest Laodice, since it shows a fairly mature woman, while the surviving tombstone inscription describes a young, unmarried girl.

As has already been mentioned, the back of the portrait is only outlined (Fig. 4B), and the fact that the unfinished part of the hairstyle begins at the ear level – meaning that it takes up almost the entire back half of the portrait – leads us to infer that this sculpture was displayed inside a niche. The total measurements of the piece, which is 385 mm high and 245 mm wide, indicate that it was part of a larger-than-life-size statue. Taking into account the ideal proportions suggested by Vitruvius and the dimensions of the statue's head under study (250 mm), the total height of the sculpture should have been about 2.0 m. For this reason, we believe it is more plausible that this figure was created to be placed in a public monumental setting, and not in the domestic setting where it was found. As has been stratigraphically demonstrated, this portrait was exhumed from a levelling stratum that raised the level of the floor of the house. It is therefore reasonable to think that the head ended up there following the destruction of the architectural structure that had previously housed it, which may well have been in the city's agora, located some 60 m to 80 m away from the house (Fig. 2). Its relatively good state of preservation and the archaeological context where it was found rather indicate that it was relocated from the place where it has been originally displayed due to the abandonment of its function with time.

Based on all the above-mentioned factors, we propose placing this head in the early Antonine period or shortly afterwards. Regarding the style of the piece, it can be concluded that it was produced in the Eastern provinces, either in a workshop located in the Greek East or by travelling artisans who had been trained there. This is indicated by the combination of clearly Roman aspects, such as the realist tendencies of the sides of the portrait and how the hair is arranged at the centre of the forehead, with tendencies from the Hellenic tradition, including the *melonenfrisur* and the rejuvenation of the face, that resemble the concept of the "non portrait". Furthermore, the delicate treatment of volumes and the fine chisel work where the hair begins and in the modelling of the locks are more in keeping with the sculptures produced in the Eastern provinces than with those produced by workshops in the Roman West[19,33]. This head is characterized by a combination of principles of portraiture from the Roman East and West that connect it with workshops in the Greek East.

Analysis of the stone material of the head has determined that it was sculpted from Paros marble. Although raw Paros marble was widely distributed in the East and the West, this further supports this argument. The beautiful white lychnite marble was quarried in two subterranean shafts located near each other in the valley of Agios Minas south-east of the present village of Marathi in the central part of the island of Paros[34]. More output of the same lychnite marble was obtained from a number of open quarries also in the valley of Agios Minas. Moreover, there is a symbolic aspect of the choice of lychnite marble from Paros as the material of the woman's statue from Chersonesus Taurica. Lychnite marble was more translucent than other types of Greek white marble. This characteristic is reflected in its Greek name "λυχνίτης (λίθος)," which in turn derives from the word "λύχνος," meaning "lamp"[35]. In Classical Antiquity, light and translucence were associated with the gods of light, brightness, radiance, and purity[34]. Lychnite marble was beautiful, expensive and rare. Thus, the material for the statue symbolised the social status and eminence of both the model of the sculptor and its donor, who was obviously a person of good taste and wealth. This is all the more striking as the statue was placed in Chersonesos Taurica, an important yet provincial political, economic and cultural centre on the edge of the Roman Empire.

Details of the portrait's hairstyle, eyes and facial shape point to the middle decades of the second century AD. The epigraphic sources allow us to assume that the sculpture was made in the 140s. The measurements and the unfinished cut of the bottom part indicate that it was intended as a full-body statue that was most likely displayed in a niche in an architectural setting associated with a prominent public place, e.g. an agora in Chersonesos Taurica, where it must have depicted a lady from the local elite, judging by the high quality of the carving, the size of the piece and the subject's dignified expression.

The most challenging task was identifying the historical figure whom the sculptor portrayed. However, we were able to determine it to be Laodice, a member of the aristocratic family of Titus Flavius Parthenokles. Her participation in the activity of obtaining *eleutheria*, which was the reason for

erecting the statue with an honorary inscription on the pedestal according to the decision of the city's authority. The findings of this study have demonstrated that matrons exercised significant influence and played an active role in political life, both within the confines of Rome and beyond its borders in the first centuries AD.

Data availability

The data used in this study are available from the corresponding author upon reasonable request.

Received: 5 March 2025; Accepted: 30 July 2025;
Published online: 14 August 2025

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Acknowledgements

This iconographic research of the portret was funded by MICIU/AEI / 10.13039/501100011033 and for FEDER, UE (grant number PID2022-137896OB-I00 ANTIQUAE FEMINAE. Classical female portraiture: antique and antiquarian contexts, analysis and digital reconstruction). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript. The authors received no specific funding for this research.

Author contributions

E.K. wrote the Introduction, Archaeological context, Discussion & Conclusion, reviewed & editing the main manuscript text and prepared Figs. 1–3, 8, 9, and 11; A.B. wrote the Archaeological context, Methods, Discussion and prepared Figs. 6 and 7, M.C. wrote portrait description, Discussion & Conclusion; P.Z. wrote the Methods, Conclusion and prepared Figs. 4, 5, and 10. All the authors reviewed the manuscript.

Competing interests

The authors declare no competing interests.

Additional information

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