

This Old Foot: Identification of Ancient and Modern Reuse in a Ptolemaic Child Sarcophagus

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Figure 1 Ptolemaic Child Sarcophagus

The subject of this paper is an ancient Egyptian anthropoid sarcophagus lid in the collection of the San Diego Museum of Man (fig. 1). A technical analysis was undertaken as a graduate thesis project in the fall of 2012. As the evaluation of materials and methods of manufacture progressed irregularities became evident. Consultations with Egyptologists Kara Cooney (2012) and Lorelei Corcoran (2012) provided key information about the form and

iconography, and both scholars observed anomalies in the face block and in the foot block, and suggested these components might be reused from other sarcophagi. Determining reuse became a focus of the project, and this paper presents the evidence of both ancient and modern reuse.

The San Diego Museum of Man describes this object as a “sarcophagus” lid rather than “coffin” lid, and the term is used throughout this text. The word “sarcophagus” comes from the Greek meaning “flesh eating” based on an ancient belief that the stone of the funerary containers caused the bodies to decompose. According to Ikram and Dodson (1998, 244) the term most commonly indicates a stone container that contains a coffin, and the “coffin” in turn contains the remains of the deceased, but the terms are used interchangeably.

The object was a gift from a private collection to the Museum of Man in 2005. There is no record of the trough, or bottom part, to this lid and there is no record of associated human remains. The museum record includes only a very brief historical analysis, but the author is unidentified.

Wood was not abundant in ancient Egypt and as a result sarcophagi were often pieced together, rather than each being carved as a single whole and it was a common practice to reuse elements from other sarcophagi in this process (Cooney 2012)(Svoboda 2013).

This object is comprised of a base structure with applied wood components. The base structure is a hollowed out cross section of a tree trunk that extends the full length of the object from the top of the head to the foot and is 129.5 cm long (fig. 2, and fig.3).

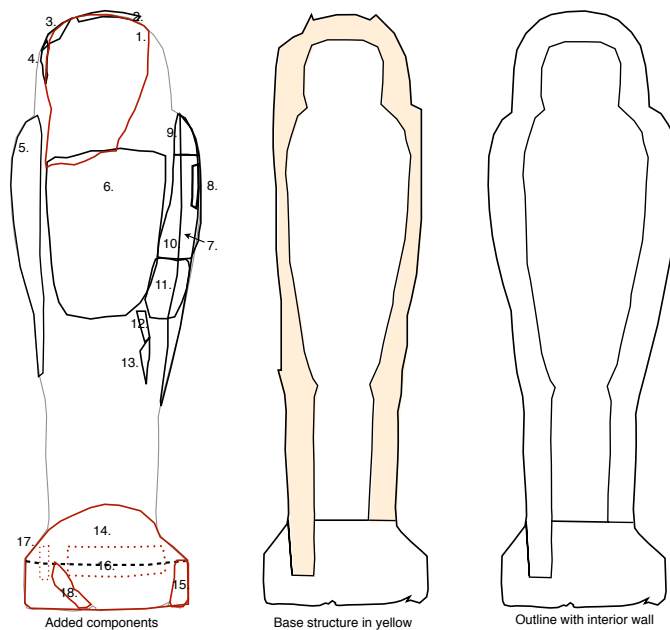
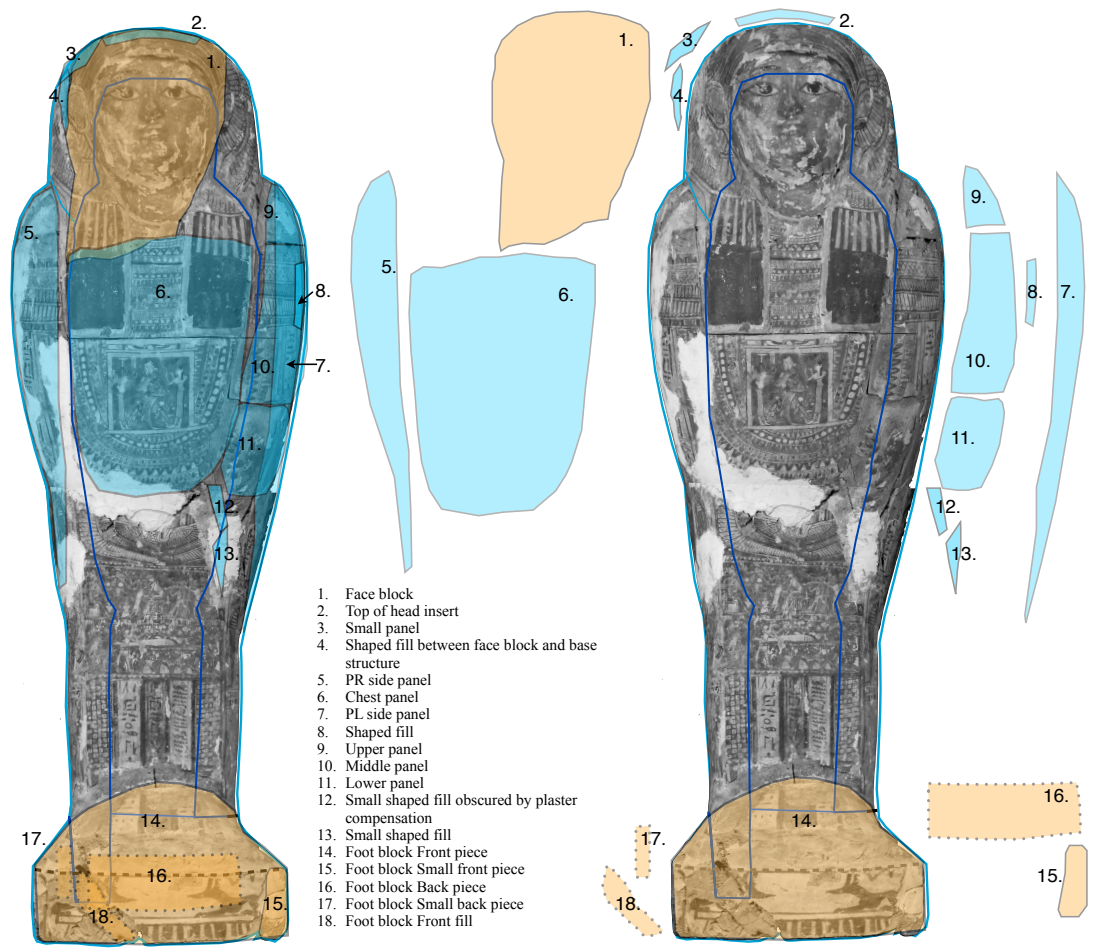


Figure 2 (l) base structure with component pieces (m) outline of the base structure (r) outline of the complete structure



1. Face block
2. Top of head insert
3. Small panel
4. Shaped fill between face block and base structure
5. PR side panel
6. Chest panel
7. PL side panel
8. Shaped fill
9. Upper panel
10. Middle panel
11. Lower panel
12. Small shaped fill obscured by plaster compensation
13. Small shaped fill
14. Foot block Front piece
15. Foot block Small front piece
16. Foot block Back piece
17. Foot block Small back piece
18. Foot block Front fill

Figure 3 The structure (l) The numbered component pieces (r)

The head, the chest and form of the torso, and the foot block are made of eighteen pieces of shaped wood that are attached to the base structure. With the exception of the foot-block, all pieces are secured with wooden dowels. The dowels are slightly odd shapes when viewed in cross section, which enhances their holding capacity (fig. 4). There is no evidence of an adhesive used in the ancient joinery.



Figure 4 Sample images of dowel ends

The bottom 10.0 cm of the proper left (hereafter PL) side and the front of the base structure has been removed to accommodate the foot block (fig. 2). The proper right (hereafter PR) side was retained and extends through the foot block to the bottom surface of the object, although 2.0 cm have been roughly cut off, again, to accommodate the foot-block.

The interior is hollowed and roughly defines the shape of the body, consistent with the structure of anthropoid sarcophagi from earlier dynasties through the Ptolemaic period (fig. 5).

There are chisel marks over the surface and no interior coating or evidence of interventions.

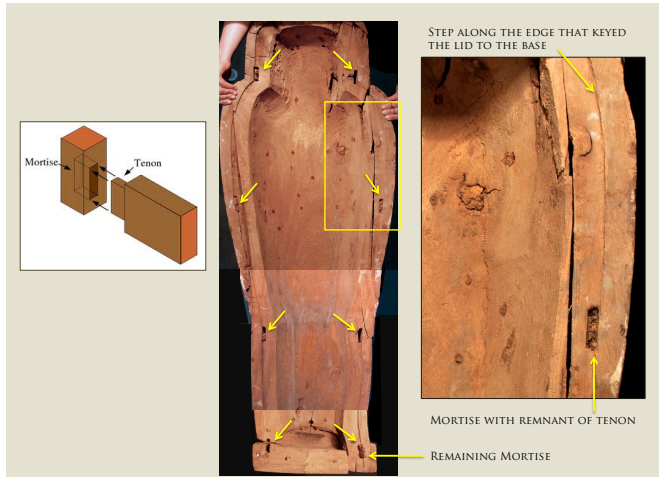


Figure 5 Yellow arrows in the center image indicate the mortise and tenon joints. Arrows on the right hand image indicate the stepped edge of the lid.

The edge is stepped to fit to the now missing bottom or trough, and there are eight mortise and tenon joints spaced evenly around the edge

that secured the lid and trough together.

The materials and the application of the surface layers are consistent with documented ancient Egyptian practices for the manufacture of polychrome sarcophagi (Lee and Quirke 2000, 116-117)(Stein and Lacovara 2010, 7) (Watkinson 1995, 37). A brown granular paste-like material with plant fibers is applied directly to the wood as a base for the gesso layer and paint layers (fig. 6,a). Localized textile layers were applied over the granular base to support the paint layer over transitions where the wood components abut and where irregularities in the wood were filled with compensation materials (fig. 6,b and c).

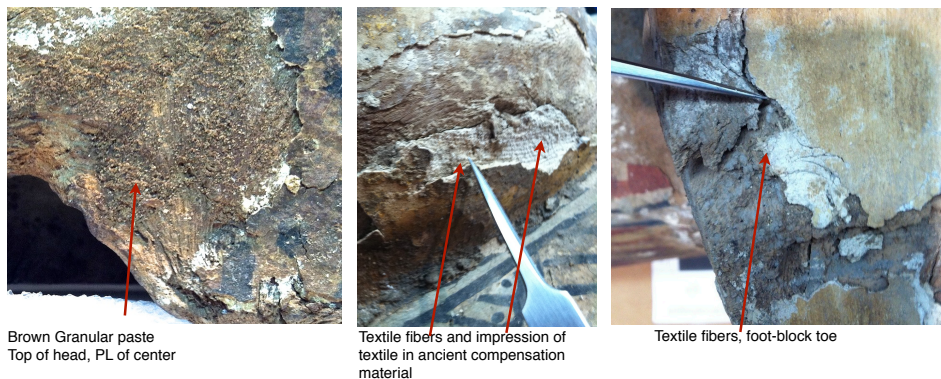


Figure 6 a,b,c

The gesso and pigments were analyzed using complimentary destructive and non-destructive methods. These are described in the appendix.

Non-destructive analytic techniques

Visible Induced Infrared Luminescence Spectroscopy (VILS), Infrared Reflectance Imaging (IR), Ultraviolet-induced Visible Fluorescence (UV), X-radiography (X-ray), Portable Energy Dispersive X-ray Fluorescence Spectrometry (XRF).

Destructive analytic techniques

Powder X-ray Diffraction (XRD), Polarized Light Microscopy (PLM), Fourier Transform Infrared Spectrometry (FTIR), Gas Chromatography Mass Spectrometry (GC-MS).

The ancient gesso layer is primarily calcite with quartz and gypsum. Both the paint and gesso layers are water-soluble. GC-MS was used to analyze a small set of binders. Both animal protein and plant carbohydrate based substances have been identified and these are consistent with ancient use (Newman and Serpico 2000, 476). Joy Mazurek at the Getty Conservation Center carried out the GC-MS analysis.

The palette of ancient paints is consistent with known Egyptian practice (Lee and Quirk 2000, 108-116) (Taylor 2001, 164-176) (Lukas and Harris 1962, 338): blue, pale blue, green, red, orange-red, yellow, black and white. Colors and pigments are listed in table 1. below.

Table 1. Ancient Palette		
Color	Identified Pigment/Colorant	
Blue	Egyptian Blue	$\text{CaCuSi}_4\text{O}_{10}$
Green	Atacamite (Deterioration product of malachite)	$\text{Cu}_2\text{Cl}(\text{OH})_3$
Red	Red Ochre, Hematite	Fe_2O_3 ,
Red/Orange	Realgar	As_4S_4
Yellow: Face, wings, figures	Orpiment,	As_2S_3
Yellow: Sides	Yellow Ochre, Goethite	$\text{FeO}(\text{OH})$
Black	Carbon Black	C
White	Calcite	CaCO_3

All blue on the object is the synthetic pigment, Egyptian blue: cuproriviate or calcium copper tetrasilicate ($\text{CaCuSi}_4\text{O}_{10}$), and residual glass and quartz (fig.7). The technology to manufacture Egyptian blue was developed in ancient Egypt or Mesopotamia and the first documented use in Egypt is dated to approximately 2600 BCE (Daniels 2004). The technology

was lost by the ninth century CE (Lee and Quirke 2000, 111), which provides a terminus post quem for objects on which it is present.¹

The green colorant has been identified as atacamite, using FTIR (fig. 8). This is understood to be a deterioration product of malachite (Scott 2011, 34-36).

The yellows are the arsenic sulfide, orpiment (As_2S_3), (fig. 10 and 11) and hydrated iron hydroxide [$\text{FeO}(\text{OH})$] which is also known as Goethite or yellow ochre. Use of orpiment on Egyptian sarcophagi is dated to the 12th dynasty (1900 BCE) and there are documented examples of the use of orpiment throughout the Ptolemaic period (Lee and Quirke 2000, 110-111). Yellow ochre is found on objects from early dynastic periods through Ptolemaic period (DiStefano 2011) (Lee and Quirke 2000, 115).

The bright orange-red pigment, the arsenic sulfide, realgar (As_4S_4) has been observed only on the foot block, and identified using XRD analysis and microscopic observation. The red paint on the object is uniformly red iron oxide, or red ochre and hematite (Fe_2O_3) (fig. 9).

The blacks were most effectively identified using PLM, and all are consistent with charcoal including the over-paint on the lappets. The particles of the ancient black have characteristic sharp angular edges. The black sampled from the PL lappet and from a restoration have a distinctly softer profile that has been associated with modern mechanically ground pigments (Scott 2013)(Winter 1983). Gesso serves as white and there are bright white details that may be a more finely ground gesso or calcite (fig. 12). The absence of magnesium eliminates the possibility that this bright white could be the magnesium calcium carbonate, Huntite ($\text{CaMg}_3(\text{CO}_3)_4$) which has been identified on 3rd century BC funerary objects (Pages-Camagna and Guichard 2010, 26).

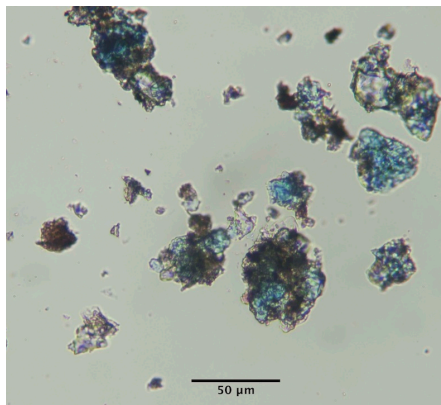


Figure 7 Egyptian Blue (PR Side)

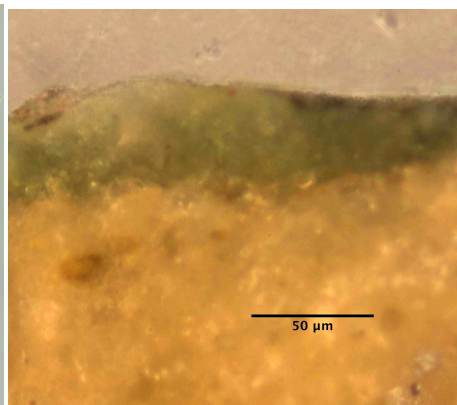


Figure 8 Green Paint, cross section (Torso)

¹ Use has been discovered on occasional later objects but not as a common colorant.

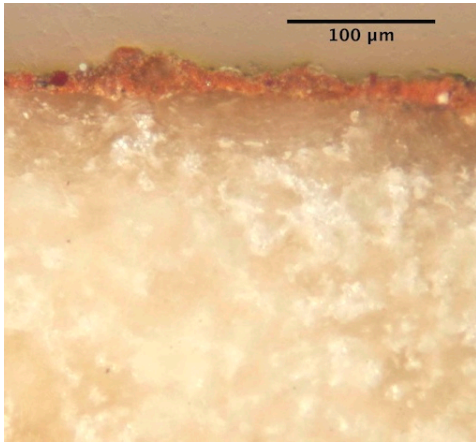
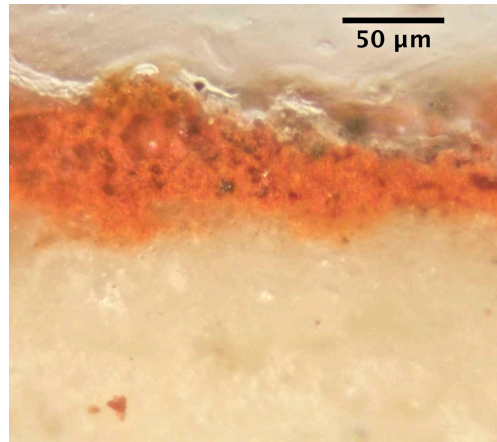


Figure 9 Ancient red heterogeneous red particles



Modern red homogeneous red particles and quartz

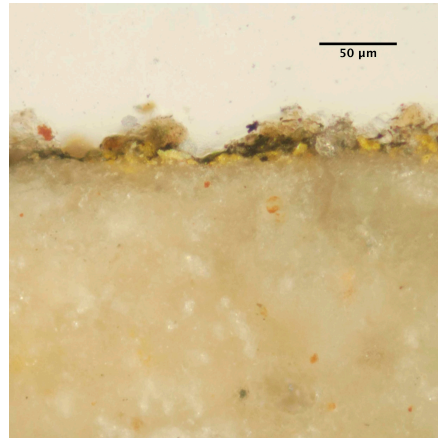
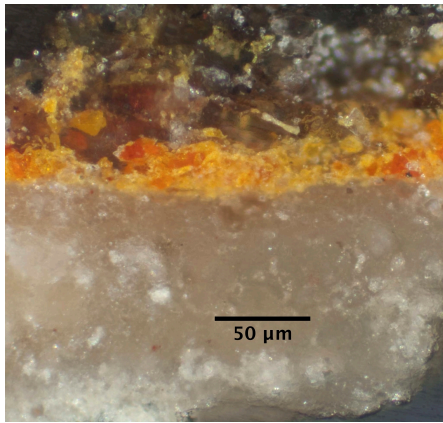


Figure 10 (l) Orpiment from the face with coating layer above and calcite rich ground beneath (r) orpiment on the wing of the goddess Nut.

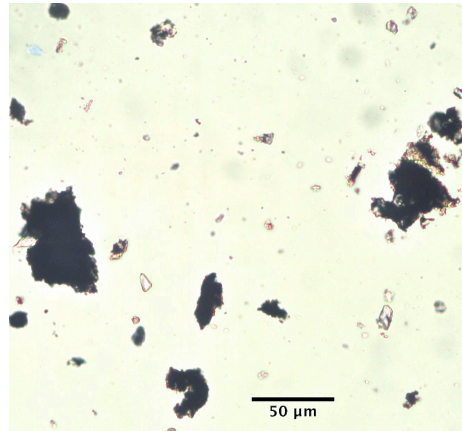
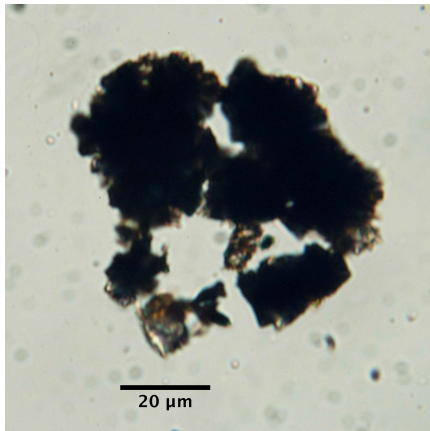


Figure 11 Left: Soft edged charcoal particles of modern black. Right: Sharp edged charcoal of ancient black.

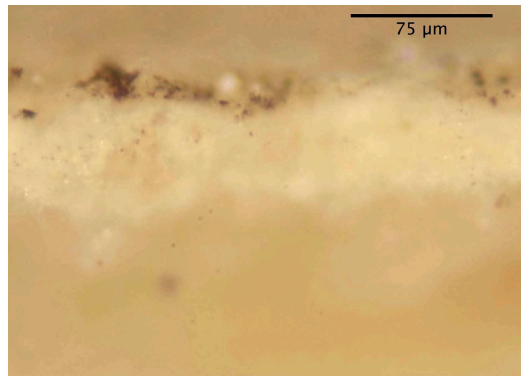


Figure 12

The iconography on this coffin is consistent with traditional Egyptian funerary practices (Cooney 2012) (Corcoran 2013) (Taylor 2001, 2014-17). The text is somewhat nonsensical, which was common from the 21st Dynasty through the Ptolemaic period. The Ptolemaic Period extended from 332 BCE to 30 BCE (Ikram and Dodson 1998, 11-12). This period commenced with the conquest of Egypt by Alexander the Great and during this time Egypt became a globalized society in which Greeks, not Egyptians, were the political and social leaders (Cooney 2012). The Ptolemaic period concluded with the death of Cleopatra VII and the commencement of Roman rule.

The degree to which Egyptian beliefs and religious practices were retained or diluted during this period is a challenging topic for scholars but may provide an explanation for the less rigorous use of text on this object. It certainly doesn't disqualify its authenticity (Ikram and Dodson 1998, 50) (Cooney 2012)(Corcoran 2013).

The diminutive size of the sarcophagus, measuring 129.5 cm from the head to the foot, is taken as an indication that it was made for a child. The figure wears a vulture headdress that is characteristic of females. (Fig.13)

Children were rarely provided with such expensive funerary furniture. Cooney (2012) has suggested that the expense of a sarcophagus would only have been justified if this child had entered adult society and this was most probable for a female who would have gained status beyond her chronological years through marriage.

The lappets of women are usually depicted as blue (Cooney 2012)(Greco 2013). Although the lappets on this object are painted black, XRF analysis and VILS imaging (fig.14), as well as observation under magnification have identified the remains of an over-painted blue layer. The black paint is believed to be a modern application indicating black is not the ancient color of the lappets.



Figure 13 Headdress outlined in yellow and modern restorations shaded in red (right)

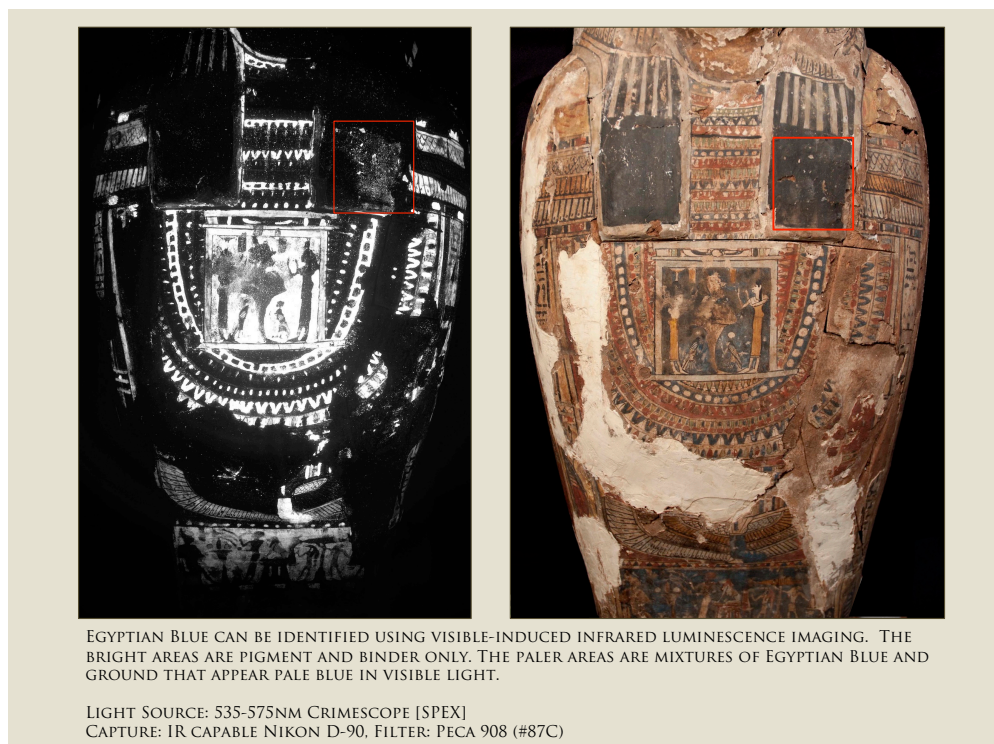


Figure 14

The rectangular image below the lappets imitates a pectoral, a type of jewelry consisting of a framed image (fig. 15 upper left). It depicts Osiris flanked by his sisters Nephthys and Isis, who was also his wife, which was a common motif, particularly on Roman coffins (Corcoran, 2013). Below the pectoral is the goddess Nut with outstretched wings (fig. 15 middle left),

protecting the deceased into the afterlife. The two images panels immediately below the winged goddess (fig. 15, lower left) depict the weighing of the heart of the deceased and the embalming of the deceased from the Egyptian Book of the Dead (Taylor 2001) (Cooney 2012)(Corcoran 2013).

The vertical elements on the leg may depict the entrance to the netherworld (fig. 15, center) (Bettum 2012) and the recumbent animals on the toe are Wepwawet jackals that lead the deceased to the afterlife (fig.15, bottom center)(Corcoran 2013)(Bettum 2013). All of these images are consistent with ancient practice (Taylor 2001, 31-38)(Corcoran 2013).

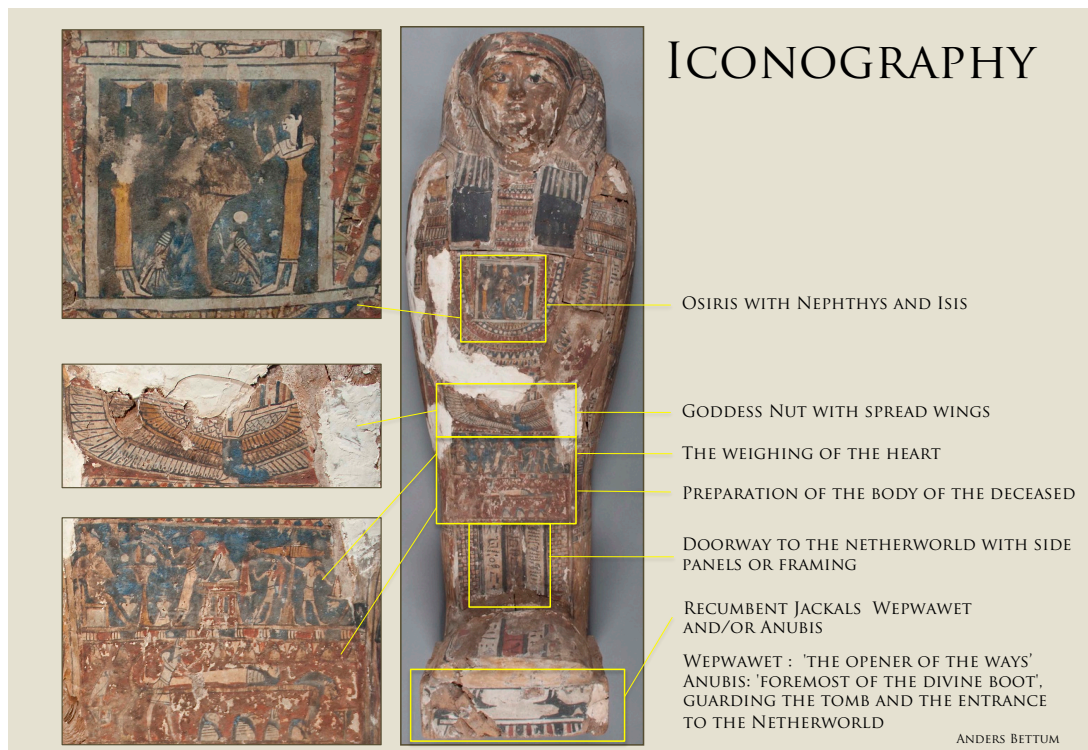


Figure 15

There are anomalies to the materials and processes just describe that provide compelling evidence that the face block and the foot block have been taken from other coffins and reused in the construction of this object. The evidence also suggests that these were incorporated at different times with different intentions: the face, an ancient component serving funerary needs, and the foot-block a modern one added to complete the form for the antiquities market.

The face is carved into a block that is secured onto the base structure (fig.16). It extends 31.75 cm from the top of the head to the top of the chest and includes the PR but not the PL ear.

The block is 12.7 cm thick at the top of the head. The green area in the right hand diagram is an estimate of the thickness of the wood inset behind the face that cannot be observed.

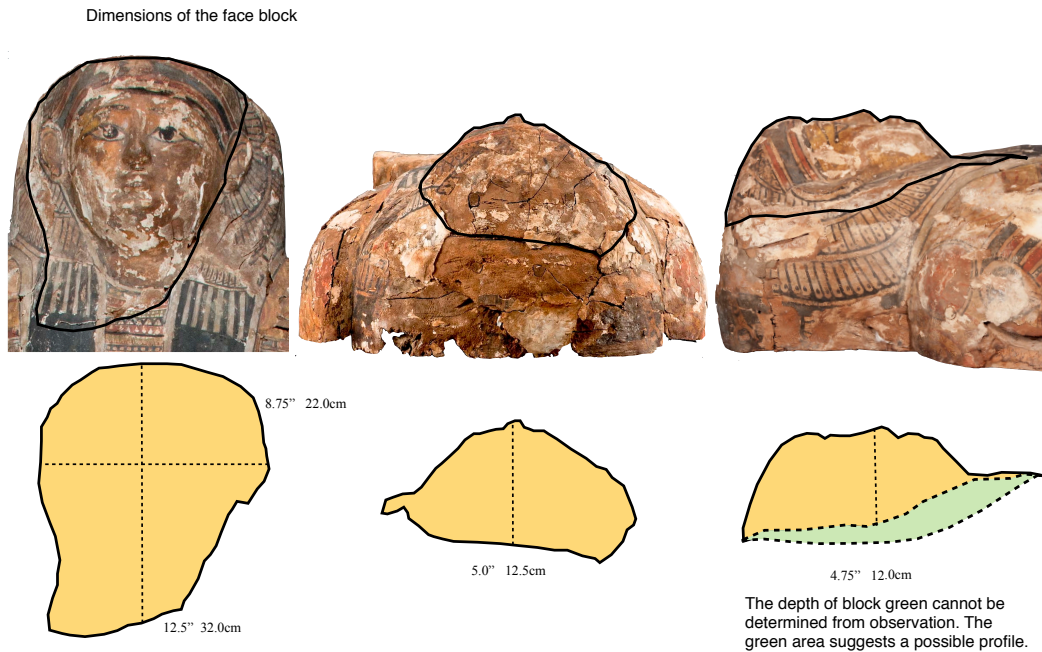


Figure 16 Face-Block dimensions: front (l), top (m) and side (r)

Distinctive characteristics of the face block- that combine to suggest reuse are the following:

- Fine carving of the facial features
- Difference in the substrate of the gesso layer on the face
- Pigment layer and coating on the face
- Integration of the face block into the sarcophagus structure

The facial features are finely carved and this is the only place on the object that exhibits this level of craftsmanship.

The face has lost approximately 40% of the polychrome surface, exposing the gesso layer beneath. There is no evidence of the grainy brown base layer described previously that is clearly visible in loss areas on all other parts of the object.

The face was colored vivid yellow with orpiment, or arsenic sulfide that is covered with an obscuring brown coating. This coating is restricted to the painted surface possibly indicating that it's ancient and now discolored- although it has not yet been identified.

During this period the Egyptian gods were believed to have skin made of gold, and presenting the dead with gold skin allied them with the deities. Because of its golden color and sparkling quality orpiment was commonly used to color the faces of sarcophagi, possibly in lieu of more expensive gold leaf.

Identification of arsenic and sulfur using XRF together with macroscopic and microscopic observation indicate that orpiment is the colorant of the yellow of figures on the chest and the yellow decorative feather bands (fig.10 r). These applications of orpiment are distinguished from the application on the face by the muted yellow. Also, the figures are an even somewhat saturated coloration and the feathered bands somewhat matte and neither has an obscuring coating.

Overall the face block appears integrated into the object but losses along the PL and PR sides reveal gaps between the face block and the base structure, in contrast to the close fit joints evident on the torso (fig. 17). The observed gaps are the result of irregularity in the wood or fungal rot of the wood.

The gap on the PL side of the face at the cheek reveals a deep space that is not attributable to shrinkage, movement, or irregularities in the wood. The remaining fill material in this space appears to be ancient. On the PR side of the head, the gap between the face block and the base structure is filled with a carefully shaped piece of wood.

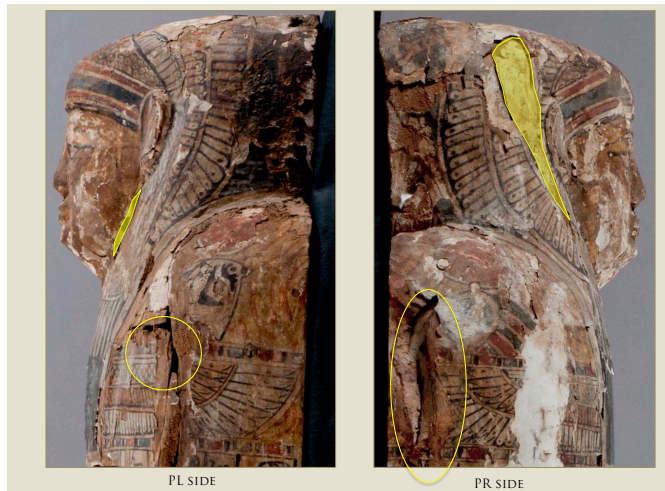


Figure 17 Shaded areas indicate the gaps between the face block and the base structure. The yellow ovals indicate gaps that result from damage or irregularities in the wood.

X-ray imaging identifies a void behind the face along the PL side (fig.18). A void behind the PR side of the face can be probed through a gap in the base structure assessable only on the interior of the head.

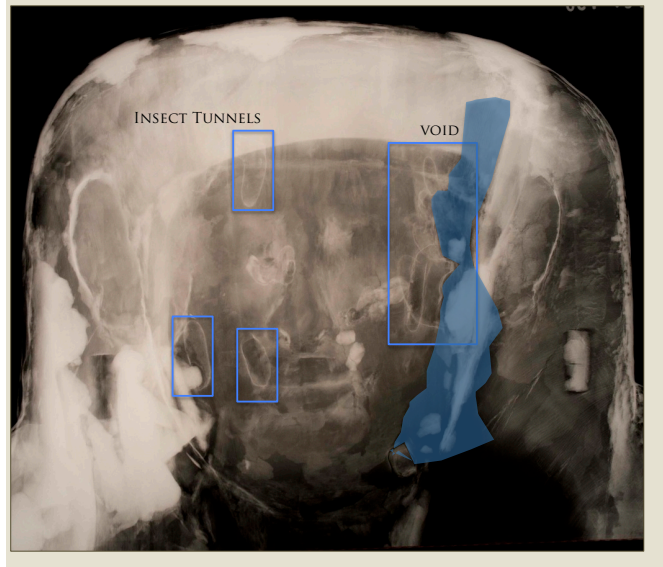


Figure 18

A shaped wood piece is fit flush into the top of the head and abuts the back edge of the face block. It is secured with two dowels (fig. 19). This piece obscures the void between the face-block and the base. Also two empty dowel holes can be observed on the interior surface next to the two dowels that secure this piece in place, suggesting there was a prior configuration of attached pieces in this area at some point.

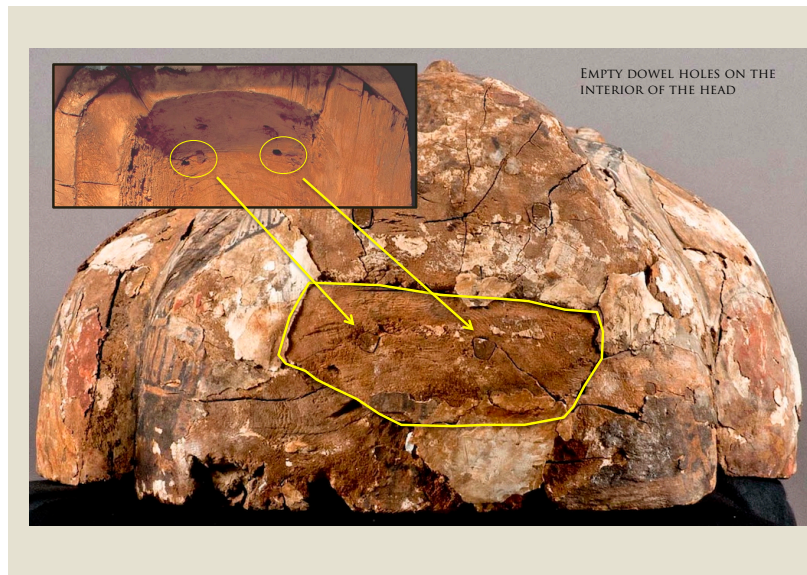


Figure 19

Insect tunnels are identifiable in x-ray imaging (fig. 20) and can be seen concentrated in the head block but absent from the adjacent areas of the base structure. The majority of these

tunnels emanate from the void area to the PL. The apparent preferential infestation of the face block suggests that this damage occurred before the wood was applied to this sarcophagus.

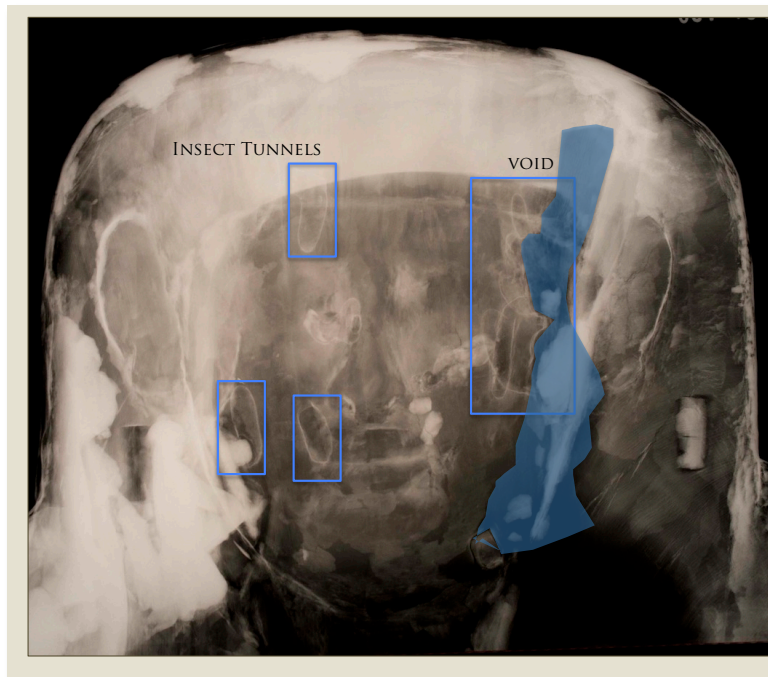


Figure 20

Collectively these factors indicate that although the face block is carefully integrated into this object it is not shaped specifically to fit this structure and modifications were required to conform it into a visually cohesive object. This accommodation is believed to be evidence of reuse.

The tremendous expense and elaborate ritual associated with death did not protect these material remains even in ancient Egypt. It is important to recognize that tomb robbery was widespread and documented in ancient writings such as the Abbott Papyrus that describes penalties for tomb robbery (Capart 1936, 169)(Ikram and Dodson 61-64)(British Museum). Also, as Dr. Cooney has explored in her scholarship, repurposing of coffin parts was widely practiced in Egyptian antiquity (Cooney 2012). The considerable cost of purchasing a coffin certainly contributed to these related “industries” which are reflected in modern repurposing as well.

The foot-block is the second component of this object that shows significant evidence of reuse, in this case modern. The term “modern” refers to the post excavation period, which is assumed to be the middle to late 19th century to the present.

The structure describes a simplified foot on a low pedestal consistent with similar sarcophagi from the Ptolemaic period but several aspects indicate reuse:

- Construction of the foot,
- Attachment to the sarcophagus
- Surface treatments

The foot block is a complex assemblage of multiple pieces (fig.22). These pieces are attached together with a modern polymer adhesive that is visible along the joins. It is evident from the shape that one major component (fig. 22, no.16) was removed from the side of a similar style wooden sarcophagus but one with different dimensions. The step on the edge of this piece is narrower, shallower, and out of alignment with the step along the edge of the rest of the object (fig. 23, B).

The mortise at the PL bottom corner spans two pieces of wood, which renders it dysfunctional (fig. 23, A). There is an empty dowel hole and two dowel holes with cut off, non-functioning dowels, at the bottom edge of the base structure indicating a different attachment at a prior time (fig. 23 and fig. 24 red rectangles). In general the cuts and joins of all elements of the foot block are rough unlike the careful joinery seen elsewhere on the object.

The modern metal screws identified in the X-ray imaging (fig. 24) are clearly a modern intervention and provide further evidence that the foot-block is a modern construction. Although the screws could have been used to reattach an original ancient foot, the removal of part of the base structure, the composite construction, and the use of modern adhesive provide a context of modern construction.

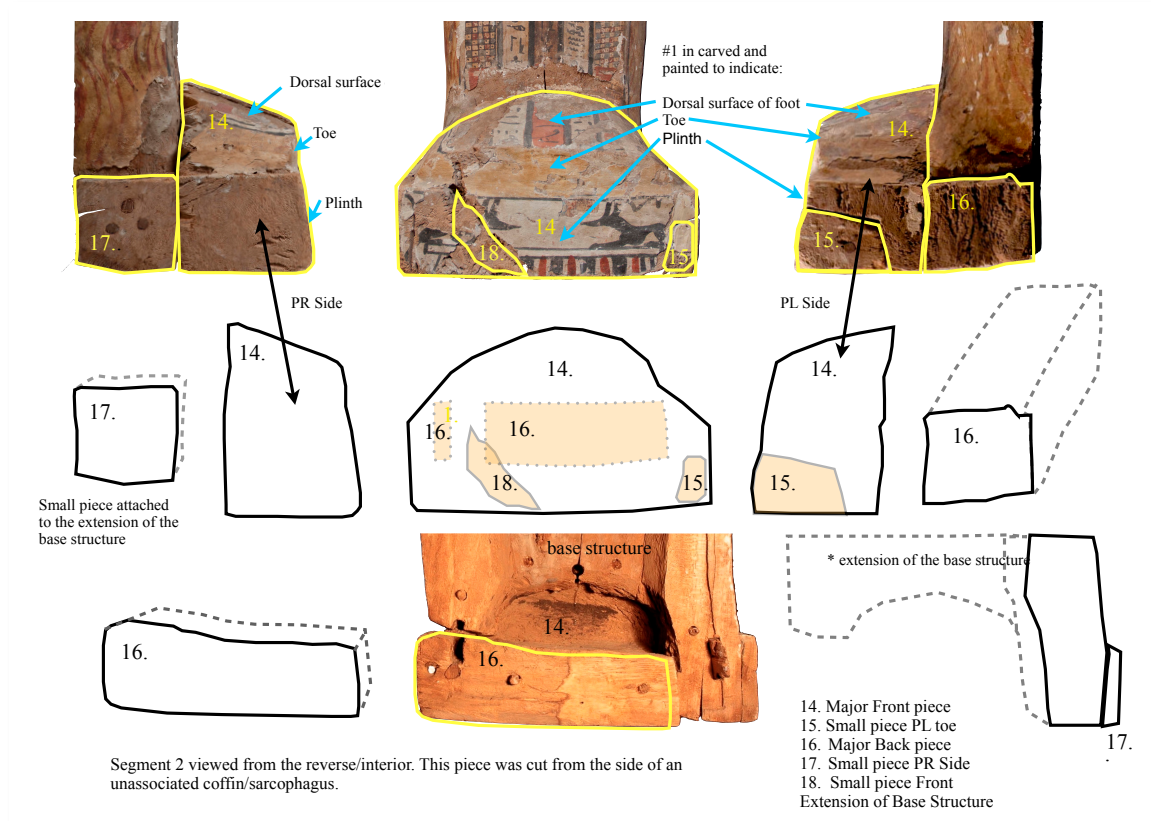


Figure 21

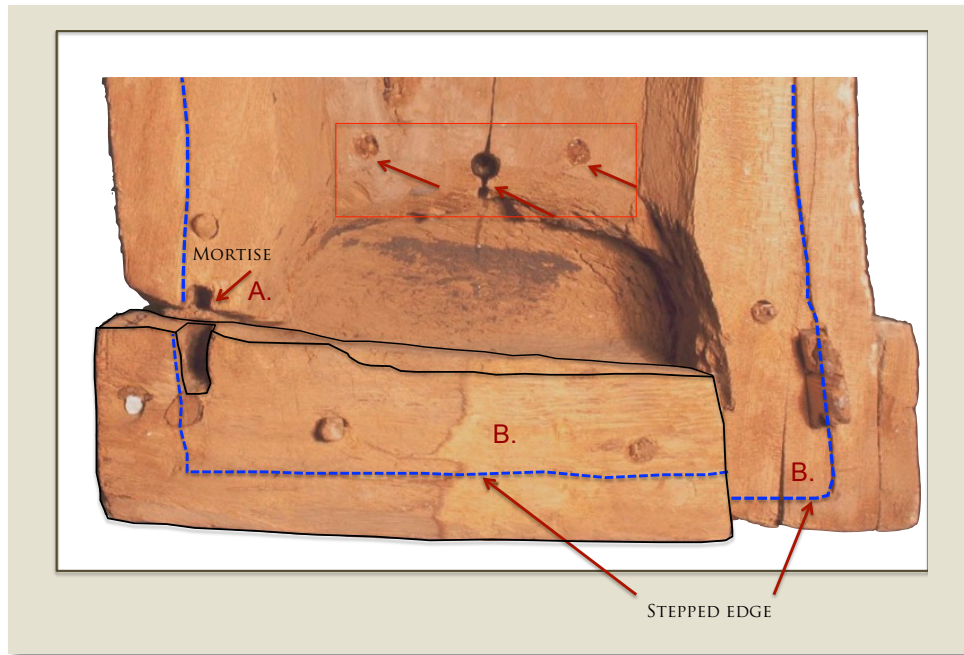


Figure 22

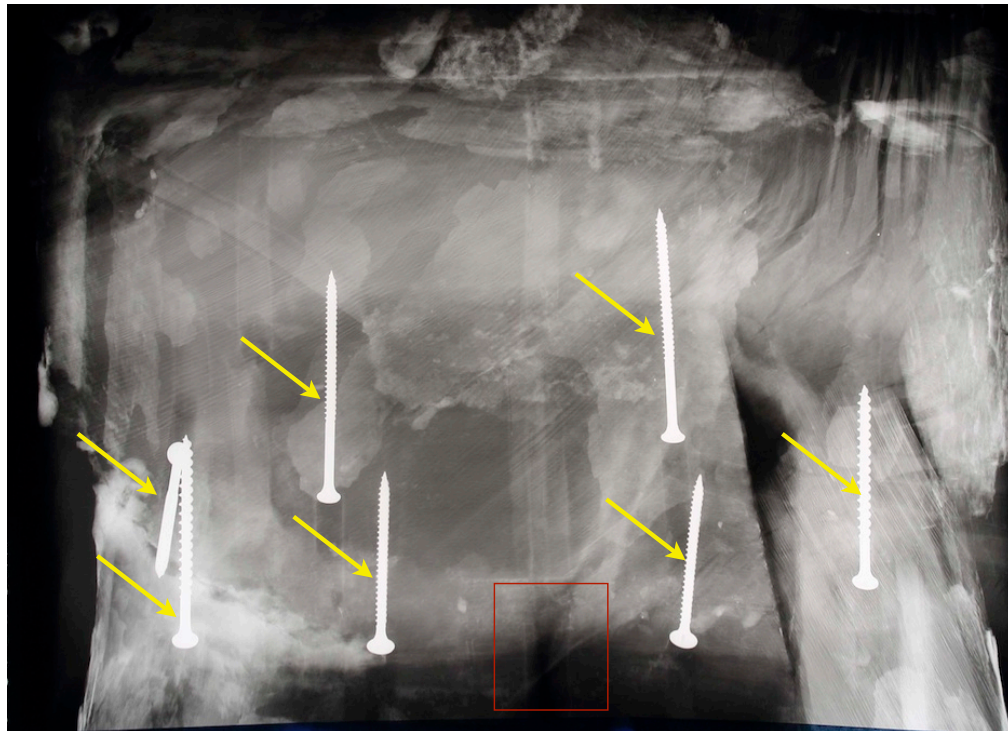


Figure 23 X-radiographic image of foot-block with seven modern screws. The red rectangle identifies the partially removed empty dowel hole.

Aspects of the surface and paint layers of the foot block corroborate a thesis of the modern reuse of ancient parts. There are only traces of any surface layers on the sides while the rest of the sarcophagus has an applied layer overall. This can be observed in figure 25, below. Also there are two paints layers on the top surface, which is unique on the object (fig. 24 right, C.).

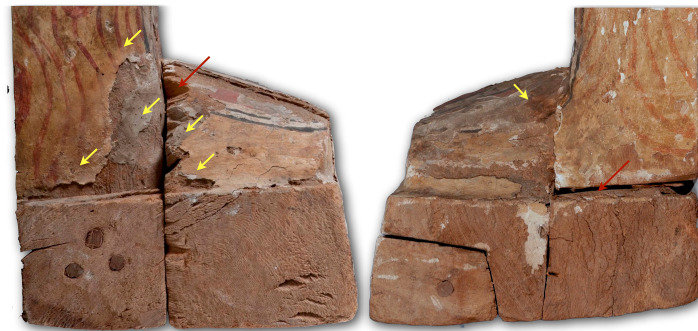
Pigments visible on exposed areas of the under-layer have been identified in analysis as red ochre, realgar, and Egyptian Blue (fig. 24 left, A.) .The presence of the Egyptian blue makes a strong argument for the ancient origins of this under-layer of polychrome and this piece of the foot block. The outer polychrome layer has only red and black details and no indication of characteristically ancient pigments. Although the gesso layers are not diagnostically distinct in XRD analyses the outer gesso layer has a rougher appearance.



(L) A. Egyptian blue on under-layer, B.Red on under-layer, C. Realgar on under-layer (R) D.Two paint layers, Yellow rectangle: limited palette of the outer layer

Figure 24

Finally, the roughly executed join of the foot block to the base structure created a wide gap that required extensive compensation material and surface coatings. There are residues of three failed modern campaigns (fig. 25). These multiple campaigns were carried out in a manner that is inconsistent with those exhibited in the ancient manufacture of this object.



Yellow arrows indicate failed compensation and coating materials Red arrows indicate gaps between the base and foot-block

Figure 25 Examples of compensation materials (yellow) and gaps in structure (red)

Conclusion

Examination of the face block paint, deterioration and attachment to the base structure provide compelling evidence that the ancient construction was included elements that had been “repurposed” from older sarcophagi. The fill materials, the over-layer of paint, the modern methods of attachment and the combination of disparate parts all support an argument that *this old foot* is a modern addition and that creative recombination was employed to make a whole out of parts to suit the needs of the antiquities market.

These examples of reuse bookend the temporal span of interventions that determine the nature of this object. These additions were determined by the values and economics of these two eras, far apart in time and close in motivation.

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Appendix I

Methods of Pigment analysis

Non-destructive forensic imaging techniques

VILS Visible Induced Infrared Luminescence Spectroscopy

This forensic imaging technique is used to identify regions painted Egyptian, including those that may no longer be discernible. The Cu^{++} ion in the Egyptian blue emits a diagnostic luminescence or fluorescence² in the infrared region of the electromagnetic spectrum around 950 nm when it is stimulated with visible light, which is between 400-700nm (Verri).

A Mini Crimescope® (Spex) was used to illuminate the object at between 500 and 600 nanometers. Photographs were taken with a Nikon D90 digital camera with UV and IR spectrum sensitivity and a Nikkor 16-70mm lens with a PECA 908 (#87C) filter to capture between 800 and 900nm (Kakoulli 2012).

IR Infrared Reflectance Imaging

IR (above 700 nm) is more penetrating than UV or visible light and has been used to identify highly absorbent carbon materials under the surface layer, notably carbon based under-drawings. IR images were captured with a Nikon D90 with UV and IR spectrum sensitivity and a Nikkor 16-70mm lens with a PECA914 (89B) filter.

UV Ultraviolet-induced Visible Fluorescence

Some materials exhibit a characteristic fluoresce in the visible light range of the electromagnetic spectrum (400-700 nm) when they are exposed to long-wave ultraviolet light in the 300 to 400 nm range. Coatings, resins and adhesives

Observation and imaging was done to identify qualitative differences in surface materials using a hand held UV light source (365nm), and with a Mini Crimescope® (Spex) to illuminate the object in the 300-400 nm wavelength range of the electromagnetic spectrum. A Nikon D90 and a Cannon Rebel IOS T4 were both used during the project.

X-ray X-radiography

X-ray imaging can identify structural components including individual wood elements and dowels, and metals. Jeffrey Maish, associate conservator at the Getty Villa, performed the x-radiography.

Non-destructive analysis

p-XRF or ED-XRF Portable Energy Dispersive X-ray Fluorescence Spectrometry

XRF analysis is used to identify inorganic elements by inducing and measuring signature x-radiation energy. The analysis was carried out using a Bruker Tracer III unit with a rhodium analyzer detects elements between sodium (11 on the periodic table of elements) to Uranium (92).

Approximately seventy pXRF analyses were carried out to acquire consistent results. Reference analysis of a clear methyl methacrylate (plexiglass) blank indicated the presence of chlorine, and small peaks of calcium, iron and copper. Rhodium analyzers have been found to falsely indicate presence of strontium when calcium is a major element in a sample. In this case the calcite ground is present over all parts of this object and strontium peaks are attributed to this.

(Walton)(Muros). Iron is identified in all spectra.

Destructive analysis

XRD Powder X-ray Diffraction

X-rays generate characteristic diffraction patterns of crystalline structures to identify compounds as well as elements. A Regaku R-Axis Spider X-Ray machine to collect Debye-Scherrer rings of samples collected from all colors. Samples were placed on a glass spindle with Apiezon grease. The base line was corrected and MDI/Jade v8.2 software was used to compare the spectra with ICDD data (International Center for Diffraction Data). David A. Scott and Vanessa Muros carried out the XRD analysis.

PLM Polarized Light Microscopy

Plane and cross-polarized light observation can identify organic and inorganic materials by a number of known qualities and measurements.

Ninety-nine dispersion samples and fifteen cross section samples where prepared.

Olympus BH-2 Microscope.

FTIR Fourier Transform Infrared Spectrometry

Infrared absorption patterns identify molecular bonds to generate characteristic spectra.

Herant Khanjian, scientist at the Getty Conservation Institute carried out micro-FTIR analysis of two materials, the exudates and the green pigment. Analysis of paint and gesso samples has been carried out by the author using a Nicolet *is* FTIR spectrometer with a diamond ATR.

GC-MS Gas Chromatography Mass Spectrometry

Identifies organic compounds such as resin and waxes by separating and identifying the components. Joy Mazurek, scientist at the Getty Conservation Institute carried out GCMS analysis of several samples.

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