Analysis of an Egyptian Sarcophagus Fragment

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The object:

This section of a painted Egyptian sarcophagus, assumed to be an edge piece from the lid of an anthropoid sarcophagus, was brought to the Art Conservation Department for study. The segment consists, from top to bottom, of a painted layer, a thin ground layer, a balanced plain weave textile, a thick ground layer, and a wood base. The proposed date of the object is New Kingdom, 20th dynasty (1185-1070 BCE; Superior Coin and Stamp Company Catalog).

Sarcophagus fragment, normal illumination

The objectives:

The fragment was analyzed using a range of destructive and non-destructive analytical techniques. Methods used to characterize the pigments, ground, textile, and wood included polarized light microscopy (PLM); imaging techniques including infrared luminescence, x-radiography, and multi-spectral imaging; scanning electron microscopy – energy dispersive spectroscopy (SEM-EDS); Raman spectroscopy; and X-ray fluorescence (XRF).

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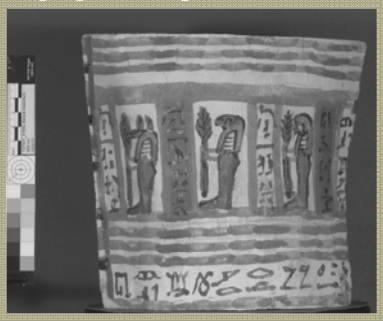
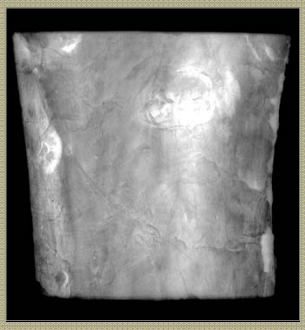
Information from Imaging Techniques

Multispectral imaging (in the IR) showed the presence of an underdrawing. It can be seen in the outlines around the multi-colored bands and marking a beard on the human figure. The underdrawing appears to have been done in a blue or dilute black pigment. Underdrawings were typically done with brown or red pigments, which renders the use of black pigment here unusual.



X-radiography revealed the textile. As is characteristic in Egyptian sarcophagi, several patches of linen were used to line the wood.



Infrared luminescence confirmed the presence of Egyptian blue pigment, (cuprorivaite, $CaCuSi_4O_{10}$). The pigment is known for its singularly intense luminescent emission qualities in the 800-1,000 nm range. The brightly luminescing areas are the borders around the figures and the striped bands.

Pigment Identification

Yellow pigment:

XRF detected high levels of arsenic and sulfur, the components of realgar, orpiment, and degradation products of these pigments. PLM analysis showed close similarities to pararealgar, the light-induced polymorph of realgar. Raman analysis corresponded closely with known spectra for realgar. Because pararealgar in often found in close association with realgar, it is likely that the yellow pigment contains both phases, **realgar (As_2S_2) and pararealgar (AsS)**.

Blue pigment:

PLM and XRF confirmed the infrared luminescence image identification of **Egyptian blue, $CaCuSi_4O_{10}$**.

Red pigment:

XRF analysis showed major peaks for iron, sulfur, and calcium. PLM showed similarities with iron-oxide red samples. Raman analysis was inconclusive. The red is likely **an iron-oxide based pigment**.

White ground and pigment:

PLM and XRF observations were consistent with the characteristics of **calcium carbonate, $CaCO_3$**.

Black pigment:

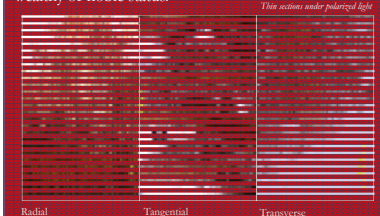
PLM and XRF suggest that the pigment is **carbon black**.

Green pigment:

As is typical among Egyptian pigments, the green pigment was the hardest to characterize. XRF and SEM-EDS analysis indicated the dominant presence of copper and minor presence of chlorine. Raman analysis was inconclusive. Characteristics noted in PLM did not correspond with any reference collection pigments. It is possible that the particles are copper chloride degradation products, **possibly atacamite or pseudomalachite**.

Wood and Fiber Identification

Thin sections of wood from the object were examined. The presence of vessel elements in the transverse section identified the wood as a hardwood species. The wood was unlikely to be imported, as imported wood tended to be of higher quality and thus used in sarcophagi for those of wealthy or noble status.



Thin sections under polarized light

Radial Tangential Transverse

Hardwoods native to Egypt include acacia (*Acacia sp.*), Christ's thorn (*Zizyphus spina-christi*), and sycamore fig (*Ficus sycomorus*). Key features in the sample were identified and then compared with known samples.

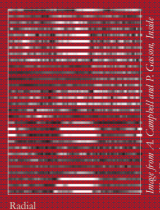


Image from A. Campbell and P. Gasson, Inside Wood Database

Radial

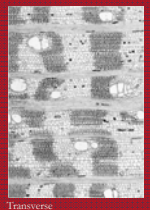


Image from P. Baas, Inside Wood Database

Transverse

Key features in the sample include multiseriate rays, axial parenchyma that are more than three bands wide, thick-walled fibers, tyloses, and ray pits in the vessels.

These identifying features, together with a comparison with known samples, suggest that the wood is likely sycamore fig (*Ficus sycomorus*).

Radial, *multiseriate rays*

Transverse, *tyloses and axial parenchyma*

Transverse, *ray pits in vessels*

Fiber sample under polarized light.

The characteristic nodes with V, X, and I markings identify the fiber as linen.

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Conclusions:

All materials used are consistent with those expected. Stylistically, the fragment appears to be from later than the given date, but still likely within the pre-Roman period. To give a more accurate assessment of the age, radiocarbon dating of the wood could be performed. XRD or other instrumental analysis may aid in the characterization of the green pigment.

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