

# Technical Analysis of a Third Intermediate Period Yellow-Type V Egyptian Coffin

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## Introduction

Within the collection at the Master of Art Conservation (MAC) program at Queen’s University, there are housed three Egyptian coffins that have been dated to the Third-Intermediate Period (c.1076-c.723 BC). One of these coffins (AA2190.A) has been identified as a “white” coffin from the 25<sup>th</sup> dynasty and as the rarer example, has been the subject of several research projects completed by past students. However, the coffin remains in multiple fragments, many of which are dissociated among fragments of the other two coffins in the collection, which have been identified as “yellow” coffins from the 21<sup>st</sup> dynasty. These “yellow” coffins have yet to be the subject of a research project undertaken by a Queen’s MAC student, therefore, the goal of this research project is to perform a full and thorough technical analysis of one of these “yellow” coffins (AA2190.B), to gain a better understanding of the materials used in its construction, and to document its condition.

## Experimental

Coffin AA2190.B is an anthropoid coffin composed of over 20 fragments. Five fragments were selected for analysis (fig. 1), taking care to ensure that the materials and techniques used in the construction of the coffin, as well as the overall condition of the coffin, were well represented. A number of non-invasive and micro-destructive analytical techniques were used, including portable handheld x-ray fluorescence spectroscopy (pXRF) for elemental information of the polychrome surface, Fourier transform infrared spectroscopy (FTIR) to identify the varnish and paint binding media, and polarised light microscopy (PLM) as well as scanning electron microscopy with energy dispersive x-ray spectroscopy (SEM-EDS) to identify the wood species. The pigments and the textile found within the mortise and tenon joints were also analysed via PLM



Figure 1. Fragments selected for analysis

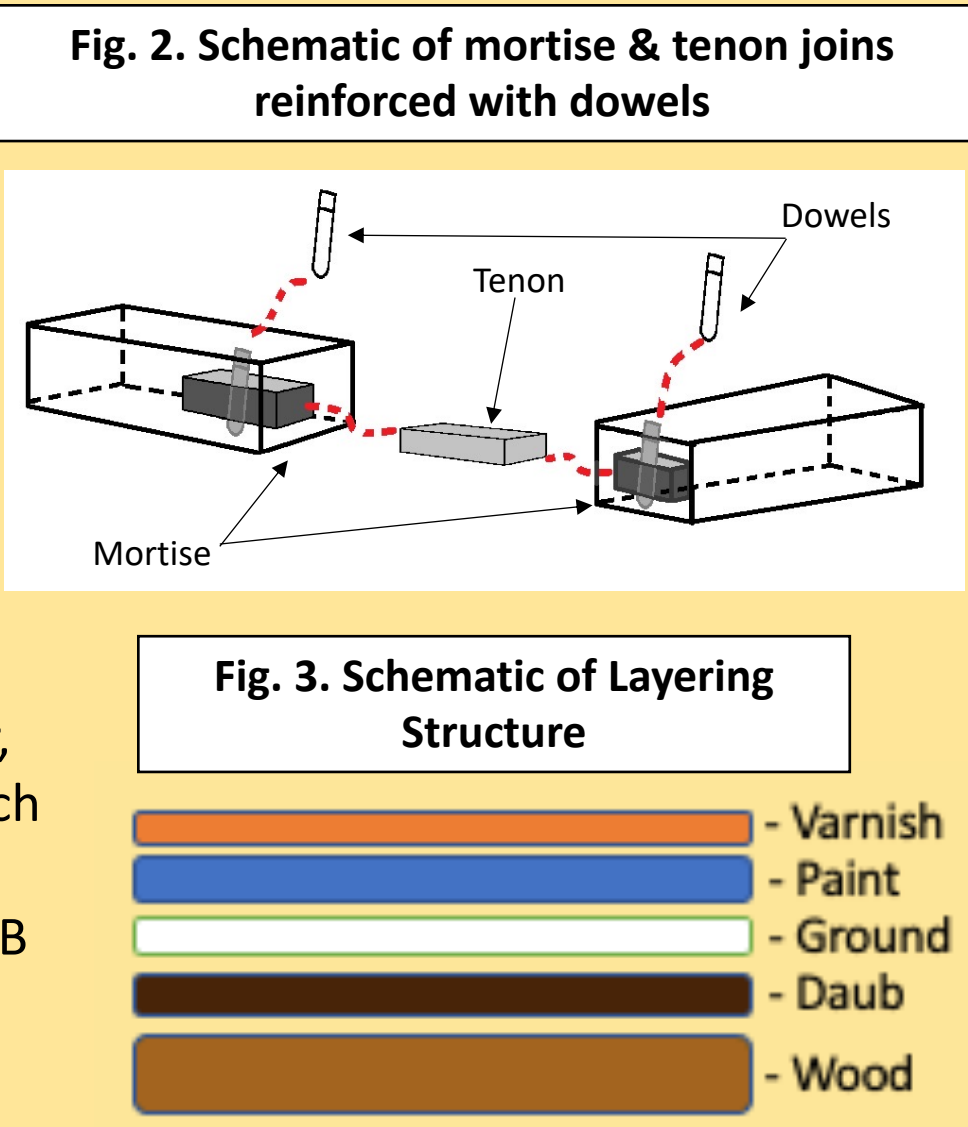
## Construction

### Method of Construction

Coffin AA2190.B has been constructed using multiple pieces of wood, secured together via a combination mortise and tenon joints, reinforced with wooden dowels (fig. 2). No evidence of adhesive was found within these joints; however, small sections of textile were found in several of the mortise joints.

### Layering structure

Coffin AA2190.B displayed a similar layering structure to that of the white coffin. The daub layer, which is a mixture of mud and organic materials such as straw commonly applied to wooden coffins to mask imperfections in the wood, on coffin AA2190.B however was unusually thick, ranging from 0.5-2.0cm. Coffin AA2190.B was also finished with a varnish, unlike coffin AA2190.A, the white coffin.



## Results & Discussion

### Materials Identified

#### Pigments

Colour	Elements identified	Pigment	Methods of analysis
Blue	Cu, Si, Ca, Sr	Egyptian blue	P-XRF, PLM, SEM-EDS
Green	Cu, Si, Ca, Sr	Egyptian green frit	P-XRF, PLM
Red	Fe, Ca, Sr	Iron earth	P-XRF, PLM
Yellow	Fe, Ca, Sr	Iron earth	P-XRF, PLM
White	Ca, C, Sr,	Calcite (calcium carbonate)	P-XRF, PLM
Black	C, Sr,	Carbon black	P-XRF, PLM

Egyptian Blue, which is composed mainly of Cuprorivaite ( $\text{CaCu}(\text{Si}_4\text{O}_{10})$ ), with lesser amounts of unreacted quartz ( $\text{SiO}_2$ ) and wollastonite ( $\text{CaCu}_3(\text{Si}_3\text{O}_9)$ ), can sometimes be hard to identify via PLM (fig. 11) because it is a multi phase material. Small cross sections were therefore made of the blue polychrome and analysed via SEM-EDS. Spectra were then collected from 8 different particles within the blue pigment layer (fig. 12), confirming that the pigment was in fact, Egyptian blue.

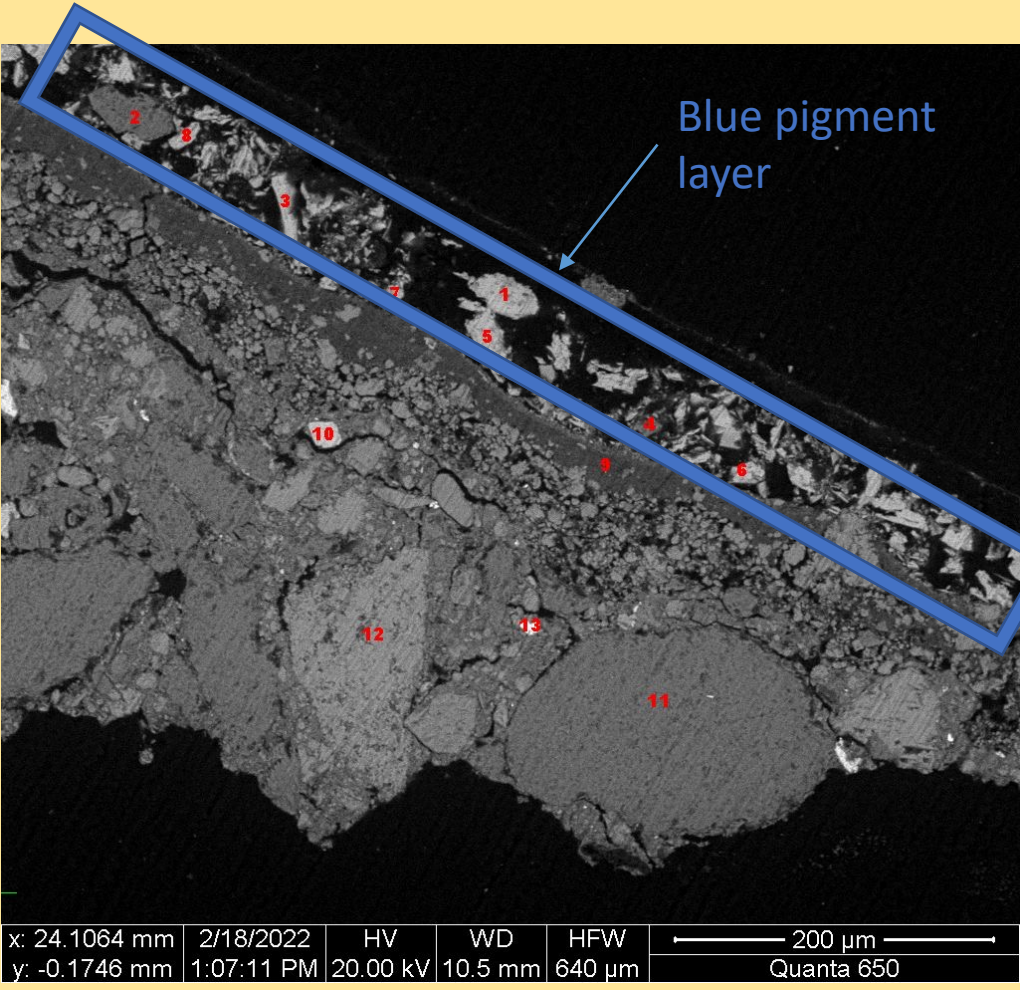
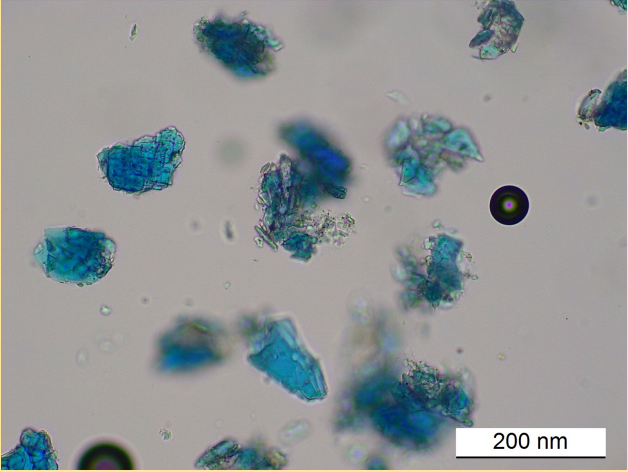


Fig. 11 (left) Blue pigment under PLM  
Fig.12 (above) Cross section of polychrome with blue pigment highlighted, showing number of particles analyzed via SEM-EDS

#### Wood Species

Identified as a hardwood via PLM (fig. 4 & 5) & ESEM (fig. 6), likely Acacia or Sycamore Fig, due to the presence of diffuse pores, abundant tyloses, and simple perforation plates.

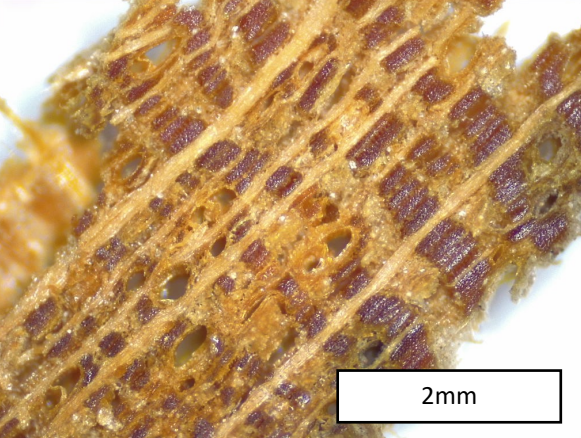


Fig. 4. Transverse section under PLM

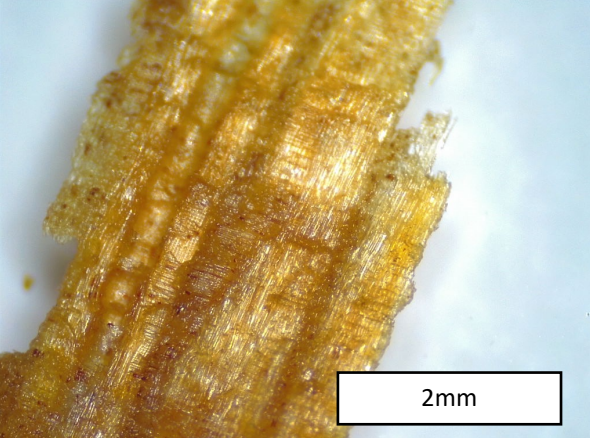


Fig. 5. Radial section under PLM

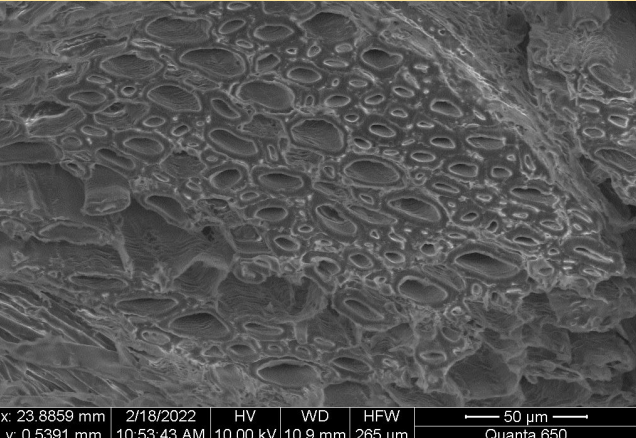


Fig. 6. Transverse section under ESEM

#### Ground

Coffin ground (red) was identified as calcite (calcium carbonate,  $\text{CaCO}_3$ ) via FTIR (fig. 7) & PLM.

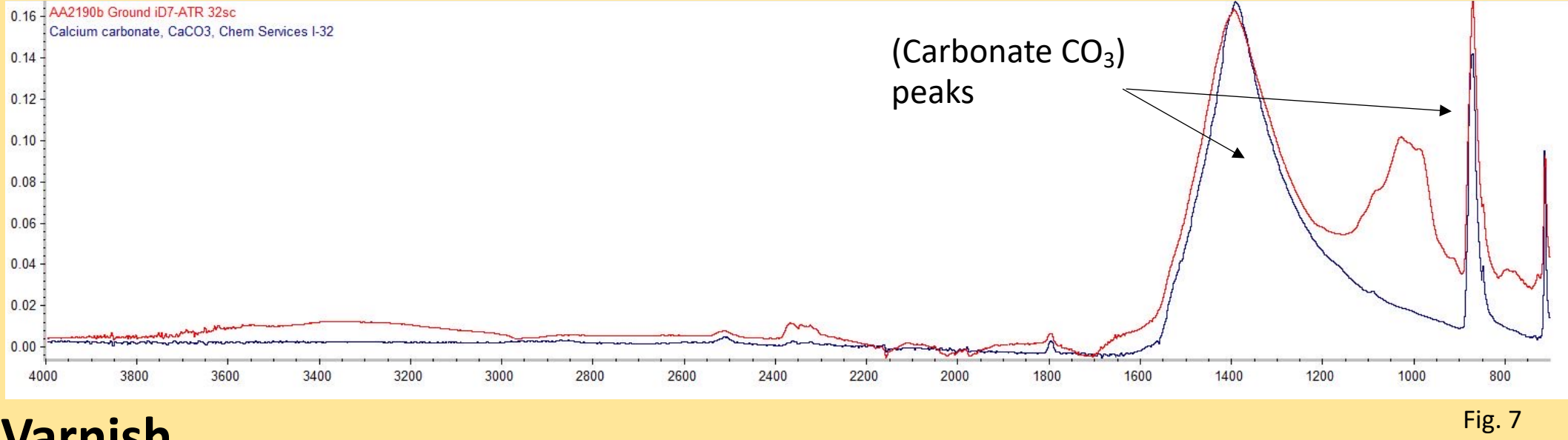


Fig. 7

#### Varnish

Coffin varnish (blue), was identified as a mastic resin via FTIR (fig. 8), comparable to *pistacia lentiscus* (red).

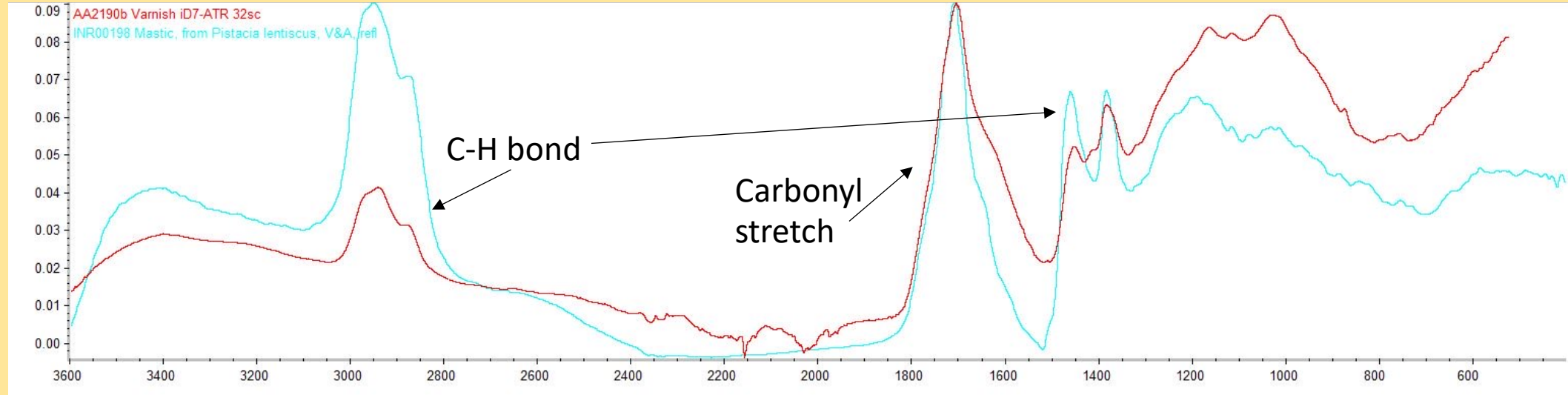


Fig. 8.

#### Textile (from interior of join)

Identified as linen (flax) based on presence of nodes seen under PLM (fig. 9), and discernable ‘S’ twist under XPL



Fig. 9. PLM

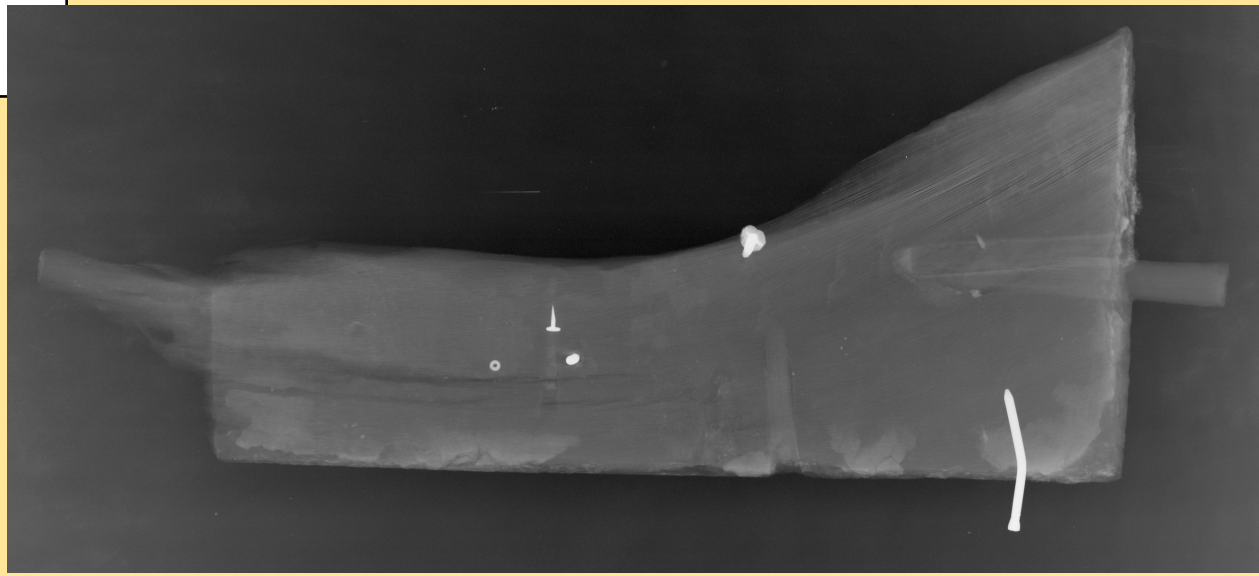


Fig. 10. Unmounted fiber - stereomicroscope

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### Previous Restoration Materials

While conducting a condition assessment on the coffin fragments, evidence of previous restoration work was discovered.



Several ferrous nails were found embedded in one of the fragments belonging to the base of the coffin (fig. 13), and large amounts of adhesive were also found on several of the coffin fragments (fig. 14).



This adhesive was identified as nitrocellulose via FTIR analysis (fig. 15)

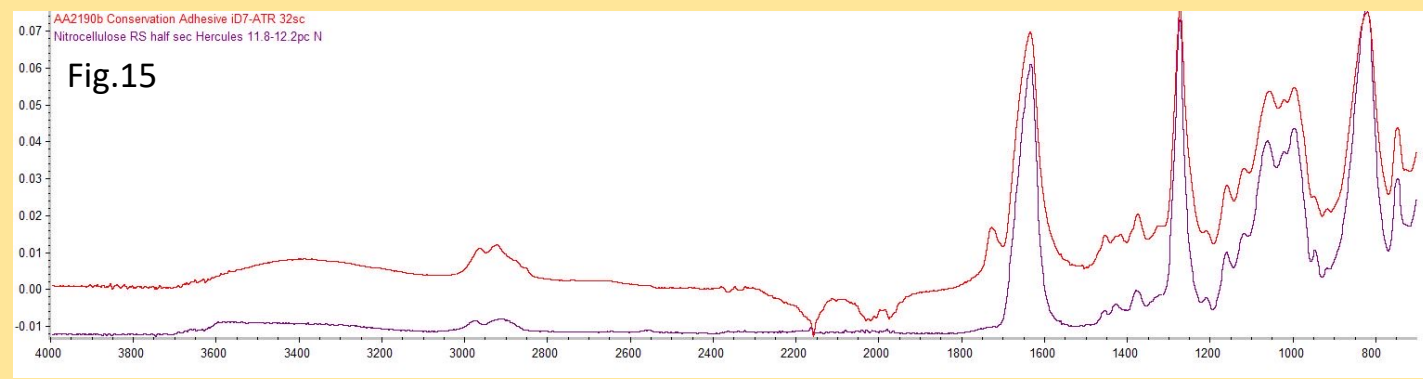


Fig.15

### Conclusion

The results of these analyses, as well as the analyses already performed on the “white” coffin (AA2190.A), will contribute to the long-term goal of identifying those fragments that remain unassociated, and reconstruction for one, or all, of the coffins that are housed in the Queen’s University Art Conservation Program collection.

### Key References:

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