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Identification of Greco-Roman Wooden Funerary Masks: an analytical study

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Abstract

In this study, methods of inspection and analysis were employed to pinpoint the elements of painted wooden mask from the Greco-Roman era as well as to pinpoint the production process.

Scanning electron microscope (SEM-EDX) , Optical microscope (OM), infrared (IR), and Raman microscopes were used for inspection and analysis.

Through the findings, it was discovered that the black color was made by burning bones, which was one of the uncommon procedures. The red hue is derived from hematite. The mask's construction included sycamore wood. One of the local woods that were used extensively was sycamore.

It also revealed degradation regions and the emergence of reinforcing material remains on the mask's surface through examination.

Keywords: Mask;; Greco-Roman era; Black bones;Hematite; Sycamore wood.

1. Introduction

A mask made of painted wood. It refers to the Greco-Roman period. This mask is a part of an archaeological coffin cover. It covers an area of the face and a small part of the neck. This mask belongs to a man, it has big eyes. The red pigment has covered the face and neck. Eyes are painted in yellow and black. The hair is painted with black. On the back part of the mask appears a layer of gypsum that was used to fix the mask on the wooden cover of the coffin.

Masks were sculpted individually and fastened to the coffin's head with wooden pegs. In most cases, the ears were cut apart and attached to the cover at the sides of the face. The masks are designed in a lapidary manner and depict fundamental facial features.[1]Wooden masks were used to decorate wooden coffins in the shape of the deceased's face. They were fastened to the coffin with wooden joints, such as pegs, and covered in calcite (calcium carbonate) preparation layers before being painted. During Egypt's pharaonic period, this technique was widely used.[2]

[1] **S. V. Ivanov (2017**): Greco-Roman Coffins from Deir el-Banat (Fayoum) in Egypt and Neighbouring Countries 4 (2017): p3

[2] **Yassin Z., Nesrin N., Mourad F. (2016):** Examination and analyses of a wooden face at the museum storage at the faculty of archaeology, Cairo university: Mediterranean Archaeology and Archaeometry, Vol. 16, No 2 (2016), pp. 1-11

Ancient Egyptian used limestone powder and animal glue that was commonly employed in ancient Egypt as preparation layer on wooden artifacts, cartonnage mummy masks, and coffins.[1]Sycamore wood is a native Egyptian wood that was widely used during the Greco-Roman period.

Ficus sycomorus was used in making the wooden mask. It is known to the Egyptians as nht, was undoubtedly the most important tree to the ancient Egyptians, as seen by its extensive exploitation and dominant place in Egyptian art, iconography, and mythology. It was extensively employed in the Roman period for "mummy portraits," which were representations of the departed painted on slices of wood and put over the heads of their prepared mummies. These the boards were cut radially from the tree. The ancient Egyptians showed their love and admiration for sycomorus fig in a variety of ways. It was revered by many gods; the sycamore was particularly associated with Isis and Hathor, who was known as the Lady of the Sycamore. As early as the predynastic period, the wood or fruit of the sycamore fig has been discovered in burials.

Throughout the centuries in Egypt, sycamore wood (Ficus sycomorus) was widely employed. Because it is natural wood, it has been employed for structural purposes as well as for the production of coffins and sarcophagi since the Fifth Dynasty. Sycamore wood is stated to have been used for boat construction in one text from the Eighteenth Dynasty and another from 251 B.C. This wood is frequently used to create statues and masks, which can be discovered in Egyptian museums, storages, and excavations. In the Greco-Roman era, the ancient Egyptians used Ivory and bones as a source of black color in painted wooden masks fig1-2.

[1] **M. Abdel-Ghani. (2009):** A Multi-instrument Investigation of Colors, Binders and Varnishes from Egyptian Paintings (AD 1300-1900): Molecular and Elemental Analysis Using Raman, GC-MS and SEM-EDX Techniques: PhD Thesis: University of Bradford: p41

Dimensions of the mask

The length of the mask is 36 cm ؛ The width is 32 cm and the thickness of the mask is 15 cm fig.3.

Fig. 1 The Greco-Roman mask of painted wood from the front

Fig. 2 the Greco-Roman mask of painted wood from the back

Materials and Methods

The painted wooden mask is covered with a preparation layer and painted using red and black colors.

Optical Microscope

Olympus BX51 stereomicroscope equipped with an Olympus DP10 digital camera was used to identify the type of wood. The optical images were captured in the reflected light.

Scanning Electron Microscope

The environmental scanning electron microscope model of Philips XL30 FEG is equipped with the secondary electron (SEM) and backscattered electron (BSE) detectors and EDS was used to study the compositions and the characterization of the painted wood composition.

Fourier Transform Infrared Spectroscopy (FTIR)

KBr technique was used for analysis. Spectrum was measured at a resolution of 4 Cm-1 and 20 scans were recorded per sample. IR Prestige-21 FTIR Spectrometer and the IR resolution software were used. Spectrum in the range 4000-400 Cm-1 was baseline corrected and atmospheric compensation was done.

Raman Spectroscopy

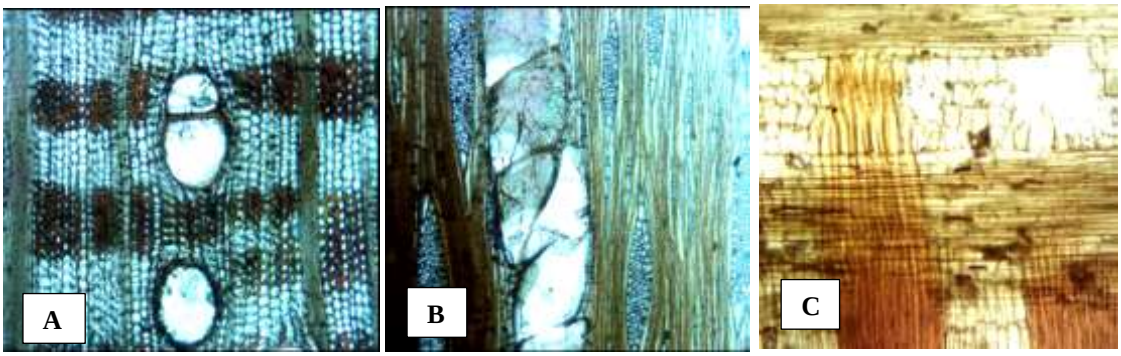
Raman confocal microscope Bruker Senterra II. Laser 785 all except blues 532 laser. Power 1micro watt. Magnefication 20x

Results and Discussion

The support (Wood)

Optical microscopic investigation indicated that the wood of the mask is (Fig sycamore – Ficus sycomorus).

Sycamore wood is a native Egyptian wood that was widely used



during the Greco-Roman period fig3.

Fig. **3** The anatomical characteristics of sample 1 by OM in transmitted light: A- Transverse section (TS); B- Tangential section (TLS); C- Radial section (RLS

SEM examination showed losing parts of wood tissue, as well as the loss of the structure. The imaging revealed mechanical damage cause compression and collapse to the wood structure , where there is disintegration in the fibers, as well as the presence of remains of consolidation materials on the surface which was applied by conservators in the past to protect the mask from damage fig 4.

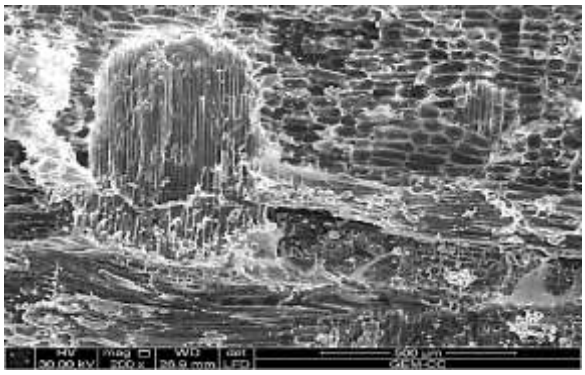


Fig.4**:** Shows SEM photomicrographs of archaeological wood in the mask (Mag. 200X, bar=500µm), loss of parts of the structure of wood as well as the presence of consolidants on the surface.

Preparation layer

SEM shows grains of calcite. The results of EDS carried on calcite show the presence of $CaCO_3$. Additionally, Mg, Ca, and CO_3 were found as a result of the utilization of powdered dolomitic limestone. Aside from sodium chloride (Na Cl) as a salt source in addition to appeared Feldspar fig.5.

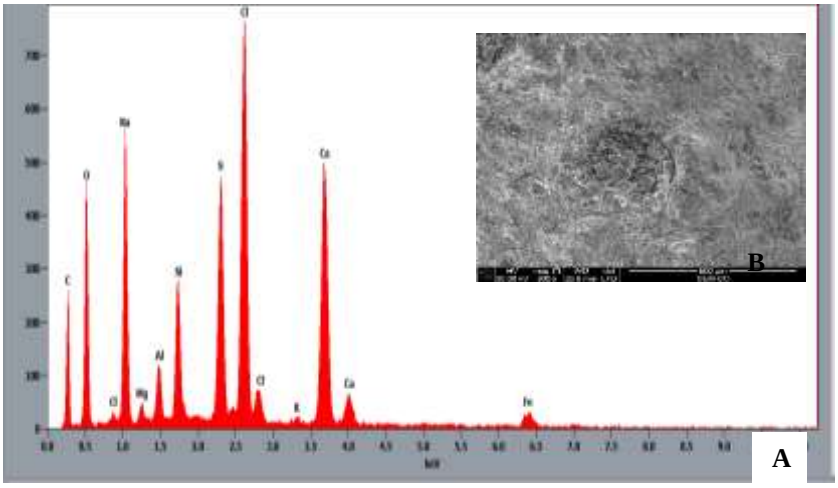


Fig.5 shows analysis and investigation of preparation layer in the mask A) EDS pattern B) SEM photomicrographs of preparation layer distribution on the surface**.**

FTIR detected the presence of animal glue that was used as a medium. The results were confirmed with Raman Spectroscopy revealed the presence of calcite ($CaCO_3$), as well as a percentage of gypsum, kaolinite as a source of clay. There are Goethite FeO (OH), Quartz (SiO_2) as well as Aragonite ($CaCO_3CaO$),Baryte($BaSO_{4)}$,Dolomite($CaMg(CO_3)_2$.
Montmorillonite, and the presence of animal glue and Feldspar (Al Si $_3O_8$). Furthermore, there is Massicot (PbO) which is used as a yellow fig6.

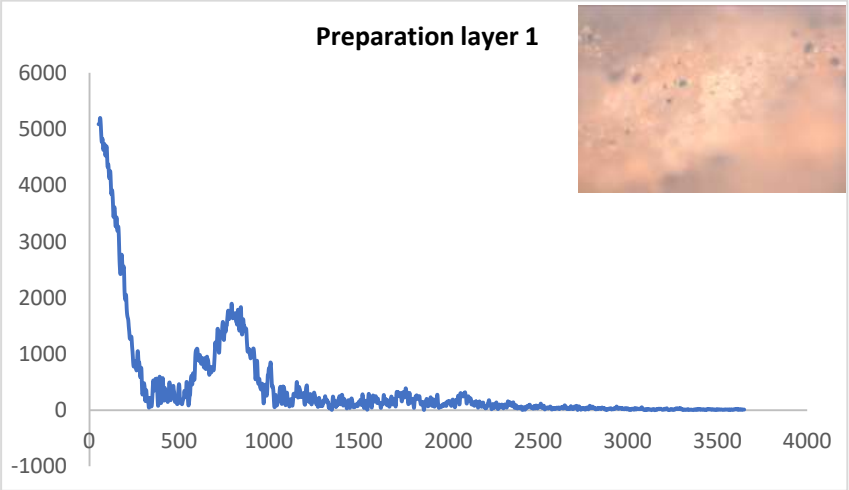


Fig 6. The sample of preparation layer showed the presence of calcite and clay minerals and a percentage of animal glue

Black pigment

SEM shows grains of the black pigment form of burned bones. the pigment grains show homogeneity in size and distribution.

The results of EDS carried on the black pigments show the presence of C as a result of black bones in addition to sodium, Calcium, and Aluminum Silicate ((Na,Ca)Al (Si, Al_3) $O_{8)}$, there is Silicon dioxide (Quartz) in the presence of Calcium Carbonate ($CaCO_3$) and Calcium Sulphate as a preparation layer and Sodium Chloride (Na Cl) as a source of salts fig.7.

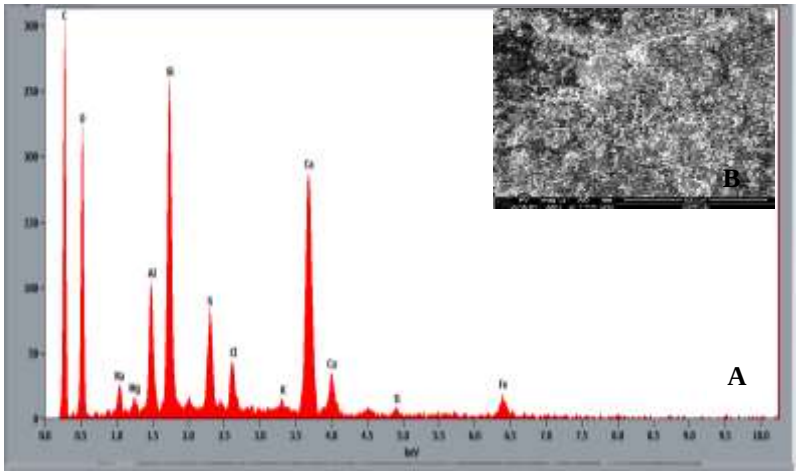


Fig. 7: Analysis and investigation of black pigment in the mask A) EDS analysis B) SEM photomicrographs of the black pigment distribution on the surface

FTIR: The sample represents the black pigment in the mask, and the results of the analysis using FTIR revealed that the black pigment in the sample is carbon from black bones and pigmented substance. Furthermore, the existence of C-H at 2962 cm^{-1}, N-H at 3393 cm^{-1}, C=O at 1629 cm^{-1}. That means using animal glue as a chromatic media and their Si-O-Si at 1088 result in an appearance of Quartz as impurities. Appearance of Paraloid B-72 in sample based on its distinctive bands at 1020-1228 cm^{-1} and 1727 cm^{-1}, indicating previous restoration occurred in mask fig.8.

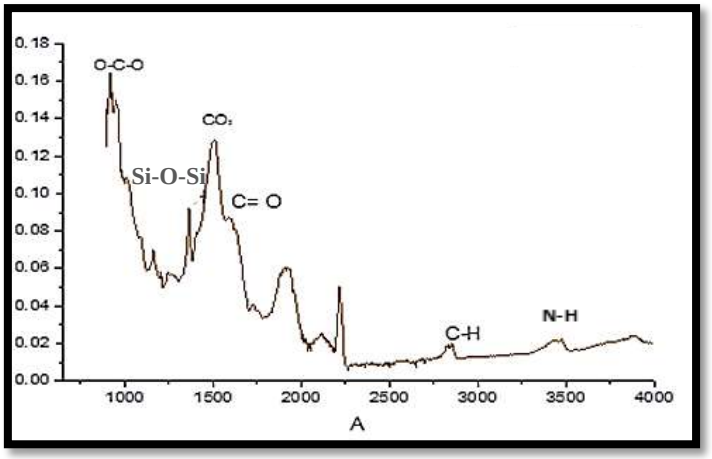


Fig. 8 shows the FTIR spectra of the black pigment of the mask and identification of binding media and layers of ground

Raman Spectroscopy :The sample of black pigment cleared the presence of black bones which used as a source of black pigment and carbon was found too, calcite was used as a preparation layer, animal glue was used as a media, as well as Aragonite ($CaCO_3$ CaO), Feldspar (Al Si $_3O_8$), Hydroxy apatite, Calcium silicate were found fig 9

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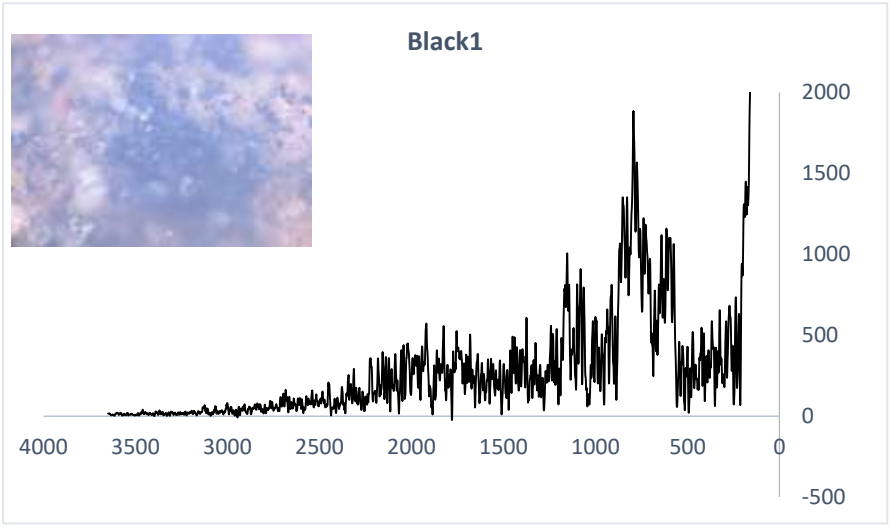

Fig.9. The sample of the black pigment showed the presence of black bones, calcite, a percentage of animal glue

Red pigment

SEM reveals granules of red pigment type of hematite. The pigment granules are uniform in size and distribution. The presence of Fe as a result of hematite is
revealed by the results of EDS on red pigments. The composition of the preparation layer is also evident in the EDS result as a result of electron beam penetration into the preparation layer as well as powder of dolomitic limestone were used result of Mg, Ca, and CO_3**.**In addition to Sodium, Calcium, and Aluminum Silicate ((Na, Ca)Al (Si, Al_3) $O_{8)}$, there is Silicon dioxide (Quartz) in the presence of Calcium Carbonate and Calcium Sulphate as a preparation and Sodium Chloride (Na Cl) as a source of salts.

Magnesium was also discovered, together with Calcium, Carbon, and Oxygen, indicating that dolomite was present (calcium and magnesium carbonate fig.10.

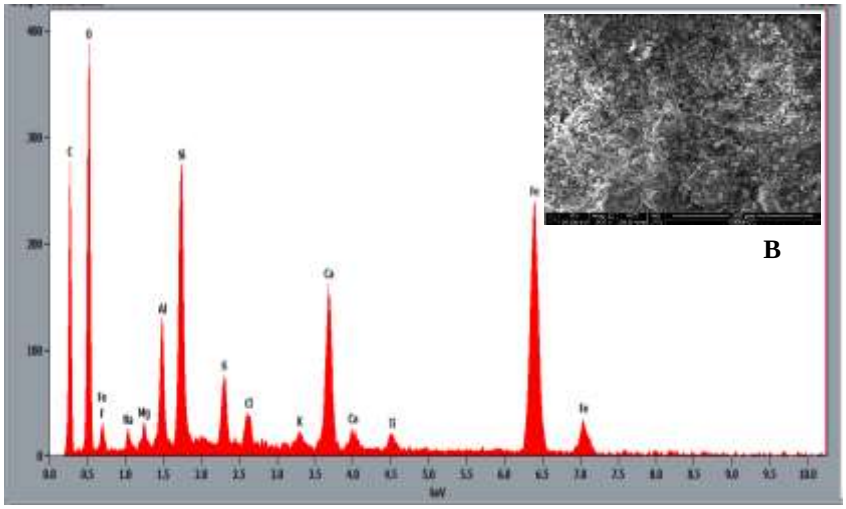

Fig.10: Analysis and investigation of red pigment in the mask A) EDS analysis -B) SEM photomicrographs of the red pigment distribution on the surface

FTIR: There are C-H at 2962 cm^{-1}, N-H at 3393 cm-1 in sample from Red pigment. That means using animal glue as a chromatic media respectively with the animal glue and There is Si-O-Si at 1088 in sample evidence of an appearance of Quartz as impurities fig11.

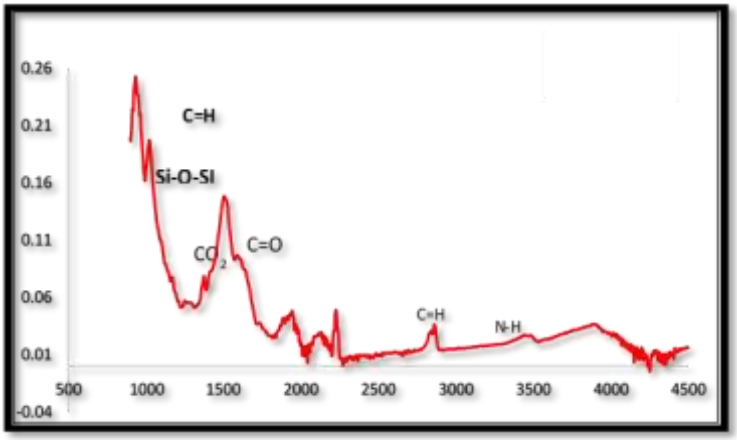

Fig.11 the FTIR spectra of the red pigment of the mask, identification of binding media, and layers of ground

Raman Spectroscopy: Hematite, calcite, and animal glue were found in the red pigment sample after Raman analysis. Animal glue was used as a medium and Hematite was utilized as a source of red pigment. Calcite was used as a preparation layer. feldspar, illite, kaolinite, Aragonite, Pyrite, Sodium montmorillonite, and Magnetite were among the impurities found fig.12.

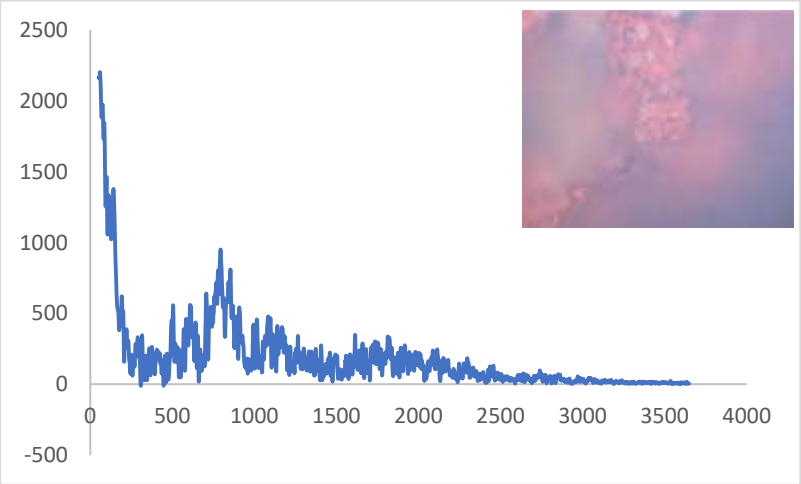

Fig. 12. Hematite appeared in the red sample - the first mask.

Conclusion

The painted wooden mask contains hematite as a source of red color and carbon as a source of black color. The wood used was sycamore wood. Calcium carbonate was used as a preparation layer and animal glue was found as a color medium and the conversion of part of the calcium carbonate to calcium sulfate in the presence of moisture in some areas with the presence of some impurities such as silica and sodium chloride and Feldspar. The wood used was sycamore wood. Paraloid B72 was used as consolidate with weakness and fragility in the cell wall of wood.

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