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SYNCHROTRON RADIATION BASED INVESTIGATIONS OF COLORED LAYERS , BINDING MATERIALS AND RESINS OF THE GOD PTAH-SOKAR-OSIRIS WOODEN STATUETTE AND ITS MUMMIFIED FACON WHICH ARE DATING BACK TO 26th PHARAONIC DYNASTY

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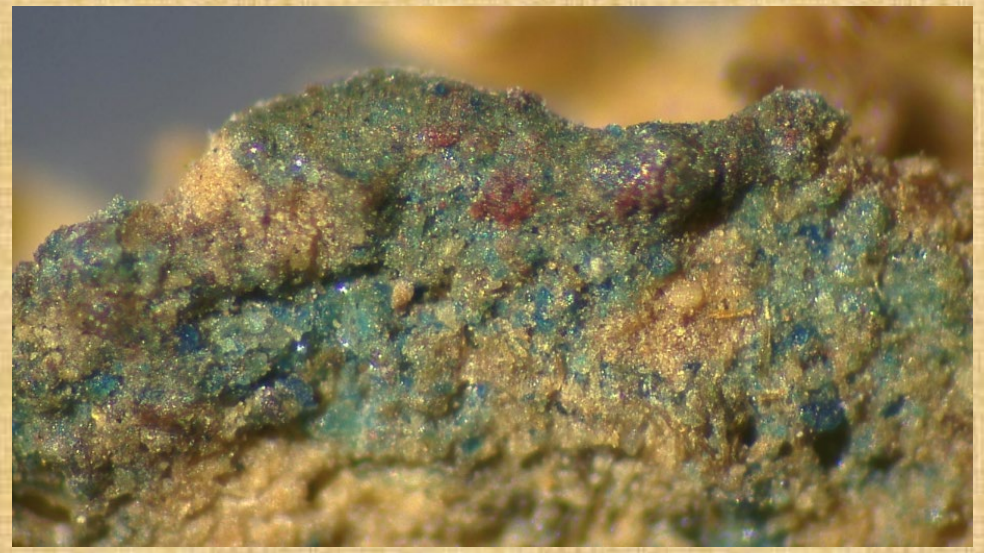


Introduction
(The God Ptah-Sokar-Osiris Wooden Statuette)

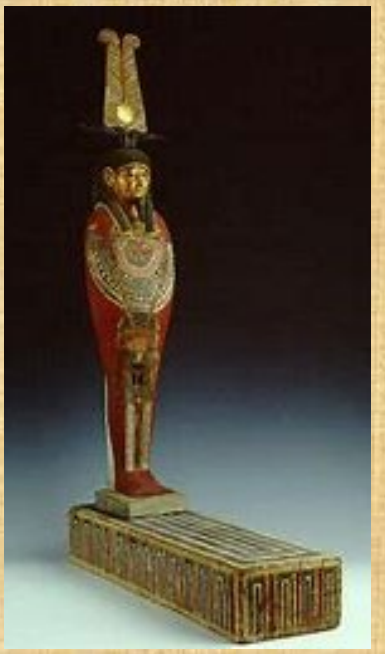
- The God Path – Sokar – Osiris are models appeared at the end of the New Kingdom, and became a very common feature of elites' burials through late period until the Roman one.

- Egyptologists couldn't know the specific meaning of such objects accurately, but they thought that the reasons for placing such models of this idol next to the mummy of the deceased might be due to the religious rituals related to their beliefs.

Introduction
(The God Ptah-Sokar-Osiris Wooden Statuettes)





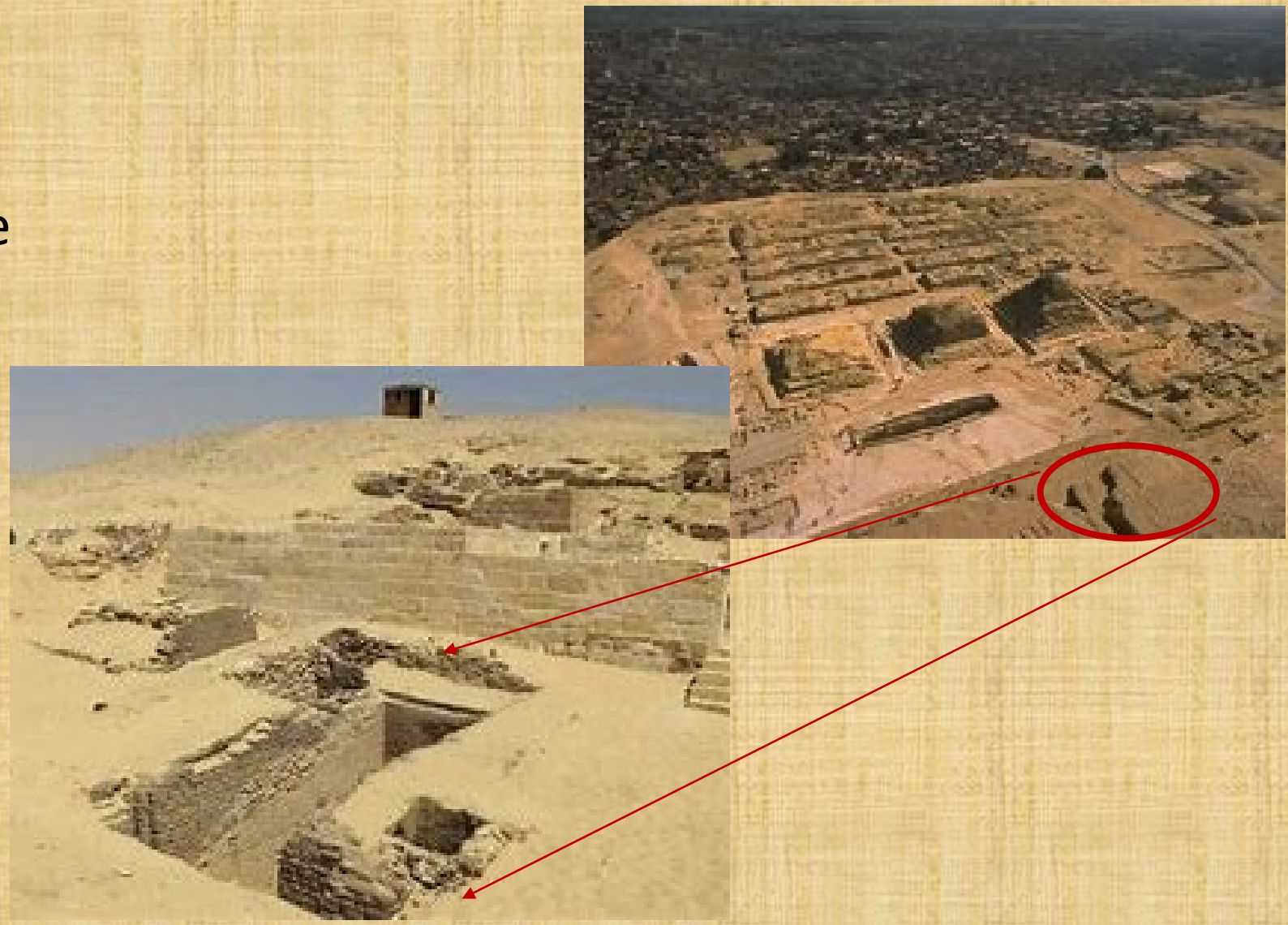



Introduction (Excavations in Giza Necropolis)

- In Giza necropolis site that located at the Western edges of Giza desert, the statuette that investigated here has been recently discovered by Egyptian excavation mission headed by Dr. Mustafa Waziry the head of Supreme Council of Egyptian Antiquities (July 2020).

Introduction (Excavations in Giza Necropolis)

- It is found in a double tomb for two people in Tari cemetery that is located in the south eastern part of the pyramids area.
- The cemetery, dating back to "the beginning of the first half of the Fourth Dynasty", was reused in the 26th dynasty as suggested from the nature and the artistic features of the excavated statuette and its inside mummified falcon.



Statuette Description

- A unique polychrome wooden statuette of the God Path – Sokar – Osiris (dates back to 26th dynasty (664 –525 BC)) was studied.

- The dimensions of the statuette are 85 cm length and 23 cm shoulder width
  it was based on a rectangular
  wooden base (77 cm W, 27 cm L, 10 cm H).

- The mummified falcon was preserved in
  a rectangular cavity covered by a lid, in the base
  of the statuette as shown in Figure

Objectives

The main objectives of this study are;

- To study such unique object by analyzing several samples of pigments, preparation layers, resins and linen rolls collected from the statuette and its mummified falcon.
- To evaluate the deterioration stage of the statuette by analyzing the collected salts and the wood samples.

These measurements improved our knowledge about the chemical nature of pigments, the adhesives and binding materials used by the ancients and also their manufacturing techniques.

Moreover, this work will help us strongly to set the best strategies of conservation, museum storage and exposition.

Experimental Work

Due to the object nature of degradation, the size of collected samples as well as the limitations of ordinary diagnostic techniques.

- 24 samples are measured using SR based techniques, X- ray diffraction, μ-FTIR spectroscopy and X- ray fluorescence at Elettra Synchrotron – Italy.

- The samples were classified in to three sets as reported in the table.

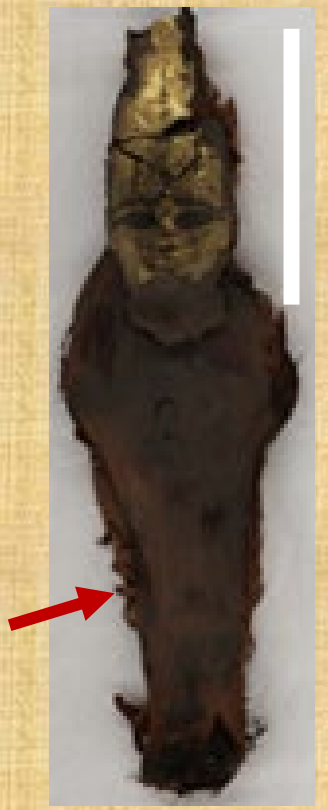
Set	Type of Samples	# of samples	Sample description	Samples position
Set A	Colors	7	Blue, Red, Yellow, Green, Black, Off-white and (preparation layer)	Fallen parts from statuette
	Colors	7	Blue, Red, Yellow, Green, Black, Off-white and (preparation layer)	Fallen parts from the rectangular base.
Set B	Wood	3	2 samples of deteriorated wood, 1 sample of standard wood	From different positions of the statuette and its base.
	salts	3	Salts with different shape and colors	The salts collected from the object surface
	Soils	1	Soil from the excavation site	
Set C	Textile	1	Fragmented parts of linen	Its collected from the linen rolls
	Resin	2	Resins	from the base and the falcon

Results (XRD & micro FT-IR results)

- The measurements were performed at MCX, micro FT-IR and XRF beamlines of Elettra Synchrotron, Trieste, Italy.

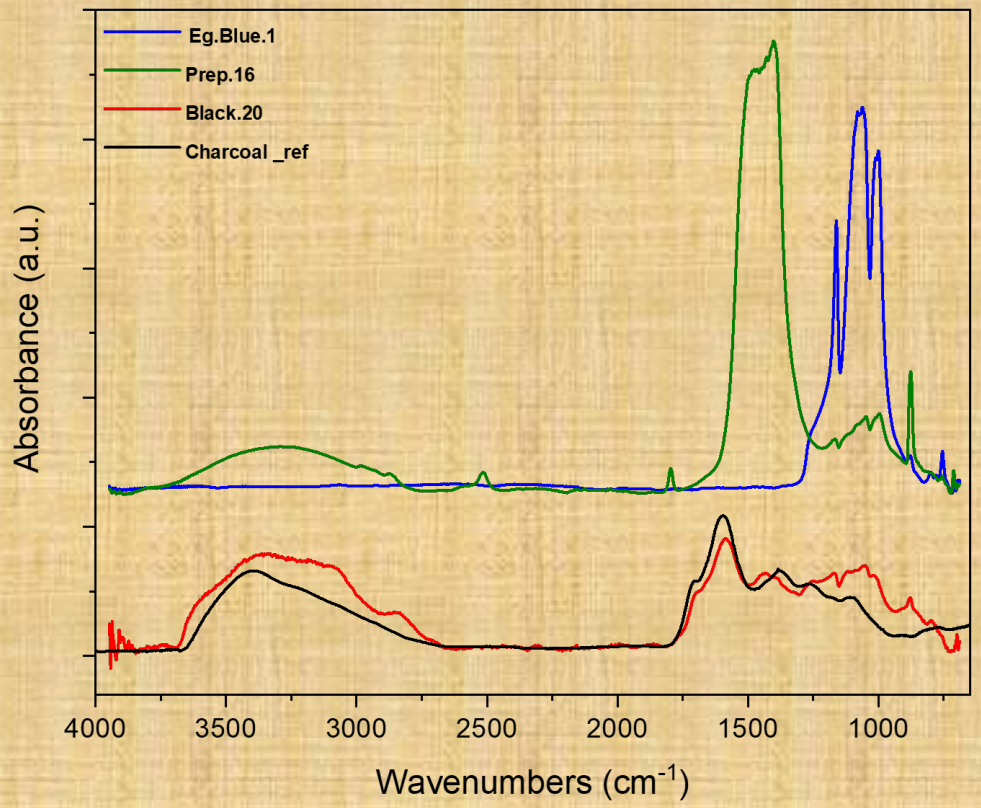
- Multiple colored minuet samples, wood and soil samples were analyzed in order to identify the ancient colors composition as well as trace the degradation degree of the object.

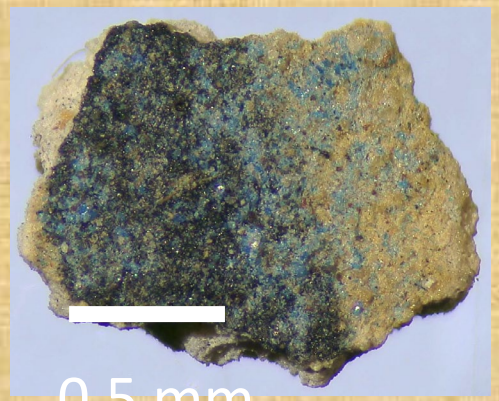
- The arrows in the obbosite figure point to the position of the measured samples.



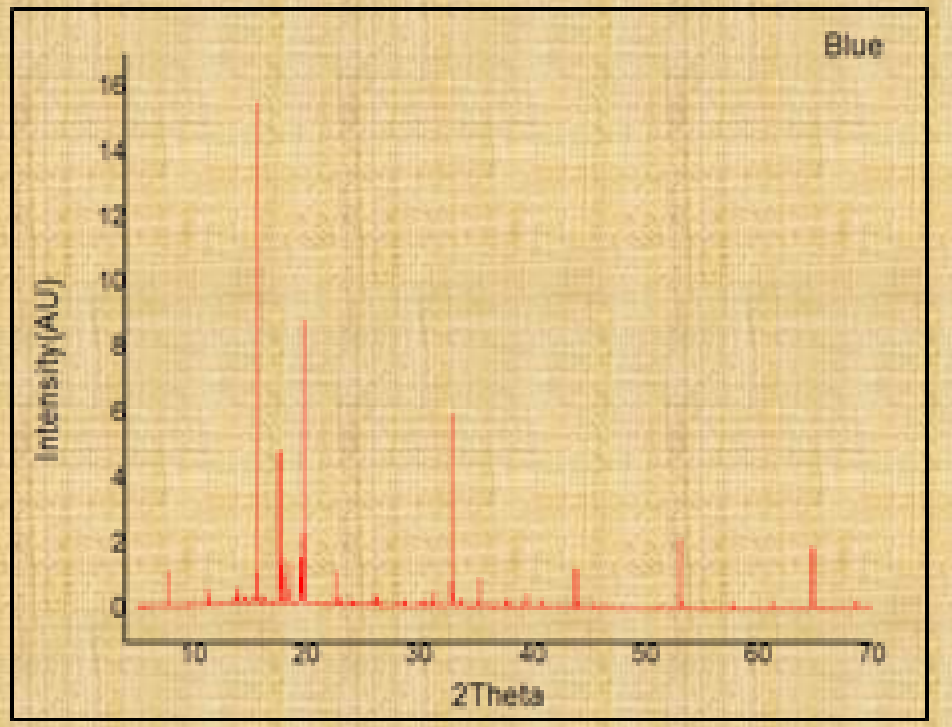
Results (Blue Sample)

FT-IR Spectrum





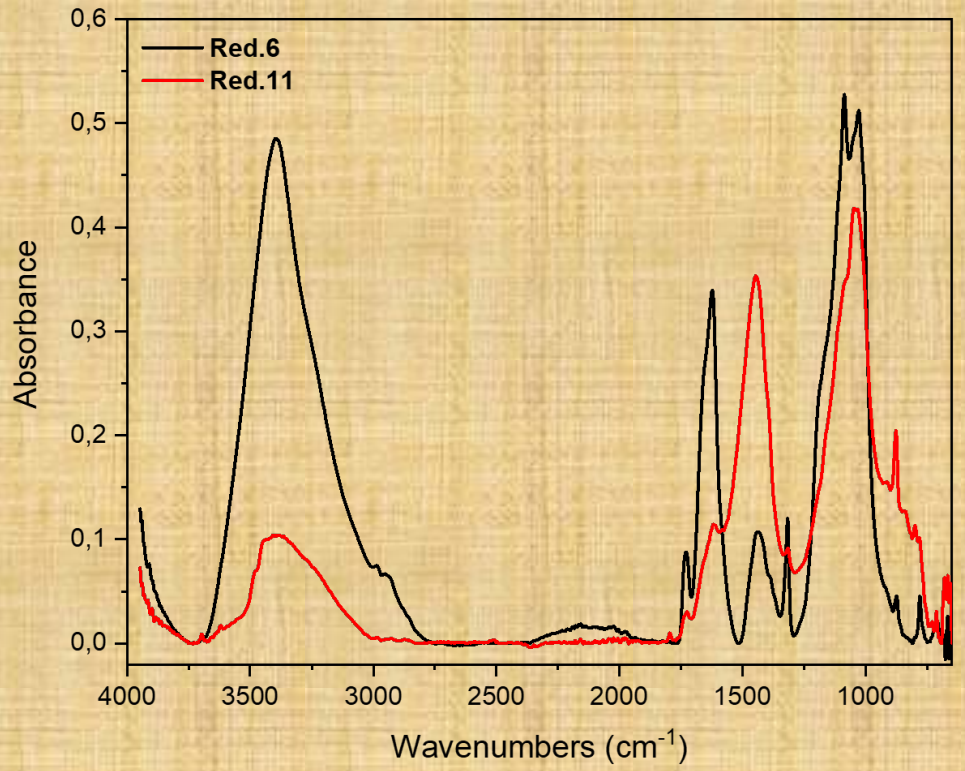
XRD Pattern

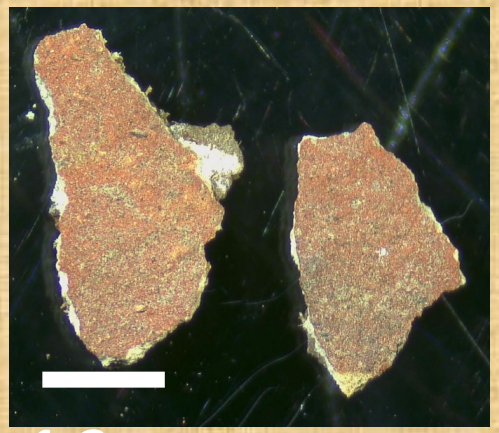


- Blue layer contains Egyptian blue (Cuprorivaite) , carbonates from preparation layer and black pigment which is carbon black

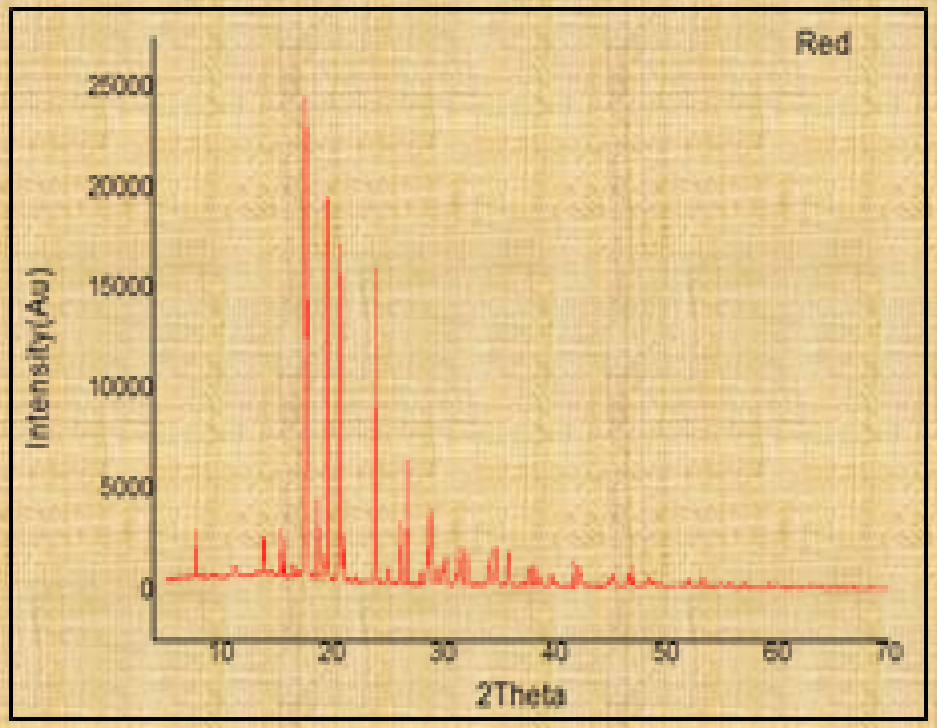
Results (Red layer)

FT-IR Spectrum



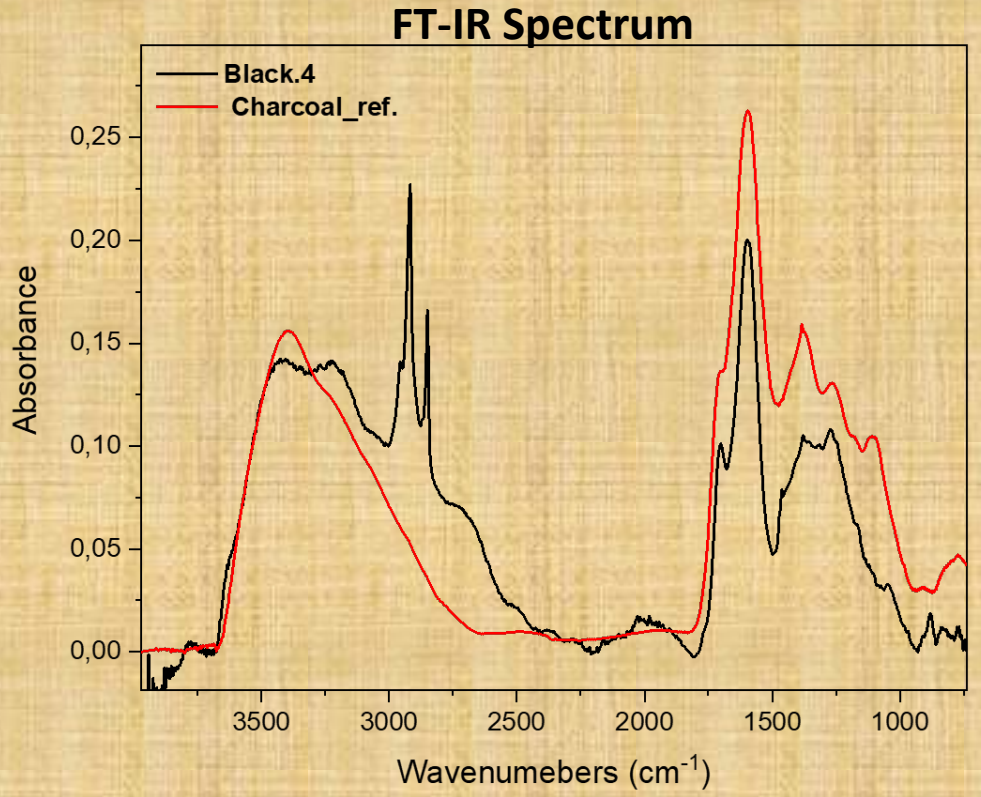


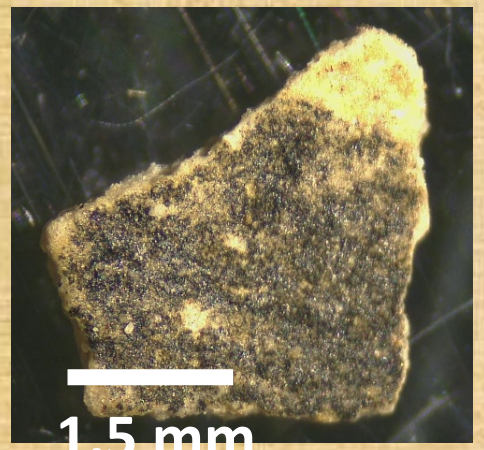
XRD Pattern

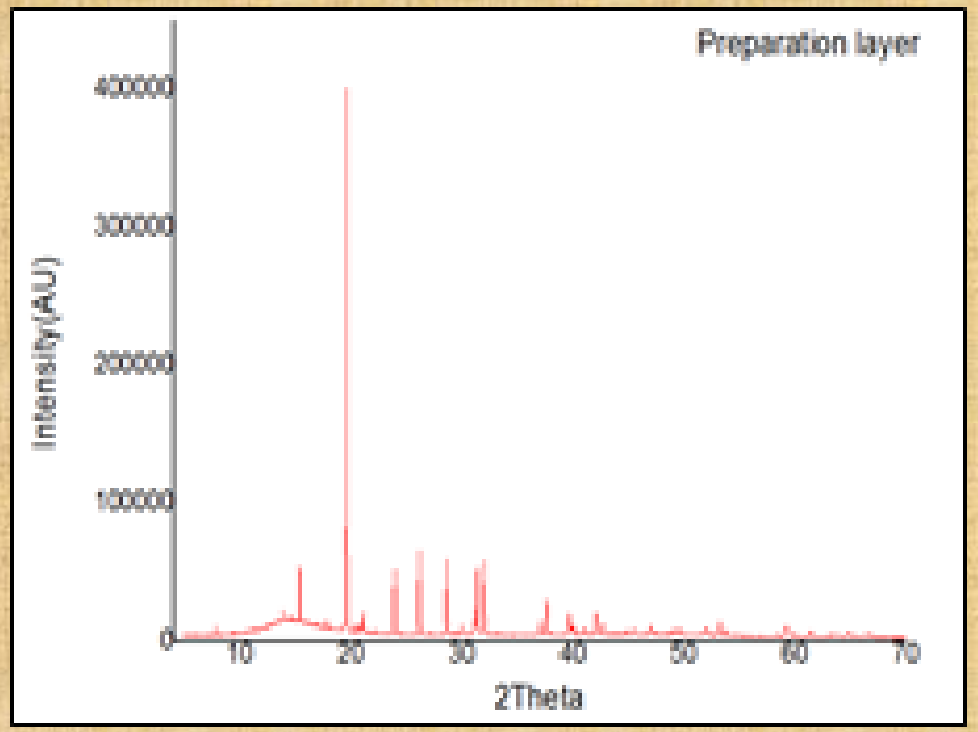


Carbonates and Silicates, peaks 1730, 1650 and 1318 cm-1 indicate possible presence of natural gum, maybe tamarisk gum or Karaya/tragacanth gum. The red is as Ochres confirmed by XRD.

Results (Black layer)

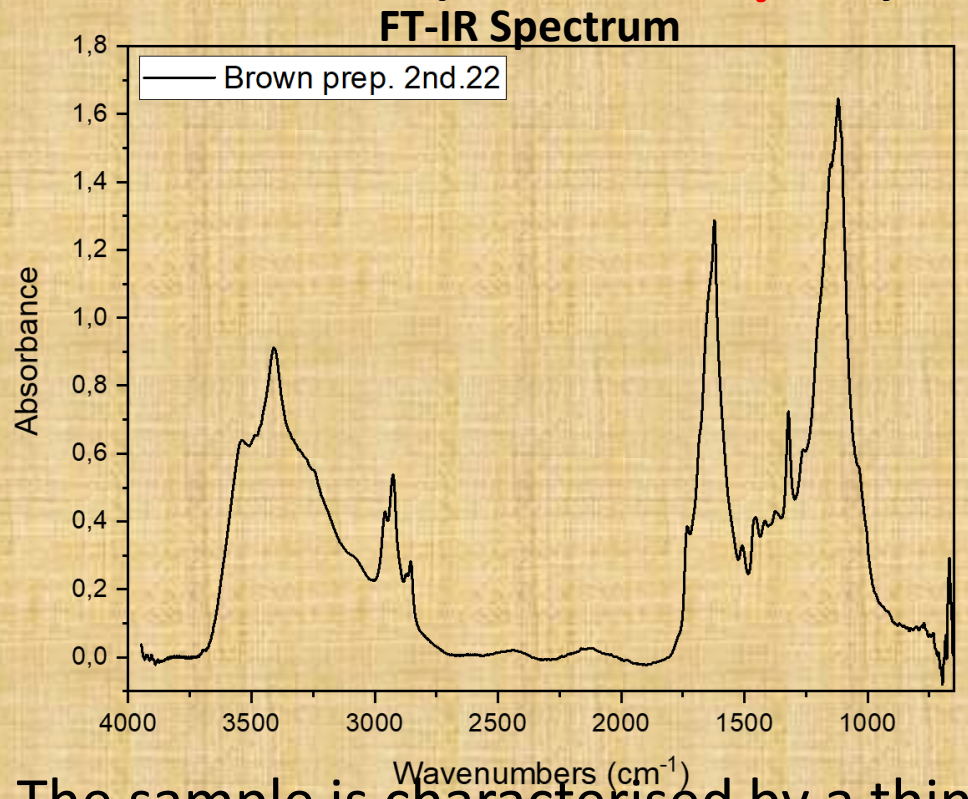


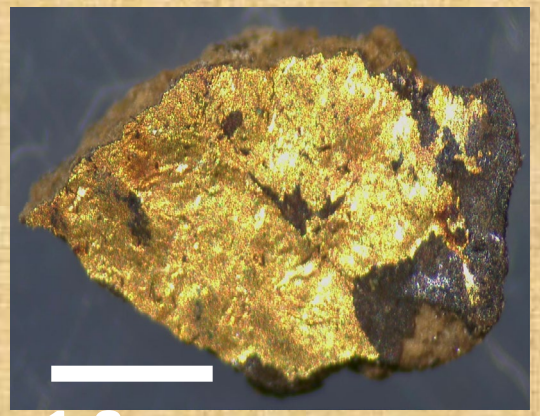


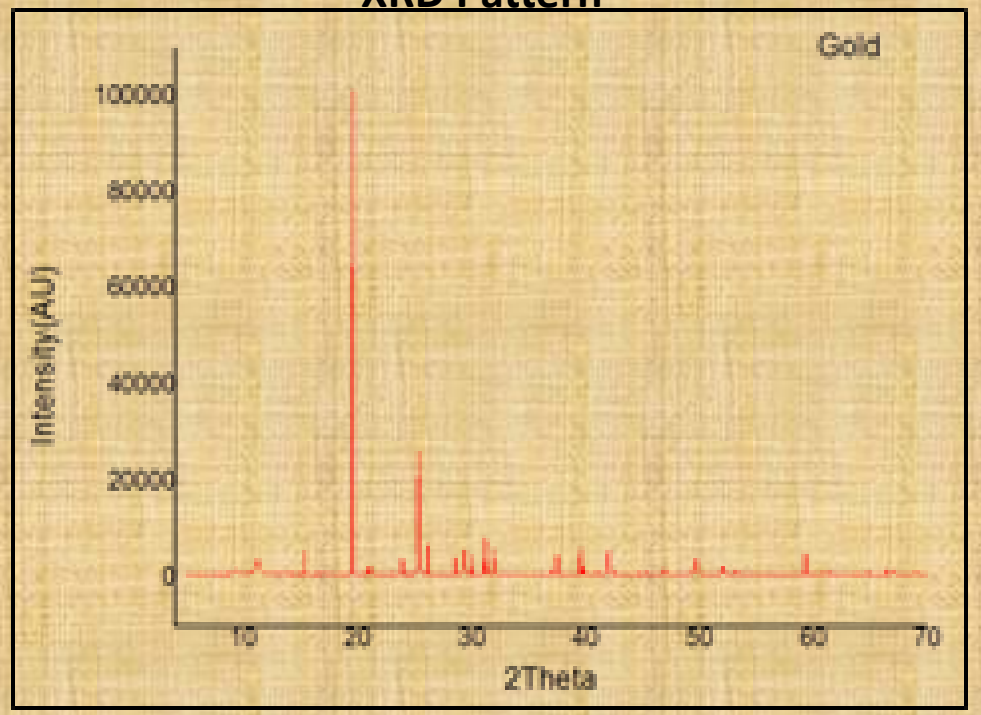


- Peaks around 1710 – 1600 present the Black part of the sample which is indicate degraded organic substance
- Compared with a charcoal reference spectrum → the black pigment could be carbon black
- white part of the sample → preparation layer → carbonates

Results (Gold layer)





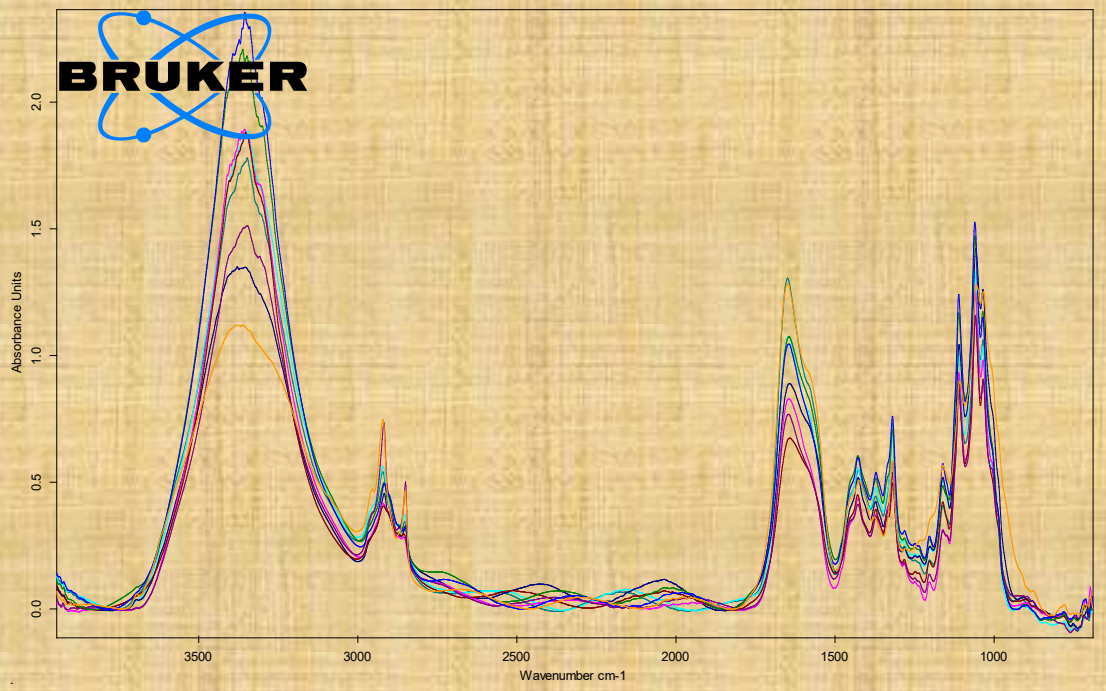


The sample is characterised by a thin layer of a gold leaf. It cover a first dark-brown, maybe a bole layer, and a second light-brown preparation layer.

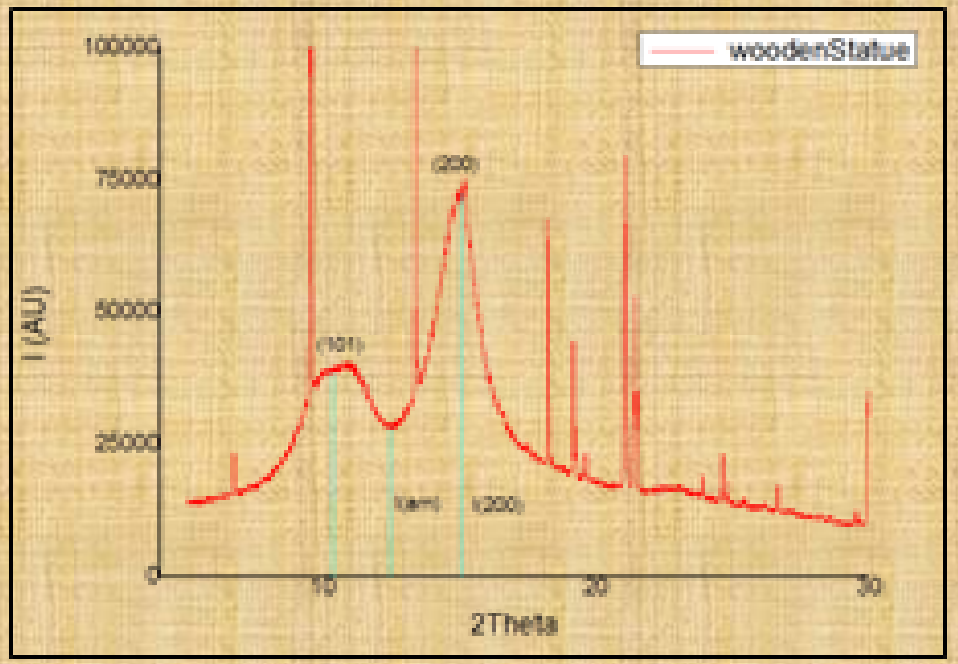
The layer is mainly composed by gypsum. Signals of an organic fraction, probably a protein, were clearly detected. The possible mix with a resin or a gum, cannot be excluded.

Results (Measurements of Cellulose Crystallinity)

FT-IR Spectrum



XRD Pattern



Cellulose Crystallinty index measurments of the examind samples of wood and textile were performed in order to indicate the degree of cellulosic parts degradation.

Conclusions (Statuette)

- The preparation layer made by carbonates, probably calcite;
- Red and yellow were recognised to be composed mainly by silicate, they can be identified as ochres;
- To obtain pink colour, red ochre e gypsum were probably mixed;
- The black pigment is probably carbon black. Further analysis would be necessary to confirm this;
- The blue pigments has been recognised as Egyptian Blue (Cuprorivaite);
- Possible traces of a binder, maybe a natural gum or a protein, were detected in the red and yellow pigments analysed.

Conclusions (Base and Mummified Falcon)

- The technique of preparation of the mummy requires more analysis;
- The yellow and red pigments have not been completely identified. They have an organic origin. Madder lake and turmeric have been suggested for red and yellow, respectively.
- The green pigment is probably a degraded Egyptian blue or an Egyptian Blue intentionally mixed with a plant gum or a proteinaceous material to obtain a green colour;
- The Blue Sample showed a well preserved Egyptian blue;
- A gold leaf sample on a dark-brown preparation layer probably composed by gypsum and probably a proteinaceous material.

Thank you

Acknowledgements

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