



Cartonnage, plasters and pastes in Egyptian coffins



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PlaCe-ITN
Pre-modern Plasters and Ceramics

A variety of 'pastes' was used on ancient Egyptian objects. These include gypsum and lime plasters produced by heat treatment, but also mud 'plasters' and pastes made from ground-up calcium carbonate and calcium sulphate minerals mixed with an organic medium such as animal glue.

Precise and detailed characterization is rare in the literature and potential to contribute to context and provenance studies is under-explored.

Aims of the PhD Project

1. Chemical and elemental characterization of pastes, to refine the definition of different types of plastering materials.
2. Developing an analytical protocol
3. Systematic characterization of these materials from the Third Intermediate Period (c. 1070–655 BCE) to highlight similarities and differences in the craftsmanship tradition of this period of relative lack of political cohesion.
4. Comparison of the information obtained from these objects with that from plasters used in building materials and reported in the literature, to enable an understanding of the "modus operandi" for the plaster production, pointing out similarities and differences.

Methodology

The work will employ mostly non-destructive and non-invasive techniques, such as: μ CT, OM, PLM, SEM, XRF and Raman Spectroscopy.

If necessary, destructive techniques such as XRD and FTIR will be carried out on representative samples.

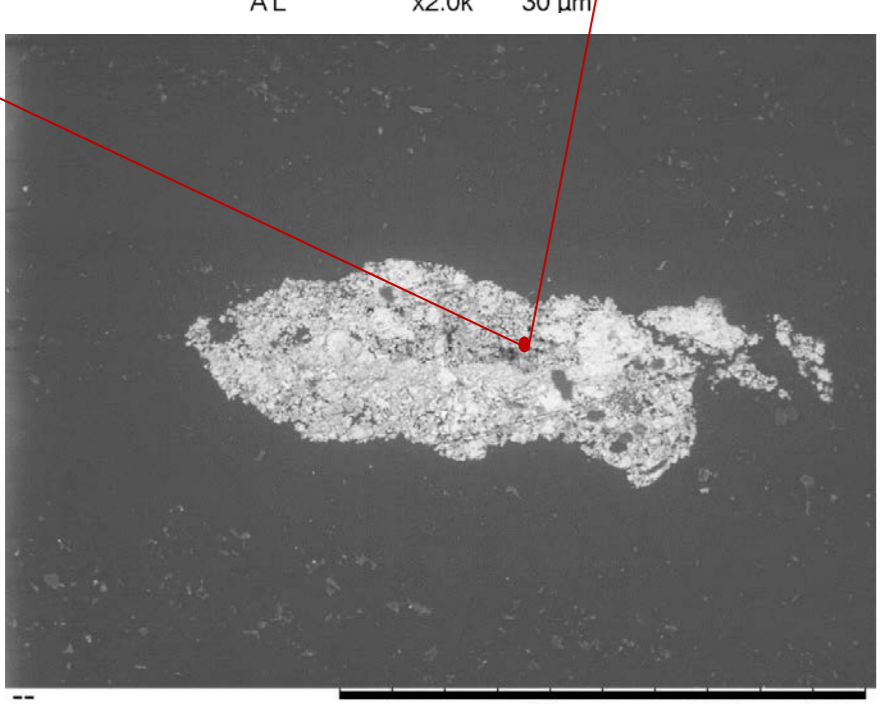
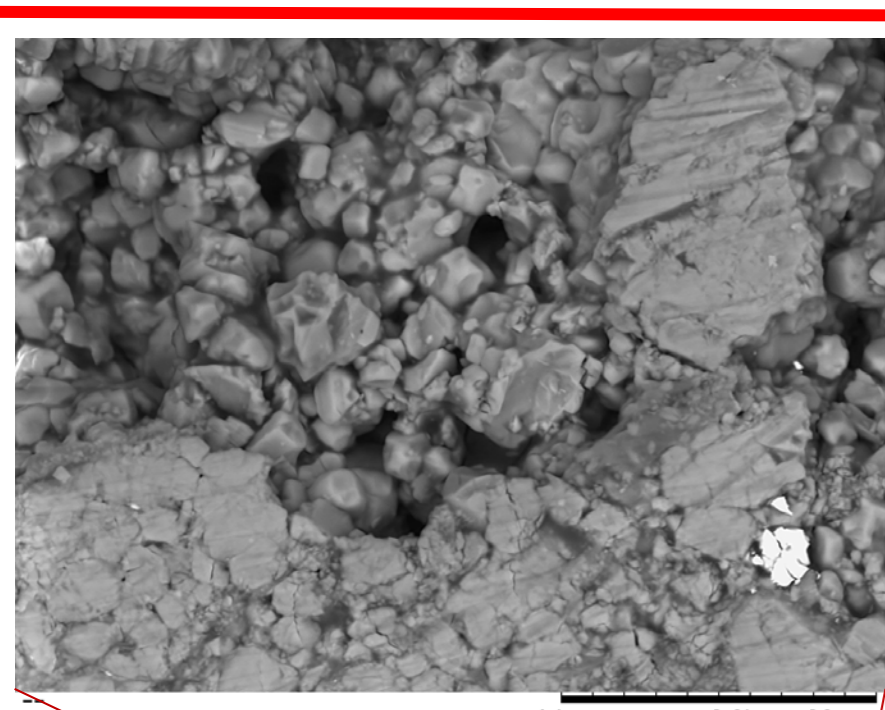
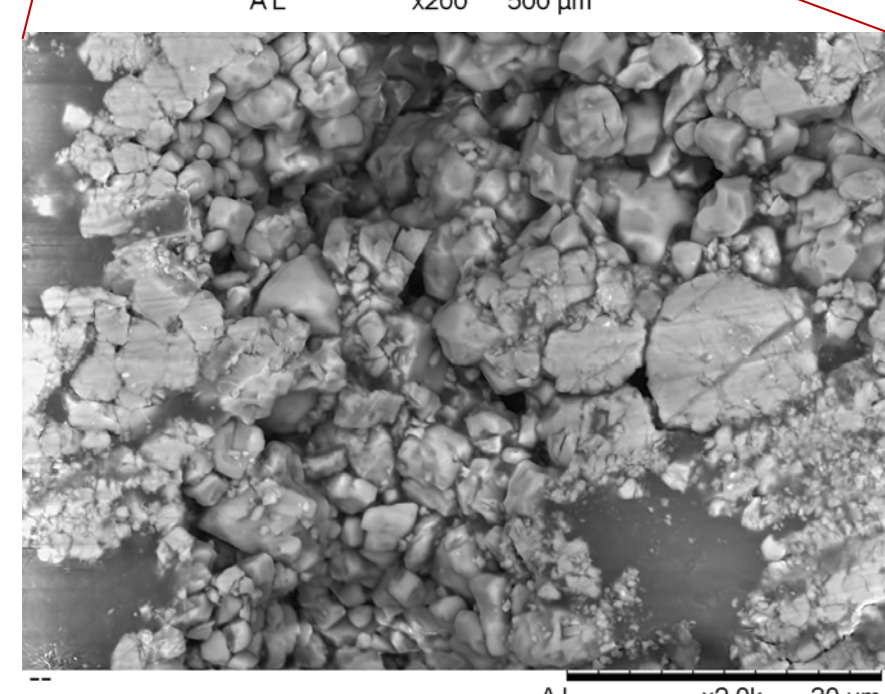
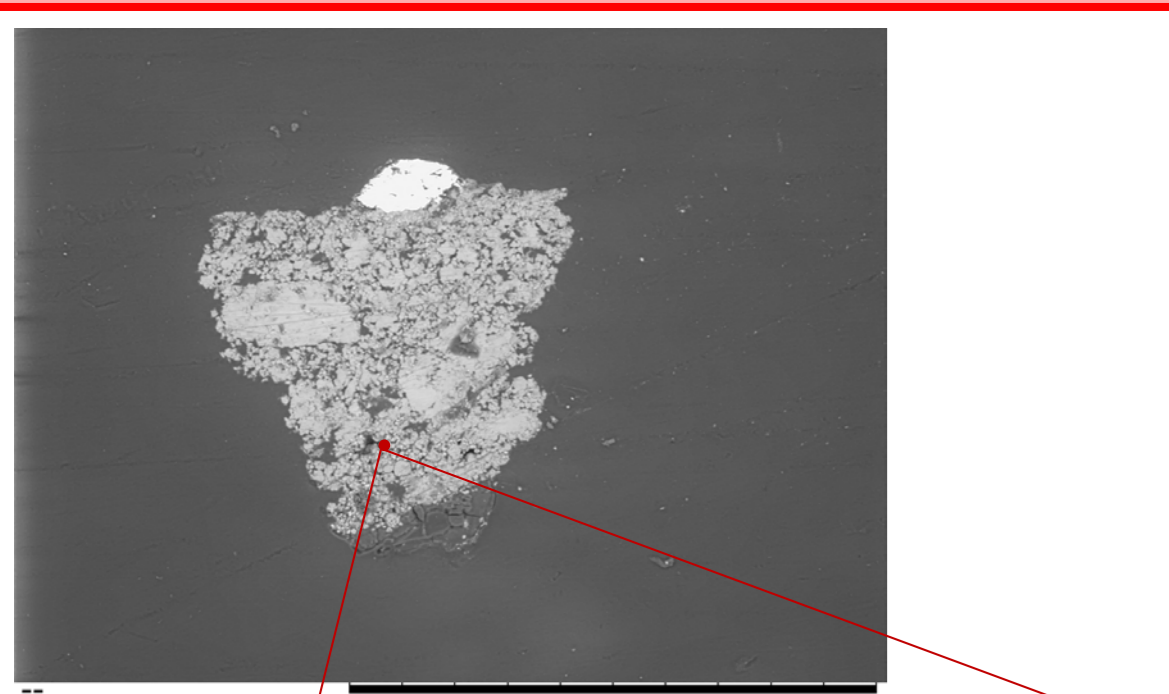
Paleoproteomic techniques will be employed to characterize the organic materials included in these pastes, especially fibers and glue.

Pilot Study: Pakepu's coffin set

The set was excavated at Thebes and is dated to the late 25th Dynasty (about 680–664 BCE). It comprises an inner and an intermediate coffin, both made of wood. The intermediate coffin has a simple surface of two paste layers onto which the decoration was painted. The inner coffin has a complex surface structure of multiple layers and resembling cartonnage (pseudo-cartonnage). The pilot study will extend and develop recent imaging and analysis of the set (www.egyptiancoffins.org). Aims of the pilot study:

- Analysis of the surface layer pastes of both coffins
- Analysis of the 'fibrous glue' layer on the inner coffin
- Comparison with cartonnage and coffin fragments from the same period and area

SEM analysis



Inner and intermediate coffins of Pakepu
Fitzwilliam Museum E.2.1869
© Fitzwilliam Museum

Cartonnage

Cartonnage is a free-standing composite material.

From the Old Kingdom (2700–2170 BCE) onwards it was used to model mummy masks. By the beginning of the 22nd Dynasty (945–735 BCE) the whole mummy case was created from this material.

Cartonnage was characterized by layers of linen, soaked in glue or gum, interspersed with layers of paste.

These were applied over a mold that was removed after the external cartonnage structure had dried. White paste was applied on the outside, to obtain a smooth surface for the application of painted decoration.



Cartonnage mummy case of Hor E.8.1896
© Fitzwilliam Museum



PLASTER	CHEMICAL COMPOSITION	PRODUCTION STEPS
Mud	Same structure as clay, with the presence of some aggregates	
Gypsum	<ul style="list-style-type: none"> - $CaSO_4 \times 2H_2O$ (calcium sulphate dihydrate) - $CaSO_4 \times \frac{1}{2} H_2O$ (plaster of Paris) - $CaSO_4$ (anhydrite) 	$CaSO_4 \times 2H_2O (s) \rightarrow CaSO_4 \times \frac{1}{2} H_2O (s) + \frac{3}{2} H_2O (g)$ $(100^\circ C < T < 190^\circ C)$
Lime	$CaCO_3$	<ol style="list-style-type: none"> 1. $CaCO_3 (s) \rightarrow CaO (s) + CO_2 (g)$ $(750^\circ C < T < 850^\circ C)$ 2. $CaO (s) + H_2O (l) \rightarrow Ca(OH)_2 (l)$ 3. $Ca(OH)_2 (l) + CO_2 (g) \rightarrow CaCO_3 (s) + H_2O (g)$

Fibrous Glue

Animal glue is used extensively in the manufacture of cartonnage, but the surface structure of the inner coffin of Pakepu is built over a complete layer of glue augmented with fibres.

Examination under the microscope and using FTIR indicates that this layer does not contain any textile or vegetable fibre only proteinaceous material.

Paleoproteomic techniques and further FTIR will be performed.



Magnification x30

Pseudo-cartonnage structure

Current understanding is that the surface of Pakepu's inner coffin is covered with layers of linen and paste. On the exterior it forms a "pseudo-cartonnage".

Exterior surface	Paint
	White paste*
	White paste
	Linen textile (and non-fibrous glue)*
	White paste
	Linen textile (and non-fibrous glue)
Interior Surface	White paste
	Fibrous glue
	Pink filler paste
	Wood
	Pink filler paste
	Linen (and non fibrous glue)
	White paste

* These layers are not present everywhere

Further analyses: (on both coffin set and fragments): FTIR, XRF and application of paleoproteomic techniques.



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