The ancient Egyptian coffin of Istemkheb (30th Dyn.; Asasif, TT414; Ankh-Hor project, Reg. 657): Pigment discolouration.

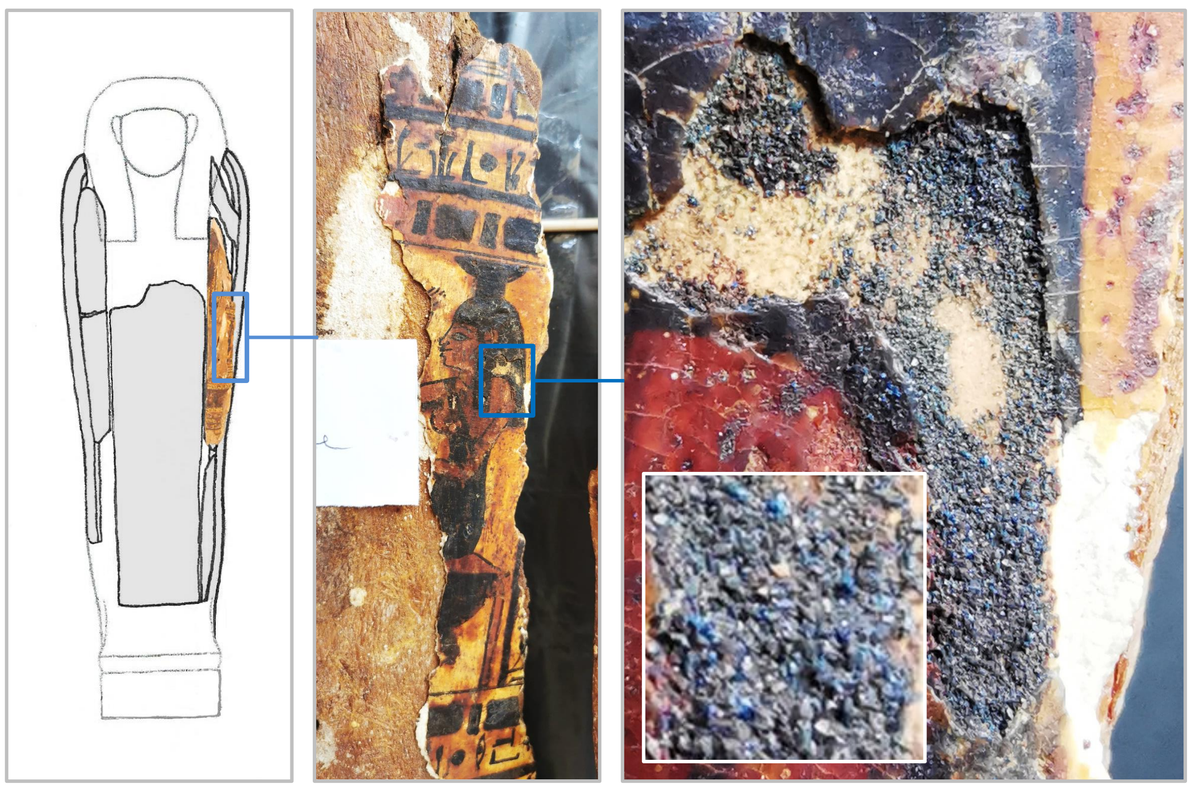
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Introduction

The Ankh-Hor project of the Ludwig-Maximilian-University Munich (directed by Prof. Dr. Budka) is located in Egypt, more precisely in the ancient necropolis belonging to the modern city of Luxor (ancient Greek name for the ancient Egyptian town: Thebes). This "Theban Necropolis" consists of several individual burial areas, which include the so-called "Asasif" and tomb number 414. The project includes Egyptological investigations, conservation and the publication of all finds that were excavated by the Austrian Archaeological Institute in the 1970s. The coffin of Isetemkheb was dated by Prof. Dr. Budka (based on stylistic criteria) to the phase from the 30th Dynasty of pharaonic Egypt to the early Ptolemaic period, which roughly covers the period from 400 to 250 BC.
The project is in the phase of "object recovery", i.e. hundreds of mixed wooden fragments (due to tomb robbery and destruction) are being sorted back into numerous objects. In 2022, the author was commissioned with the task of conservation conceptualization and partial implementation, so investigating the polychrome wooden fragments was not one of the tasks. However, condition changes perceived during the conservation implementation were documented as "snapshots" with a smartphone. This can serve as a starting point for possible art-technological investigations at a later date - among other things, with the aim of a virtual reconstruction of the colouring at the time of production.

Example: Blackening of blue pigment

All drawings and photographs (after conservation) by the author, 2022.



Description of the pigment's discolouration

The detailed photos show the supposedly black hair (or wig) of a seated female figure. The damage extends through the ancient waxy "protective layer" into the paint layer, which is why the lower areas of the paint layer can be seen. It becomes apparent that intensely blue colour particles were used (individual blue colour grains have been preserved), but most of them are blackened.

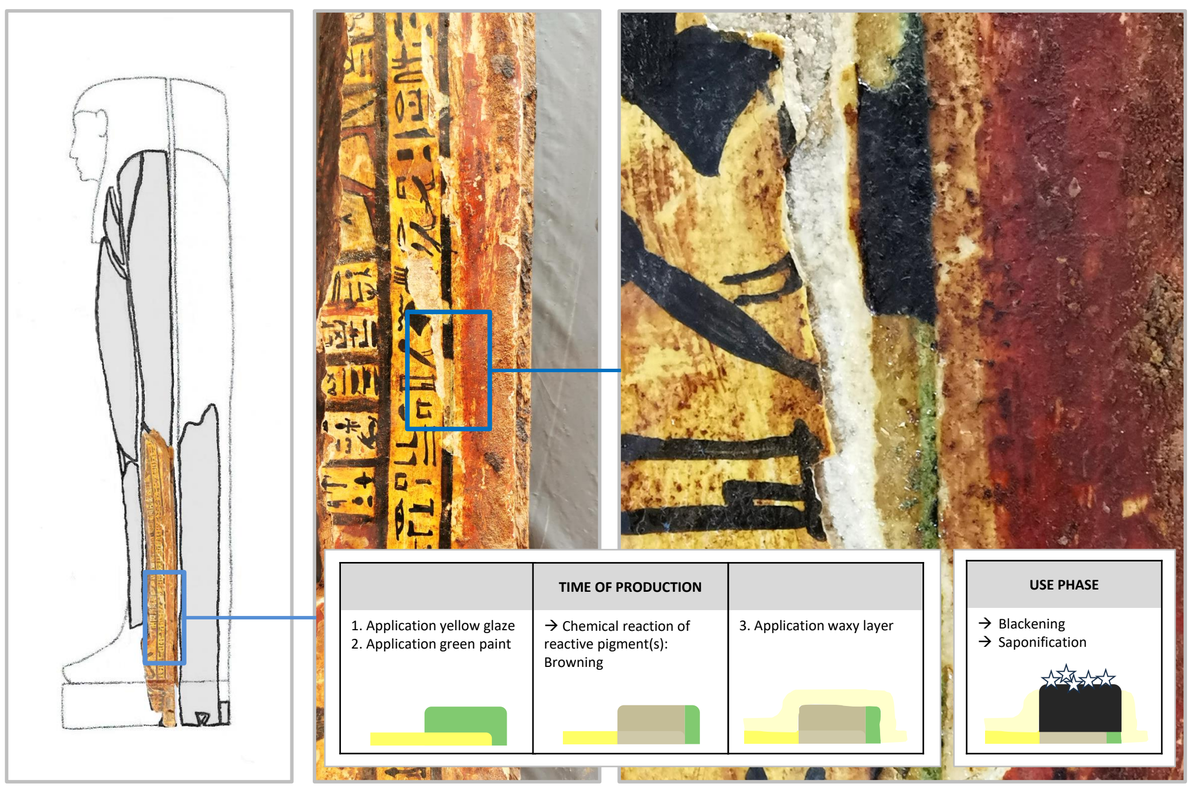
Questions about the possible pigment and the aging reaction

The only blue pigment that has been proven to be found on wooden objects from ancient Egypt is Egyptian Blue.
Numerous research results have already been published regarding the "blackening" of Egyptian blue, but these were mostly attributed to the optical appearance of the surface. A "black" surface appearance is caused by

(a) change in refractive index by transparent oil, resin or wax coatings,
(b) optical colour mixing with transparent browned substances (blue particles in browned binder, blue paint under browned coating), or
(c) optical colour mixing with opaque brownish or greyish substances (firmly adhering rock dust or earth deposits caused by water ingress during tomb or soil burial, or modern dust deposits).

In the example shown it is basically clear that it is not just a black surface view, but that there are blackened pigment particles. Since white soap efflorescence was found on the waxy surface in all areas with copper pigments (already removed in the photos), the question arises as to whether a chemical pigment transformation may be present here, which is related to the saponification of the waxy protective layer.

Example: Browning and blackening of green pigment



Description of the pigment's discolouration

The photos focus on a supposedly black framing line of an inscription band (see middle photo), which, however, reveals a two-tone greenish colour due to loss of layer (see right photo).
Of the two-tone green line, the right half shows the original colour and the left half shows browning from the time of production: The field to the left of the green line was painted with a yellow colour glaze (as the background colour of the inscription band) before the edge was covered by the green line and caused a chemical colour change.

Questions about the possible pigment and the aging reaction

The identified green pigments of ancient Egypt for wooden objects are Egyptian Green and malachite.
The literature research showed that, on the one hand, malachite was extremely rare and, on the other hand, it was not proven to have been used at this time. However, the interpretation of the aging reaction speaks in favour of malachite: the browning caused by sulphur-containing compounds (in this case an orpiment glaze) is not only known, but is even used in art-technological microchemistry to identify malachite. The question therefore arises as to which green pigment was actually used here.
The blackening as a result of long-term aging has already been discussed in the example above. However, it should be noted that in the case of the green colour there also appears to be an increase in volume.

(Notes: On top of the waxy protective layer two more original layers could be detected: a locally applied transparent browned coating and a brownish putty along the joint between case and lid.
The influences to which the finds were exposed include fire – as shown by wooden fragments with large burned areas. This could have promoted the chemical reactions.)

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Term „Colour alteration"; Syn.: „Discolouration"
Def.: change in at least one of the three colour parameters hue, lightness and chroma
Note 1 : For definitions of hue, lightness and chroma see EN 15886:2010.
Note 2 : Darkened, faded and yellowed are specific occurrences of colour alteration.
Note 3 : The colour parameters are sometimes also referred to as tint (hue), clarity/brightness/value (lightness) and saturation (chroma).
(Source: Normative Standard CEN/TS 17135:2020)