Non-invasive investigation of a 26th Dynasty painted fragment from the Palace of Apries in the Ny Carlsberg Glyptotek, Copenhagen

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Fig. 1 Fragment of painted relief from the Palace of Apries, ÆIN 1058, 26th Dynasty, 589–568 BCE. H. 10.5 cm; W. 8.0 cm; D. 2.0 cm. Actual size. Tungsten light imaging.

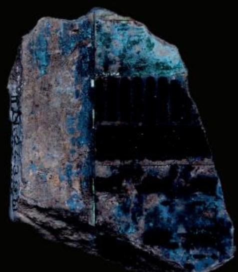

Fig. 2 UV-induced luminescence image.

Fig. 3 Visible induced luminescence image.

Fig. 4 Area of XRF-analysis.

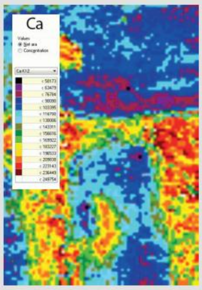

Fig. 5 Concentration (ppm) and spatial distribution of Ca.

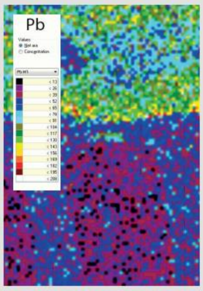

Fig. 6 Concentration (ppm) and spatial distribution of Pb.

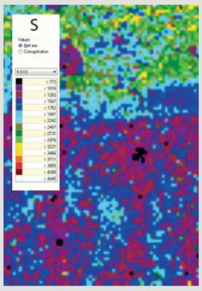

Fig. 7 Concentration (ppm) and spatial distribution of S.

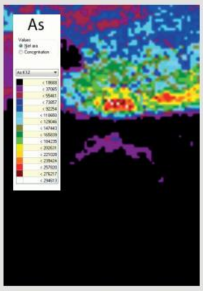

Fig. 8 Concentration (ppm) and spatial distribution of As.

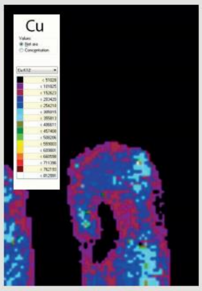

Fig. 9 Concentration (ppm) and spatial distribution of Cu.

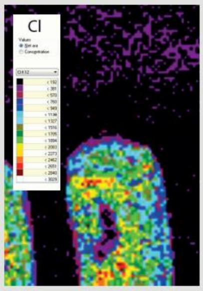

Fig. 10 Concentration (ppm) and spatial distribution of Cl.

INTRODUCTION

W.M.F. Petrie's excavations at the north end of Memphis unearthed in 1909 remains of the royal palace of Apries, 26th Dynasty, 589–568 BCE. That same year the Glyptotek in Copenhagen received a number of painted limestone relief fragments belonging to the palace.[1] Unfortunately Petrie gave no details as to where in the palace the fragments were found and the original setting remains today unknown. However, it is safe to say that they are pieces of a monumental wall decoration that could have adorned the great gate of the palace. Since 2009 the museum has been dedicated to research in antique polychromy and within the frame of 'Transmission & Transformation' – an interdisciplinary research project dedicated to ancient polychromy in an architectural context – the original colouring and painting techniques of the fragments are being investigated.[2]

This poster presents preliminary results from the documentation and analysis of the small, painted limestone fragment showing a section of the *serekh* frame. The frame is carved in slightly raised relief and painted in bright colours. The name of the king, now lost, was written in the upper, yellow part of the frame, while the lower part was decorated with a pattern imitating the façade of a palace (fig. 1).[3]

METHODS AND MATERIALS

Due to the delicate, meticulous painting of the fragment emphasis was placed on non-invasive methods of examination and analysis with focus on the elemental composition of the paint layers. A combination of different modes of analytical techniques was selected. Initially the paint layers and signs of deterioration were examined with a handheld digital microscope (LEICA DVM 5000). The visual examination was followed by ultraviolet fluorescence imaging (UVL) to investigate the distribution of luminescent materials such as organic binders and colorants, and visible-induced luminescence imaging (VIL) to characterize the spatial distribution of the synthetic pigment Egyptian blue.[4] Finally, a portable µ-XRF spectrometer (ARTAX-800) made possible a non-destructive analysis in the element range from Na (11) to U (92) and spatial mapping within a limited area. The area of analysis covers all colours represented on the fragment with the exception of the black paint.

RESULTS AND DISCUSSION

The surface is weathered and, in addition to the extensive micro cracks, parts of the original painting have been lost, thus exposing the underlying limestone. Prior to the painting, guidelines were incised with a pointed instrument into the limestone. The preparatory incisions are visible to the naked eye where the paint is lost.

The painting of the fragment is divided into two parts: the left half bears only a white ground whereas the right half is painted in green, yellow and red colours on top of a white ground. The green-coloured elements, which are supposed to resemble vegetal growth adorning the palace façade, are usually framed by a bright red outline. Red colour also appears in a somewhat darker and irregular version on parts of both the yellow and green colour. The black paint is limited to the lower section of the fragment forming parts of the green decoration.

White:
UVL imaging shows two different luminescence phenomena related to the white ground (fig. 2). The white ground which is partly visible beneath the yellow colour appears green whereas the remaining white ground on the rest of the fragment displays a more blue luminescence. µ-XRF spectrometry shows a high concentration of Ca which is limited primarily to the white ground between and right above the green leaves (fig. 4 and fig. 5). It can be ascribed to calcium carbonate. However, analysis of the white ground beneath the yellow layer provides new and unexpected results. The spectral analysis reveals a relatively high concentration of Pb (fig. 6).

Yellow:
The bright yellow colour emits a greenish luminescence in UV-light (fig. 2). µ-XRF spectrometry of the colour reveals a high concentration of S (fig. 7). Also, As is found in high concentrations in the upper half of the fragment and the elemental composition suggests orpiment, a natural arsenic sulphide, As_2S_3, with its characteristic bright yellow colour and strong tonality (fig. 8).

Green:
The green-coloured details appear completely dark under UV-light and are composed of an absorbent and non-fluorescing material (fig. 2). According to the spectral analysis the green colour contains both Cu and Cl which can be attributed to atacamite ($Cu_2(OH)_3Cl$); a green orthorhombic copper chloride hydroxide mineral used in its synthetic form (fig. 9 and fig. 10). Even if the intentional use of such basic copper chlorides as green pigments are mentioned in the literature[5] it is notable that they are more frequently attributed to the degradation of other copper-containing pigments, including malachite and green frit.[6] VIL-imaging reveals extensive luminescence properties of Egyptian blue (fig. 3). A regular distribution of relatively uniform grains shining bright white are observed on the main part of the fragment whereas a more dense concentration is restricted to the leaf ornamentation appearing green in tungsten light. There is microscopy-derived evidence that the blue pigment exists only in minute amounts mixed with various pigments to obtain tonal variations. In this context it is notable that µ-XRF does not reproduce the same picture but depicts the content of Cu spatially restricted to the green leaves.

Red:
It is not possible to distinguish the bright red outline and the superimposed red layers also appear dark and non-fluorescing on the UVL image (fig. 2). The red colours on the fragment can be affected by the absorbent properties of the green and yellow colours and does not imply the absence of organic materials. Furthermore µ-XRF analysis shows no evidence of the elements Fe, Hg or Pb and the content of As belongs to the yellow colour. This rules out the use of the most common inorganic pigments like ochre and realgar. Also vermillion and red lead pigments not attested before the late Ptolemaic period are unlikely and the red colour remains at present unidentified.[7]

CONCLUSION

The non-invasive examination and analysis of the painted fragment point in different directions. Part of the chromatic scheme is well attested. Copper-based pigments such as the synthetic Egyptian blue and atacamite were commonly used. Calcium carbonate experienced wide application in time and space from the 5th Dynasty to the Roman period and the use of orpiment is certainly attested from the Middle Kingdom and has been identified on a number of monuments.[8] But the discovery of lead points in various directions. The introduction of artificial-lead-based pigments such as lead white is usually attributed to the influence of the Graeco-Roman tradition.[9] The palace complex was most likely redecorated during the reigns of Apries' successors which could explain the introduction of lead white used as a second, finer ground. However, an alternative explanation might be that the lead content is related to the yellow colour. Mimetite ($Pb_5(AsO_4)_3Cl$) is a lead arsenate mineral that has a bright yellow colour. This could explain the content of both Pb and As in the upper part of the fragment. But although mimetite has been found associated with sculptural and architectonic polychromy it remains rare as a pigment and the discrepancies in these preliminary results necessitate more conclusive findings.[10]

ACKNOWLEDGEMENTS

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— Copenhagen, November 2014

REFERENCES

1 Bagh, T. (2011). 'Finds from W.M.F. Petrie's Excavations in Egypt in the Ny Carlsberg Glyptotek' in *Meddelelser fra Ny Carlsberg Glyptotek*. No. 13 Copenhagen: 37–43

2 Cf. www.trackingcolour.com

3 See note 1

4 Dyer, J., Verri, G. and Cupitt, J. (2013). *Multispectral Imaging in Reflectance and Photo-induced Luminescence modes: A User Manual*. British Museum.

5 Eastaugh, N., Walsh, V. Chaplin, T. and Siddall, R. (2004). *Pigment Compendium. A Dictionary of Historical Pigments*. Oxford: 27–28

6 Bonizzoni, L., Bruni, S. Guglielmi, V., Milazzo M. and Neri, O. (2011). 'Field and Laboratory multi-technique analysis of pigments and organic painting media from and egyptian coffin (26th dynasty)' in *Archaeometry* Vol. 53, 6. Oxford: 1212–1230

7 Cartwright, C. and Middleton, A. (2008) 'Scientific aspects of ancient faces: mummy portraits from Egypt.' in *The British Museum Technical Research Bulletin*. Vol. 2. London: 59–66

8 Lee, L. and Quirke, S. (2000). 'Painting Materials' in P.T. Nicholson and I. Shaw (eds.), *Ancient Materials and Technology*. Cambridge University Press: 107–116

9 Eastaugh, N., Walsh, V. Chaplin, T. and Siddall, R. (2004). *Pigment Compendium. A Dictionary of Historical Pigments*. Elsevier, Oxford: 233–235, 285–286

Scott, D.A., Warmlander, S., Mazurek, J. and Quirke, S. (2009). 'Examination of some pigments, grounds and media from Egyptian cartonnage fragments in the Petrie Museum, University College London' in *Journal of Archaeological Science* 36, Elsevier: 923–932.

10 Rouveret, A. and Walter, P. 'La peinture des stèles hellénistiques d'Alexandrie' in *Art & Chimie. La couleur. Congrés International sur l'aport de la Chimie aux œuvres d'art*, 16–18 Septembre 1998: 131–132

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