PIGMENT ANALYSIS OF A HAN POTTERY JAR, FANGHU

ASA PARIS: FRANCINE MAURER AND BERTRAND DUBOSCQ

This study was carried out using scanning electron microscopy in association with energy-dispersive X-ray spectrometry (SEM/EDS).

The four colours presented on the lid (white, green, red and blue) were analysed.
A sample of white pigment was removed together with its pottery support and incorporated in an epoxy resin. A microsection perpendicular to the surface was then produced in order to obtain a stratigraphic picture of the painted layer.

The white pigment corresponds to the association of two types of silicated mineral phases: sodic-potassic feldspars and white clays of the illite type. We also identified some rare particles of zircon and ilmenite (iron and titanium oxide).
Feldspar particles are angular. They had been crushed, and the clay probably played something of the role of binding agent in the pigment. This white had been applied directly to the pottery, which presents a very fine, iron-rich slip.

The green consists of a white phase associated with green-coloured particles.
The white phase corresponds to the white pigment described above, with a slightly higher content of iron oxide.
The green particles are crushed fragments of malachite (carbonate of copper). These malachite particles present a characteristic fibrous pattern, which is indicative of a phase of change (resulting from dissolution) after the painted decoration had been applied.

The red pigment is very crumbly and of heterogeneous appearance. It consists of crushed cinnabar combined with numerous particles of silicated minerals. These probably correspond to the impurities that occur naturally with cinnabar and indicate that the pigment is of natural origin.

The blue pigment presents a slightly violet hue. It is made up of blue or purple particles associated with colourless particles.
Analysis of the blue or purple particles reveals that these silicates of barium and copper contain traces of lead and aluminium. The colourless particles display barium, silicon and lead among the major elements.
This is a pigment type that is synthetic and is typical of the Han period. It was described for the first time in 1992 by E. West FitzHugh and L. A. Zycherman[1]. Depending on variations in composition, it may present itself in the blue ('Han blue') or purple ('Han purple') form. These authors also observed colourless particles analogous to those that we identified in the pigment on this jar. They believe they correspond to a change in the blue or purple particles related to an acidic environment in the tombs or the burial stratum.

As far as this object is concerned, therefore, we can report at least two types of modification in the pigments that are associated with natural evolution over a long period of time: the dimming of the blue or purple Han colour and the dissolution of the malachite particles.
We must also report the presence at the surface of certain siliceous test samples of fresh-water algae of the diatom type, which prove that the object was located in an extremely damp environment.

All the pigments identified - and in particular the blue - are characteristic of the painting techniques of ancient China. These mineral pigments were probably all associated with an organic binder which we did not identify in the samples, probably because it would have vanished as changes to the pigments occurred over time.

Note 1 E. West FitzHugh and L. A. Zycherman, 'A purple barium copper silicate pigment from early China', Studies in Conservation 37 (1992), 145-154.

Photo 1

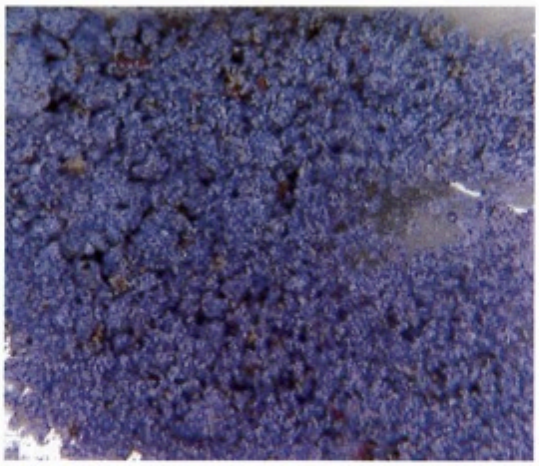


Photo 4

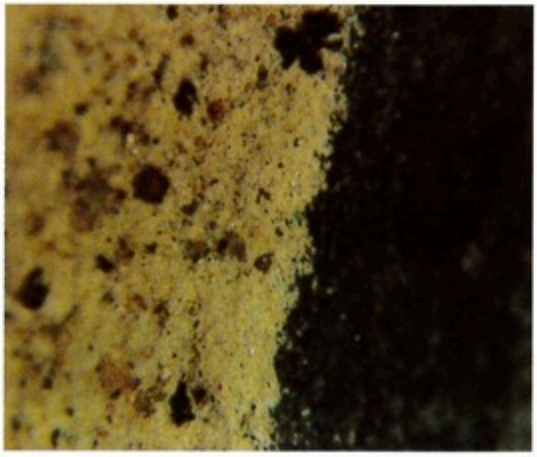
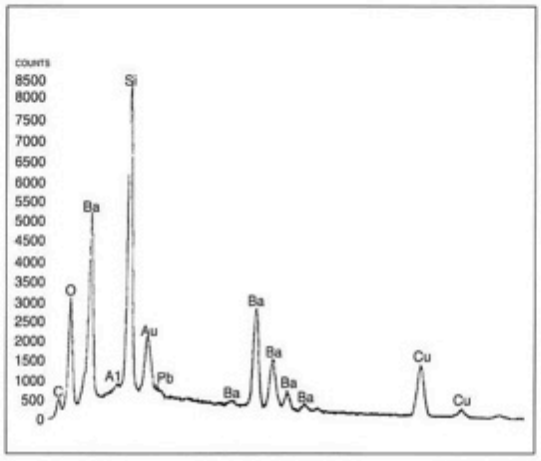


Photo 2



Spectrum 5

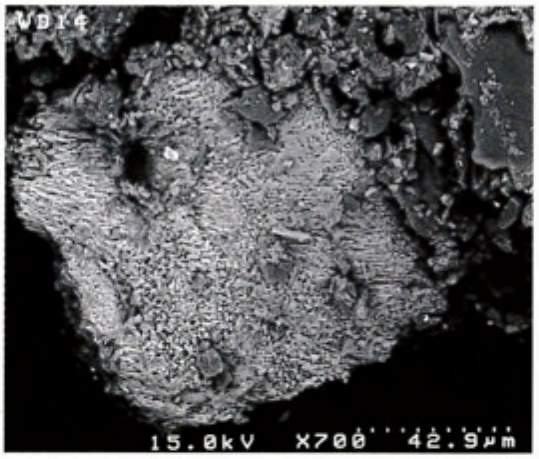


Photo 3

Photo 6

Photo 1 : White pigment : detail view of the contact between the pigment (upper part of the photography) and the ceramic (down). A very thin slip can be observed on the ceramic surface (microsection, SEM, x130).

Photo 2 : Detail view of the green pigment, mixing the white pigment with green malachite crushed particles (stereo-microcospe, x42).

Photo 3 : Detail view of a malachite particle, with a fibrous alteration morphology (SEM, x700).

Photo 4 : Detail view of the blue pigment, mixture of blue, purple and colourless particles. (stereo-microscope, x42).

Spectrum 5 : X-ray analysis spectrum of a purple particle : barium copper silicate (gold present on the spectrum is related with the sample metal coating for the SEM observation).

Photo 6 : Detailed view of the red pigment : crushed particles of cinnabar (mercurie sulphide), naturally associated with silicate impurities (stereo-microscope, x42).