

A study of scarlet inks from an ancient Egyptian temple library under synchrotron lights

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A hitherto unidentified complex composition was recently brought to light by synchrotron-based X-ray microscopy in red inks inscribed on papyri from the only institutional library to survive from ancient Egypt – the Tebtunis temple library. X-ray fluorescence (XRF) mapping revealed the presence of iron (Fe) and lead (Pb) compounds in the majority of 12 red inks that were analyzed at the ESRF on beamline **ID 21**. The iron-based compounds in the inks could be assigned to ocher, notably due to the co-localization of Fe with aluminum (Al), and the detection of hematite by micro X-ray diffraction (μ XRD). Using the same techniques together with micro Fourier transformed infrared (μ FTIR) spectroscopy analyses, the Pb was shown to be bound to fatty carboxylate and phosphate groups, thereby contesting the naïve and generic hypothesis that primarily associates the presence of Pb in ancient Mediterranean red pigments with minimum (Pb_3O_4) or other red/orange crystalline phases such as ithagite (PbO) and massicot (PbO). XRF maps performed at higher resolution accentuated a peculiar distribution and co-localization of Pb, phosphorus (P) and sulfur (S), which were present at the micrometric scale as a sort of diffused “coffee rings” surrounding the ocher in the red letters, and at the sub-micrometric scale concentrated in the papyrus cell walls (fig. 1). These elements and their co-localization support the use of Pb (mixed with a lipid binder) as a drying agent in ancient Egyptian and Mediterranean inks – as it was later employed during the development of oil painting in 15th century Europe – and not as a pigment.

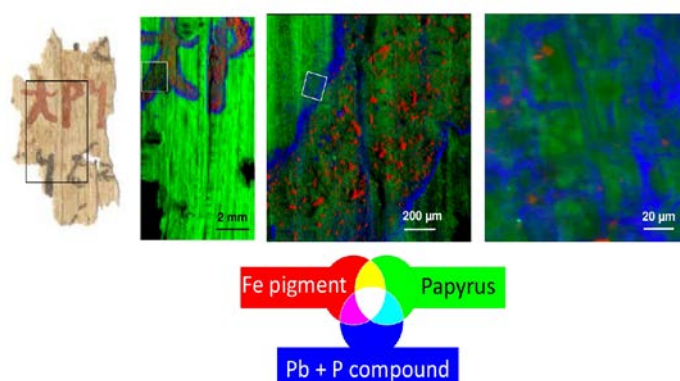


Figure 1: Macro- and μ XRF maps showing the distribution of ocher/Fe (red) and the co-localization of Pb and P (blue) in a red ink inscribed on an Egyptian papyrus (green). The papyrus fragment derives from the Tebtunis temple library and forms part of a long astrological treatise (P. Carlsberg 89) that date to 1st century CE.