Novel approach for characterising archaeological textiles exceptionally preserved in a mineralised form based on 2D and 3D synchrotron micro-imaging

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As most organic materials, textiles fibres are perishable in archaeological contexts. Nevertheless, in specific environments they may be preserved over millennia, for example in contact with metal objects. The corrosion of the metal support can enable an exceptional preservation of textile remnants in a process called "mineralisation" by archaeologists. The underlying physico-chemical mechanisms have been the subject of a very limited number of studies. An in-depth understanding of the causes and the conditions of this phenomenon, as well as of the variability of the involved processes, is yet to be achieved.

We report the study of mineralised linen fabrics identified at the surface of copper-based artefacts coming from Mesopotamia (Telloh and Susa sites, 5th–2nd millennium BC) and in the Indus areas (Nausharo site, 4th millennium BC; Gonur-depe site 3rd–2nd millennium BC), currently conserved and under study at the Louvre and the Quai Branly museums. In Mesopotamia, these finds are major direct testimony of textile manufacturing from the corresponding cultures, otherwise uniquely known from cuneiform texts.

2D and 3D synchrotron-based micro-imaging techniques were carried out to characterise in a non-destructive way these organic textile remnants in connection with the inorganic corrosion compounds. We performed and optimised synchrotron X-rays micro-computed tomography to identify and locate the distinct copper corrosion phases formed, on the basis of difference in their density. Preliminary tests using high-spatially resolved synchrotron UV/visible photoluminescence spectral imaging were performed to investigate the heterogeneity of individual mineralised bundles of fibres. We reveal the internal structure of these mineralised textile fibres in connection with the corrosion phenomena, and discussed the different mineralisation facies observed.

The present work illustrates the potential of 2D and 3D synchrotron micro-imagery to study mineralised textiles in association with metal objects.

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