NÉEL INSTITUTE Grenoble

Topic for Master 2 internship – Academic year 2022-2023

Degradation process of ancient colored papyruses

General Scope:
A large number of written and illustrated papyruses from ancient Egypt have survived through the ages, carrying stories, practices, and numerous details of the everyday life in Egypt several millennia ago. The vivid colors still visible today were preserved across centuries mainly because of the inorganic nature of most of the pigments To be used as ink or paint, pigments were usually mixed with an organic binder and water. The use of a drier that would improve the adherence of the paint is also mentioned in a few studies. Different shades could be obtained by mixing several pigments. As a result, the preparation of a single color could be quite complex, with organic and inorganic components mixed together. Ancient illustrated papyruses have been exposed to different environments over time, with temperature and humidity variations, and possible contacts with other materials during transport and storage. As a result, internal chemical reactions and phase transformations may have been promoted by different factors, over time scales today difficult to apprehend. The Champollion museum (Département de l'Isère, Vif, France) conserves a series of papyrus fragments, preserves over centuries by the Champollion family. The largest ones represent illustrated scenes from the Book of the Dead, a document essential to prepare for the afterlife in ancient Egypt. We have established a multi-disciplinary collaboration between the Champollion museum (département de l'Isère, Vif, France), the Institut Néel (Grenoble, France), and the European Synchrotron Radiation Facility (ESRF, Grenoble, France), with the object of studying these illustrated papyruses. During the course of our investigations, in most of the colored regions, we noticed the presence of specific compounds clearly resulting from a degradation process.

Research topic and facilities available:
The objective of the internship is to gain insights into the degradation processes taking place over the illustrated papyruses of the Champollion collection. In a preliminary investigation, we identified different sulphate-based phases in the red and the yellow regions, as well as several chloride-based phases in the green and white regions. The reaction mechanisms resulting in the presence of these degradation phases is still not well understood. In order to investigate the reaction paths leading to the degradation affecting the different colored regions, a series of papyrus fragments will be mapped using synchrotron X-ray diffraction (XRD) and fluorescence (XRD), Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray analysis (EDX). Elemental and structural maps will be reconstructed in order to gain insight into the distribution of the degradation products in each of the colored regions and at their interfaces, in relation with the chemical reactions leading to the degradation affecting the different colored regions. The experimental results will be confronted with the literature.

Possible collaboration and networking:
Part of the internship will be done at the high-resolution powder diffraction beamline ID22 of the ESRF (contact: Catherine Dejoie).

Possible extension as a PhD:
A project to obtain the funding of a three-year PhD is being deposited.

Required skills:
Master in Materials Science or Chemistry, good communication skills, interest in ancient materials, some knowledge about SEM, EDX or XRD would be an asset.

Starting date: spring 2023

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