Medieval Ethiopian Church Paintings: Characterisation of pigments using XRD and Micro-Raman Spectroscopy

Experiment number: **01-02-1006**

The experiment was conducted at station A of SNBL during the period 29th - 31st July, 2013 on samples from different Ethiopian Church paintings. The main objective of the experiment was to identify the mineralogical phases in the painting and preparatory layers of the painting samples prepared for stratigraphical investigations. The cross-section samples were prepared by embedding the paint samples in resin and polishing them in such a way that the different layers of the painting are visible. In order to suppress the broad band observed, originating from the embedding medium in previous preliminary examinations, the thickness of the embedded samples was reduced to few millimetres.

This experiment is a follow-up of the powder XRD measurements on SNBL B (01-01-880) on unembedded samples carried out using the unfocussed synchrotron beam. Though identifications of mineral phases were achieved from the paint micro-samples, it was essential to employ focused beam to investigate materials used in the different layers of the painting cross-section samples. Considering the highly heterogeneous painting samples of 100-500 microns in size, an XRD technique with a suitable spatial resolution was crucial. The newly set-up multi-purpose diffractometer, with a Pilatus 2M pixel area detector, at station A of the SNBL offers the possibility for the investigation of the paint micro-samples collected from Ethiopian murals and icons. The much improved optics and mechanics of the diffractometer and slit system permits to define very precisely a beam size down to about 10 x 10 microns, and to maintain the beam position on the sample during a diffraction data collection. In this experiment, we have used 100x100 microns to focus on the painting and preparatory layers. 30 samples were examined in the experiment. The wavelength of the X-ray used was 0.70158 Å. The results obtained from other techniques (such as the elemental information from SEM-EDS and micrographs from optical microscopy) will be used in the course of the interpretation of the XRD data. Micro-Raman measurements were not conducted as they can be done off-line at a later time. The unambiguous identification of the paintings materials and artistic techniques employed are important in planning well-informed

conservation interventions and art historical investigations of the Christian painting tradition of the region.

We are very satisfied with the data collected from the facilities at SNBL and the generous expertise and support provided by the staff.