	Experiment title:	Experiment number:
	In situ XANES imaging of sulphur species and heavy metals/REEs in 3.472-3.44 Ga microfossils	EC-158
Beamline: ID21	**Date of experiment**: from:05.07.07 to:09.07.07	**Date of report**: 28.02.08
Shifts: 12	**Local contact(s)**: Murielle Salomé	*Received at ESRF:*

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Report:

The establishment of biogenicity in very ancient fossil microorganisms is at present one of the most important criteria in the search for the most ancient traces of life. Utilisation of specific techniques, such as **XANES** analysis and imaging of organic and inorganic sulphur species, represents a very important tool in the battery of techniques used.

This method has been recently demonstrated by our group on relatively large (20 µm) achritarch microfossils 800 My-old from the Draken Formation on Spitzbergen (Lemelle et al., 2008 – see abstract below).

The study of very ancient microfossils has recently raised contentious issues regarding interpretation of the biogenicity of the structures. In situ investigation of certain elements, such as sulfur, within potential microfossils is a powerful complement to other methods of investigation that can provide valuable information on biogenicity. We present here a first such study on Precambrian microfossils from the 700-800 My-old Neoproterozoic Draken Formation, Svalbard, using scanning X-ray microscopy (SXM) in fluorescence mode and X-ray absorption near edge spectroscopy (XANES) at the sulfur K-edge. SXM allowed mapping of up to 300 ppm of probably endogenous sulfur within the kerogenous walls of *Myxococcoides chlorelloidea* microfossils. XANES showed that the sulfur is most likely contained in heterocyclic organic compounds, such as thiophene.

See Organic Geochemistry (2008) 39, 188.

A recent preliminary study had been previously undertaken to test the feasibility of using XANES on a 3472-3333 My-old microbial mat from the Onverwacht group in South Africa, one of the oldest biomarkers known

to date. **Organic S** was found to be associated with the kerogenous remains of the mat. However, a protective coating of Pt on the sample surface (above the microbial mat) produced fluorescence that disturbed the S signature and it was therefore necessary to repeat the experiment on a non Pt-prepared section of the microbial mat in order to have maps and spectra that are acceptable for publication.

References

Lemelle, L., Westall, F. et al.,2007. In situ imaging of organic sulfur in 700-800 My-old Neoproterozoic microfossils by X-ray spectromicroscopy at the S K-edge. Organic Geochemistry, 39, 188-202.

F. Westall, L. Lemelle, A. Simionovici G. Southam, L. LacLean, M. Salomé, S. Wirick, J. Toporksi, A. Jauss.Vertical geochemical profiling across a 3.33 Ga microbial mat from Barberton. 39th LPSC, Houston Texas 10-14 March 2008 # 1636