Putative biogenic signature found in extremely REE enriched black substance, Ytterby mine, Sweden

S. SJÖBERG[1]*, J. E. RATTRAY[1], N. CALLAC[1], B. ALLARD[2], A. SKELTON[1], C. DUPRAZ[1], M. IVARSSON[3], S. KARLSSON[2] AND V. SJÖBERG[2]

[1]IGV, Stockholm University, SE-106 91 Stockholm, Sweden (*correspondence:susanne.sjoberg@geo.su.se)

[2]Man-Technology-Environment Research Centre (MTM) Örebro University, SE-701 82 Örebro, Sweden

[3]Department of Paleobiology and NordCEE, Swedish Museum of Natural History, Stockholm, Sweden

Characterization of a black substance seeping from fractured bedrock in a subterranean tunnel revealed a manganese and calcium bearing substance highly enriched in rare earth elements (REE). This tunnel is dry and at shallow depth and was built to convert the former Ytterby mine, into a fuel deposit for the Swedish Armed Forces. To keep the tunnel dry, groundwater level is kept below its natural level which has resulted in oxidizing conditions in a previously dysoxic or anoxic environment. The deposition of the substance therefore occurs in a dark and moist environment which was exposed to changing redox conditions.

Geochemical analysis show that the substance is enriched in REEs with concentrations one to two orders of magnitude higher than in the surrounding rocks. X-ray diffraction spectra indicate that the main component is birnessite. SEM revealed an internal lamination of these Mn-oxides implying an iterative change in production. Previous results show that REE occurrences in Ytterby are localized within pegmatites in the mine. It is thus suggested that Mn colloids, suspended in the local groundwater, work as metal traps and contribute to the mobility of the REEs. The black substance is suspected to act as a sink for these metals in the Ytterby mine area.

The influence of microorganisms on the accumulation of Mn-oxides appears to be important. The occurrence of the C_{31} to C_{35} extended side chain hopanoids among the identified biomarkers provides evidence of bacterial presence in the depositional environment. The abiotic vs biotic origin of the precipitated manganese was investigated by electron paramagnetic resonance spectroscopy. The substance is composed of two or more components, with one part having a biogenic signature. Ongoing investigations of the microbial communities and the REE accumulation processes include $\delta^{13}C$ analysis of the extracted lipids, DNA deep sequencing, quantitative PCR and sequential leaching.