Lab simulations of long term diagenetic fate of biomass in Banded Iron Formations

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Banded Iron Formations (BIFs) are Precambrian sedimentary deposits of alternating iron oxide and silica mineral layers. Despite decades of intensive research the formation of these iron ores remains largely a mystery also due to a lack of modern analogues. Phototrophic iron(II)-oxidizing bacteria have been proposed to explain how early BIF sedimentation and iron oxidation can take place in the absence of oxygen. These bacteria could have oxidized hydrothermal dissolved ferrous iron to ferric iron mineral particles that slowly settled down to submerged basins together with biomass formed during microbial oxidation. After sedimentation, diagenetic and/or metamorphic transformations of minerals alters the original sediments, which alters primary textures. We are experimentally simulating the transformation of biotically and abiotically formed iron minerals and mineral-organic matter associations in order to test wether abiotic and biotic reactants yield the same reaction products such as hematite, siderite and magnetite and whether transformation of microbially-produced minerals preserves biosignatures that can be traced in BIFs. To this end, iron minerals amended with biomasss or cell-iron-mineral aggregates are incubated in gold capsules for different time periods and P/T conditions of 1.2 kbar and 170°C. Mineral and organic transformation products are analysed by reflected light microscopy and XRD. Raman spectroscopy is carried out in order to evaluate the maturity of the carbonaceous material after being subjected to these ranges of conditions. Samples will be analysed by Nano secondary ion mass spectroscopy (nano-SIMS) to accomplish a qualitative trace elements analyses of the main biological elements CHNOPS in the material and to determine the distribution of these elements during diagenesis. In addition organic biomarker analysis is carried out by GC-MS. The aim of this subproject is to understand which biomarkers are preserved, as well as to clarify which compounds can be preserved under BIF relevant conditions and can therefore be looked for in the rock record.

Temporal variations in the export of REE in boreal catchments of varying character and size

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Organic matter and iron colloids have a large impact on the mobilisation of trivalent elements such as aluminium (Al), rare earth elements (REE) and actinides. Recent results of the relative importance of these colloids are contradictive [1]; [2] and there is a lack of information of the importance of flow pathways and landscape characteristics on the relative importance of the various colloidal fractions that mobilize REE. Several speciation techniques including ICP-MS-FFF, column separation and ion exchange were used to identify and quantify the mechanisms driving the temporal variation of the trivalent ions in a series of catchments with varying size and character. REE export is mostly strongly controlled by landscape type while changes in the character of organic matter are of minor importance. We suggest that the temporal variability of the flow pathways in the riparian zone can be used to decipher the effect of chemical versus physical processes for the mobilisation of REE and Al and/or iron. using the speciation program WHAM VI [3].

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