Competition and interrelation of iron(II)-oxidizing microorganisms in marine and freshwater sediments

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Microorganisms can oxidize Fe(II) with oxygen (microaerophilic Fe(II)-oxidizers (FeOx)), with nitrate (nitrate-reducing FeOx) or with light (anoxygenic phototrophic FeOx). So far it has not be shown that these three physiological types of neutrophilic FeOx occur in the same habitat. Therefore the major objective of this research project funded by the European Research Council is to isolate and study representatives of the three different metabolic types from the same marine (coastal region in *Aarhus Bay*, Denmark) and freshwater (*Lake Constanze*, Germany) sediment. This interdisciplinary study uses expertise ranging from geomicrobiology, molecular microbial ecology, geochemistry, microscopy and mineralogy.

The first goal is to localize, quantify, cultivate, isolate and identify representatives of all three metabolic types of FeOx by using enrichments, microcosms and stratified sediment columns. Geochemical analyses of O_2, Fe(II), Fe(III), nitrate, DOC, TOC, TIC, pH, E_h and major ions are done by microelectrodes, spectrophotometric quantifications, ion chromatography and flow injection analysis (FIA). Molecular biological methods like qPCR, ITS assays, SIP and FISH are used for quantification of FeOx activity and for analysis of distribution of FeOx with high spatial resolution. To quantify the FeOx in the sediment, the most probable number count method and qPCR are used. In chemostat experiments we study the interaction and competition among these microbes.

The second goal is to determine the consequences of Fe(III) mineral formation by FeOx for the fate of metals (Ni^{2+}, Co^{2+}), nutrients (nitrate, phosphate) and the formation of greenhouse gases (N_2O). The third goal is to identify the biominerals produced by the FeOx by using XRD and Mössbauer spectroscopy. SEM and CLSM are used to characterize cell-mineral aggregates formed during Fe(II) oxidation. First results show that in both studied environments (marine and freshwater sediments) all three different metabolic types of FeOx indeed coexist in the upper sediment layers. Ultimately we intend to better understand iron oxidation on early Earth and the role of FeOx in deposition of precambrian BIFs.