Hafnium in the Arctic Ocean

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While Hf isotopes can serve as an important paleoceanographic tracer, interpreting Hf records requires understanding the distribution and behaviour of Hf in the present oceans by expanding the very limited data available. We now have concentrations and isotopic compositions of dissolved Hf in seawater from across the Arctic Ocean [1]. Combined Arctic Hf-Nd isotope compositions do not fall on the positive correlation for mantle and crustal rocks, but rather on the array of Fe-Mn crust data [2], with ε_{Hf} values of -1.9±0.8 to 6.8±1.8 that are more radiogenic than rocks with similar ε_{Nd} values. Arctic seawaters generally fall on the lower part of the array, reflecting influences of inputs from Arctic rivers and interactions of shelf waters with underlying sediments. Arctic rivers have much higher Hf concentrations (7-30 pM) than Arctic seawaters (0.36-4.2pM). The Mackenzie River has distinctively low ε_{Hf} values, and Hf concentration and ε_{Hf} relationships can be used to show that there are substantial Hf losses during estuarine mixing, though riverine Hf still has a substantial influence further in the deep basin. In the Amundsen, Makarov, and Canada basins, Hf concentrations are highest at the surface, reflecting inputs of Hf from the Ob, Yenisey, and Lena Rivers and of waters that have flowed over the extensive Siberian continental shelves and have Nd and Hf characteristics reflecting water-sediment interactions. Data for Hf in waters from the Siberian shelves and underlying sediments, collected during the recent ISSS08 cruise, are used to constrain how Hf is lost during estuarine mixing, and how underlying sediments modify the Hf signature in shelf waters.

[1] Zimmermann *et al*. (2009) *GCA under rev*. [2] Albarède *et al*. (1998) *Geophys. Res. Lett.* **25**, 3895-3898.

Magnetic susceptibility analysis as a tool to follow geomicrobiological transformation of Fe-minerals

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Iron mineral (trans-)formations are widely studied because of their environmental relevance. Following changes of iron mineralogy in laboratory or field experiments usually requires sampling and mineral analysis over time. However, in particular in lab studies sampling may disturb and thus change the system, especially in set-ups with small volumes or when larger sample amounts are needed for analysis. In order to circumvent this problem we tested if magnetic susceptibility (MS) measurements at room temperature can be used as a non-invasive tool to follow magnetic mineral (trans-)formation by Fe(III)-reducing bacteria and in soil microcosms.

In order to evaluate the MS method and to identify under which geochemical conditions magnetite [Fe_3O_4] can be formed microbially, the iron(III)-reducing strain *Shewanella oneidensis* MR-1 was incubated with ferrihydrite in the presence and absence of humic substances. An increase in MS over time correlated well with the formation of magnetite identified by µ-X-ray diffraction. In presence of humic substances the rate of microbial Fe(III) reduction was higher. MS measurements, however, revealed that the formation of magnetite occurred later than in the absence of humics. This suggests that the presence of humic substances that are known to strongly sorb to iron(III) mineral surfaces inhibits or delays the formation of crystalline iron minerals.

Microcosms with different soils amended with different C sources (none, lactate-acetate, gasoline) were set up to determine if MS measurements can also detect magnetic iron mineral (trans-)formation in complex samples with low iron content. The MS of microbially active microcosms with different soils either increased or decreased over time, indicating that magnetic iron minerals were formed or transformed. A change in iron mineralogy was confirmed by 0.5 M HCl iron extraction followed by iron species analysis. In contrast, no change in MS and extractable iron was observed in sterile controls. Therefore, it is evident that in these soil microcosms the (trans)formation of magnetic minerals was microbially catalyzed. MS measurements provide a useful tool to follow such mineral transformations without sampling.