Iron-cycling in various environments

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Iron (Fe) can limit the primary productivity in many regions like High Nutrient Low Chlorophyll (HNLC) areas od which the largest is the Southern Ocean (SO). In the Indian Ocean Sector of the SO there are two volcanically active islands: Heard and McDonald islands (HIMI) and Heard is covered with glaciers. While offshore waters are persistently Fe limited, near shore waters show a variable Fe distribution [1]. Whilst stations near the islands showed elevated Fe(II) thoughout the water column, the correlations indicate different sources: a sea-terminating glacier on the island vs. shallow diffuse hydrothermalism.

A contrasting sytem where Fe also plays a key role is in Eastern Boundary Upwelling Systems (EBUS) [2]. Where the oxygen minimum zones come into contact with the continental shelf, Fe(II) can be supplied from reducing sediments. To assess how much of this Fe makes it to the photic zone depends on mixing and the kinetics of redox and complexation processes. We measured Fe(II) and hydrogen peroxide in the water column and benthic boundary layer and applied a simple 1D mixing model. Our data indicate that throughout the OMZ, Fe(II) decay rates may be partially influenced by hydrogen peroxide, but it is most likely that nitrate-dependent anaerobic Fe(II) oxidizing (NDFO) bacteria are the main oxidizers.

[1] T.M. Holmes, K. Wuttig, Z. Chase, P. van der Merwe, A.T. Townsend, C. Schallenberg, M. Tonnard, A.R. Bowie, Iron availability influences nutrient drawdown in the Heard and McDonald Island region, Southern Ocean, Mar. Chem. (2019).
[2] P.L. Croot, M.I. Heller, K. Wuttig, Redox Processes Impacting the Flux of Iron(II) from Shelf Sediments to the OMZ along the Peruvian Shelf, ACS Earth and Space Chemistry (2019).