

Drivers of iron cycling in sediments of the sub-Antarctic island South Georgia

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Sediments of sub-Antarctic islands have been proposed to be important contributors to natural iron fertilization in the Southern Ocean [1, 2]. This potential contribution depends on biogeochemical processes within the sediment that may result in an iron benthic flux, most likely related to the degradation of organic matter (OM). Yet, the OM degradation pathways vary strongly among different sedimentary settings.

We elucidate the role of environmental factors on the prevailing biogeochemical pathways and reaction rates at three contrasting sites of South Georgia, using comprehensive solid-phase and pore-water analyses, as well as transport-reaction modelling. Samples were obtained along a transect from a glacial fjord towards the shelf during cruise ANT-XXIX/4 of RV POLARSTERN in 2013.

Oxygen penetration depth at all sites is <1 cm. Sediments recovered within the fjord are dominated by dissimilatory iron reduction (DIR) and show very high dissolved Fe²⁺ concentrations of up to 760 μM, while sulfide was not detected. In addition, Fe reduction below the sulfate/methane transition was observed. High input of reactive iron phases, possibly enhanced by bioturbation and bubble ebullition, appear to favour DIR as the dominant metabolic process for OM degradation in the basin like fjord.

Shelf sediments outside the fjord are sulfidic throughout, with H₂S formed primarily by anaerobic oxidation of methane. The conversion of Fe oxides into Fe sulfides significantly alters the initial sediment composition along the shelf, and impact the availability of iron to the water column.

OM is of marine origin at all three sites (C:N~7), indicating that Fe oxide availability and reactivity rather than the carbon source determine whether iron or sulfate reduction dominantes.

[1] Moore & Braucher (2008) *Biogeosciences* **5**, 631-656.

[2] Borriore et al., (2014) *Biogeosciences* **11**, 1981-2001.