Spatial distribution of reactive Fe(III) in Arctic fjord sediments – impact of different glacial sources and benthic Fe-cycling

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Runoff from glacial catchments is a significant source of Fe to high-latitude marine environments. A large fraction of the Fe from glacial sources deposits in fjord sediments close to glaciers. Within these sediments, the glacially derived Fe undergoes redox-cycling driven by indirect (abiotic reaction with metabolic products) and direct interactions with microorganisms.

Sequential and time-course extractions were used to determine the amount and reactivity of Fe(III) minerals from the meltwater plume, meltwater streams, icebergs, and sediments at stations with increasing distance from the glacier in three different fjords on the west coast of Spitsbergen, Svalbard. We found that Fe(III)-mineral reactivity increased with distance from the glacier fronts and decreased with depth at each station. Fe(III)-oxide reactivity from different glacial sources (meltwater plume and iceberg material of tidewater glaciers and meltwater stream material from land-terminating glaciers) differed based on source type and Fe(III) from sources was generally less reactive compared to surficial sediments distal to the glacier front. We conclude that glacial catchments supply large quantities of Fe minerals to fjord sediments but benthic recycling of Fe by microorganisms appears to be required to transform the relatively unreactive glacially-derived Fe(III)-oxides to a reactive form. Microbially driven recycling of reactive Fe(III)-oxides in fjord sediments may play a role in liberating Fe to the water column, predominantly at the mouth of the fjord, and might represent an unquantified source of Fe to Fe-limited marine phytoplankton.