Glacial influence on the iron and sulfur cycles in Arctic fjord sediments (Svalbard)

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Arctic fjord sediments of Svalbard receive clastic material from glaciers and labile organic matter from marine primary production. The ongoing retreat of glaciers in the high Arctic will alter the balance between clastic material and labile carbon, with unknown consequences for iron and sulfur cycles within fjord sediments. To investigate the role of the glacial input of Fe(III)-oxides on the rates and pathways of these cycles, in situ sulfate reduction rates and porewater geochemistry were analyzed and compared to long-term sediment incubations in three fjords on the west coast of Spitsbergen. Despite an abundance of glacially-sourced Fe(III)-oxide minerals, active sulfate reduction occurred in all three fjords. The composition of stable isotopes in sulfate suggested sulfide produced from biological sulfate reduction was reoxidized to sulfate. The rate and degree of sulfide oxidation varied between fjords and depended on the gross rate of sulfate reduction and the quantity of reactive Fe(III)-oxides delivered to the fjord sediments by glaciers. Over 128 days of incubation, biological and abiotic iron reduction caused a decrease in the highly reactive Fe(III) fraction (0.5 M HCl-extractable), but not in the more crystalline Fe(III) fraction (6 M HCl-extractable). Sulfate reduction was consistently detected and glacially-sourced Fe(III)-oxides served as oxidant for the produced sulfide in the incubation. The results show that sulfide oxidation in glacially-influenced fjord sediments is a widespread geochemical process, which will be affected by future change in metal oxide supply as glaciers melt and retreat.