Biogeochemical processing of glacially sourced trace metals in high-latitude fjord sediments

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Following release into the marine environment, trace metals derived from sub- and pro-glacial weathering processes are subject to biogeochemical processing in near-shore sediments, and may subsequently flux across the sediment-water interface. Therefore, glacially influenced sediments may be an important source of trace metals to the polar oceans. In the Arctic fjords of Svalbard (79° N), large amounts of reactive Fe and Mn oxides are delivered to the sediment by glacial discharge, while organic carbon is deposited episodically and diluted by lithogenic material. These conditions result in pronounced Fe and Mn cycling which drives rapid sulfide oxidation. Previous research indicates that the high Fe and low H_2S content allows benthic recycling and potentially out-fjord transport of Fe. In order to investigate the diagenetic cycling of other trace elements typically associated with Fe, we collected sediment cores from three Svalbard fjords and analyzed the pore water and solid sediment. Our data demonstrate the dynamic nature of these fjords, which are dominated by non-steady state processes and episodic events such as meltwater pulses, sediment deposition, and phytoplankon blooms. The analyses reveal close linkages between the cycling of some metals (e.g. Mn, Co, and Ni). Differential metal behavior, such as between Mo and U, may also indicate the dominance of some physical processes over others (e.g. diffusion vs. mixing). Our data show significant differences across a transect from head to mouth of at least one fjord that suggest a higher reactivity of metal-bearing minerals and potentially higher fluxes out of the sediment near the mouth. This study elucidates the biogeochemical cycling of trace elements in a dynamic, glacially impacted environment and will help us understand the role of fjords as sources of trace elements to a rapidly changing Arctic Ocean.