First insights into the biogeochemical cycling of (bioessential) trace metals in the proglacial zones of Arctic glaciers (Coastal Svalbard Norway)

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The Arctic is experiencing rapid climate change manifested in dramatic pan-Arctic sea-ice loss, thawing of permafrost, coastal erosion, and reduction of glacier volume. Importantly, many open questions remain regarding the linkages and feedbacks between biogeochemical processes, land-ocean interactions, and ecosystem functioning of the Arctic Ocean at present and in the future. Scientific data on the present status of the Arctic, as well as a process-based understanding of the mechanisms that drive its terrestrial and marine environmental change, are urgently needed to accurately predict and effectively plan for, adapt to, and mitigate the emerging climate and environmental changes.

Primary productivity and linked ecosystem functioning in high-latitude coastal ocean regions are proposed to be dependent on the delivery of iron and other bioessential trace metals from terrestrial glacial systems. Here, their bioavailable forms are released during (bio)geochemical weathering reactions. Changes in the pathways and rates of weathering processes as a result of glacier melting and retreat are suggested to have strong effects on the delivery of these metals to adjacent coastal waters. In Svalbard and other areas where tidewater glaciers are present, climate change is resulting in the development of proglacial floodplains following the disconnection of these glaciers from the ocean. In consequence, these areas are becoming major biogeochemical reaction zones, which is proposed to result in changes in the transfer of nutrients, such as phosphorus, nitrogen and reactive iron from the glaciers to the ocean. What is not known, is how chemical weathering processes, including pyrite oxidation and silicate weathering, affect the release of other trace metals to meltwater solutes, how these metals are subsequently cycled in the proglacial environment, and how these processes are affected by climate change. *To critically evaluate and accurately predict the effects of glacial retreat on the delivery of iron and other bioessential trace metals to high-latitude coastal waters, a detailed mechanistic understanding of the weathering processes that release these elements into solution in dissolved or other bioavailable forms and insight into the distribution and regulatory functioning of additional biogeochemical processes in the geomorphologically heterogeneous proglacial zone is crucial.*

This project aims at determining the pathways and controlling factors of the primary (microbially mediated) chemical weathering processes and secondary biogeochemical reactions that facilitate the overall transfer of bioessential trace metals from the glacial environment to adjacent coastal waters over the ablation season. The outcomes of this study will strengthen our capability to evaluate how climate change, manifested for example in glacier retreat and changes in glacial runoff volume, will affect glacier-ocean element transport and ultimately, the availability of bioessential metals for primary producers in high-latitude coastal waters. *Funding from the OVPR Seed Grant Program will ensure that an upcoming proposal to the NSF Arctic Natural Sciences Program will be highly competitive by allowing me to obtain an urgently needed preliminary set of geochemical data from distinct biogeochemical reaction zones within two Arctic proglacial areas, ultimately providing first insight into the release and subsequent cycling of a highly important set of trace metals in this environment, and thus the factors that modulate their discharge into adjacent coastal ocean waters.*