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Trace metal inputs and biogeochemical cycling in high Arctic fjords under rapid climate change

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The Arctic Ocean is undergoing rapid climate change resulting in significant reduction in multi-year sea ice, permafrost thaw and altered freshwater fluxes from glacial meltwater, sea ice runoffand river discharge. Arctic fjords, which form key interfaces between the cryosphere, terrestrial and marine systems, are significant sources of trace metal micronutrients and play an influential role in ocean biogeochemical cycling. This study quantifies trace metal distributions in several high arctic fjords including Archer Fjord, located in the Qikiqtaaluk Region of Nunavut on the eastern coast of Ellesmere Island, Nunavut. Samples were analyzed for dissolved (<0.2 um) and total seawater concentrations across a salinity gradient using a trace metal clean rosette system and in glacial runoff and river samples to characterize freshwater end-members during the 2024 expedition aboard the icebreaker CCGS Amundsen. Samples were processed offline using the seaFAST-pico SC-DX system and analyzed via Agilent 8800 ICP-MS/MS. We report on the distribution of biologically active, nutrient trace elements Mn, Fe, Co, Ni, Cu, Zn, and Cd as well as the potentially toxic element Pb. Fjords with both land and marine terminating glaciers were found to be significant sources of Mn, Fe, Co and Pb. Trace metal distributions also help to distinguish the provenance of waters transported south through Nares Strait into Baffin Bay. The distribution of trace elements and macronutrients provide insights into nutrient cycling, water mass transport and how high Arctic fjords may impact marine biogeochemistry under the influence of ongoing climate change.