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Isotopic Tracing of Trace Metal Micronutrients in Polar Fjords

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The dissolved concentration of trace metal micronutrients is a key control on modern ocean productivity, particularly in the polar regions [1] . Iron is considered the key limiting micronutrient, but other metals, including Zn and Cu, also regulate primary productivity in Fe-depleted regions [2,3]. At the present day, rivers draining glaciated regions represent about 5-6% of the total annual riverine discharge flux [4]. However, Earth history is marked by dramatic shifts between glaciated and deglaciated climate states, and Earth's present and near future is likely to be characterised by a period of enhanced glacial melting. Indeed, primary productivity is increasing in the Arctic today, thought to be due in part to increased freshwater supply of (micro)nutrients from land [5,6].

Limited published data suggests concentrations of Zn, Cu, and Fe in glacial waters that are higher than or similar to global riverine averages. However, both the absolute flux magnitudes, and the fate of these metals as they traverse the freshwater to marine transition in fjords, remain poorly known. Metal stable isotope ratios are a powerful tool to inform on metal sources and cycling. Here, we present the results of recent studies investigating the concentration and metal isotopic composition (δ^{65}Cu, δ^{66}Zn and δ^{58}Fe) in two fjords from Greenland. Fjords fed by land- or marine-terminating glaciers exhibit distinct metal isotope compositions, linked to their distinct hydrographic and ecosystem characteristics, and suggesting different source isotopic compositions and metal cycling in the fjords. We discuss the implications of these findings for the (de)glacial supply of trace metal micronutrients to the polar oceans, and the potential impact of deglaciation on riverine metal isotope fingerprints. This information is critical to unlock the potential of metal isotopes as tracers of past Earth system climate perturbations.

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