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Tracing glacial inputs through the silicon cycle over the Kerguelen plateau in the Southern Ocean

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Silicon (Si) is a key element for silicifying marine organisms. In the Southern Ocean (SO), diatoms are the main phytoplanktonic group, in particular around the northern Kerguelen plateau with seasonal blooms, an area naturally enriched in iron (Fe) and co-limited by Si and Fe. In the open ocean, the silicic acid (DSi) supply from water below the surface generally controls the production of diatoms, but since few years, studies report that (sub)glacial erosion is a potential source of DSi to the polar oceans via amorphous silica particles (ASi). We will discuss the transport and evolution of Si along the glacier-ocean continuum: (i) How does glacial material reach the open ocean (mechanisms, pathways)? (ii) Is glacial erosion a source of Si (dissolved and particulate, in which quality and quantity) for coastal zones and the open ocean?

Different freshwater, estuarine, coastal and oceanic environments were sampled in late summer 2024 during the MARGO campaign around Kerguelen Island where the Cook ice cap is melting at a rate amongst the fastest worldwide. Various chemical procedures were carried out to measure stable Si isotopes (δ30Si) in both dissolved and particulate fractions (>3µm and 0.2 – 3µm) along with the identification and quantification of particles (primary, secondary minerals and ASi). XRD analysis and SEM observations show that the bulk mineralogy is similar in both size fractions, dominated by smectite clays. Clays can play a role in the DSi pool via Si adsorption – desorption and/or flocculation along the salinity gradient in estuaries. Lakes fed by melting glaciers do not contain diatoms, and display high ASi concentrations and a lighter δ30Si than the global average for freshwater and surface local seawater. The DSi isotopic composition is not conservative in the estuary probably resulting from the complex interactions between physical and biogeochemical processes such as Si uptake by silicifying organisms, dissolution of glacial ASi and/or sediment remobilization. Si isotopic mixing and fractionation models along with Ge/Si ratios will enable us to discuss these processes and the transport mechanisms of glacial material in the surrounding environment tracking the Northern Kerguelen bloom transported eastward by the Antarctic Circumpolar Current.