Diatoms, sea ice, and sediment fluxes: Relative controls on barium cycling in the southern Ocean

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Barium cycling in the ocean is associated with a number of processes, inlcuding biological cycling, freshwater fluxes, and alkalinity. As a result, the biogeochemical cycle of barium offers interesting insights into past and present oceanic conditions. Barium is currently utilised in various forms as a palaeoproxy for components of organic and inorganic carbon storage, and as a conservative water mass tracer. However, the nature of the oceanic barium cycle is not fully understood, particularly in cases where multiple processes may be interacting simulatneously with the dissolved and particulate barium pools. This is particularly the case in coastal polar regions such as the West Antarctic Peninsula, where biological drawdown occurs in tandem with sea ice formation and melting, glacial meltwater input, and potential fluxes from shelf sediments.

Using a high-precision dataset of dissolved barium from the Palmer LTER Grid (adjacent to the West Anatarctic Peninsula) in conjunction with silicic acid, oxygen isotope, and salinity measurements, the relative control of these various coastal processes on the barium cycle can be distinguished. It can be shown that whilst the annual distribution of the diatom bloom is the primary control on surface levels of dissolved barium, there is also a secondary inter-annual variability linked to differences in the coastal freshwater regime. High levels of sea ice melt appear to exert a significant secondary control on barium concentrations, likely due to non-conservative biotic or abiotic processes acting within the sea ice itself. Meteoric water input, conversely, exerts little or no control on local barium levels, indicating that glacial melt is not a coastal source of barium to the region. These regional conclusions are considered in conjunction with a larger dataset of dissolved barium measurements from the Drake Passage and the Scotia Sea.