Benthic Silica Dynamics in the Northern High Latitudes: a Pore Water and Reaction-Transport Model Study

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Biogeochemical cycling of silicon (Si) in the northern high latitudes has an important influence on the marine Si budget, in part due to glacier input, elevated coastal diatom production, and the potential for a sensitive response to rapid climate change. While pelagic processes pertaining to primary production in changing high latitude systems are receiving increasingly more attention, less is known of the benthic Si cycle. This knowledge gap could prove integral, as previous work has estimated that the flux of Si across the sediment-water interface (SWI) from arctic sediments could rival that of riverine sources. This benthic flux is largely controlled by diagenetic processes in sediment pore waters. To improve our understanding of benthic Si dynamics in the northern high latitudes, we present a comprehensive dataset of pore water dissolved Si concentrations ([DSi]), including isotopic compositions (δ^{30}DSi) collected from three distinct regions, including: coastal Greenland, the Barents Sea shelf and open ocean sites from the Labrador Sea.

Here, we highlight results from two coastal Greenland sediment cores, which show a persistent increase in pore water [DSi] and decrease in δ^{30}DSi towards their base (~35cmbsf). These observations suggest that pore water chemistry is dominated by the dissolution of opal with light isotopic composition, such as sponges and/or glacially-derived amorphous silica. In contrast, a sediment core from Nuuk is characterised by a decrease in pore water [DSi] and increase in δ^{30}DSi below ~15cm core depth, implying increased precipitation of authigenic Si that preferentially incorporates the lighter isotope, leaving pore waters with a heavier isotopic composition. We also employ the Bigoeochemical Reaction Network Simulator (BRNS) to further disentangle and quantitativley assess the relative importance of these diagenetic processes to pore water Si chemistry and benthic fluxes. Altogether, coupling observations with model fitting improves our mechanistic understanding of the Si cycle.