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Benthic Silicon Cycling and Silicate Weathering in Icelandic Fjords: Implications for Enhanced Ocean Alkalinity and Carbon Sequestration

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Enhanced ocean alkalinity experiments are a promising and rapidly growing carbon dioxide removal (CDR) strategy. However, the field remains largely unregulated, and the biogeochemical impacts on benthic and marine environments are not fully understood. Icelandic fjords, with their high inputs of fine-grained, reactive basalt, provide a unique natural laboratory to investigate the processes that control silicate weathering and the subsequent generation or consumption of alkalinity. We present silicon (Si) concentration and isotope data from pore fluids and sequential extractions of sediment cores from two Icelandic fjords. High benthic fluxes of dissolved Si (DSi) show substantial dissolution and release of basaltic material at the sediment-water interface, providing bio-essential nutrients to the overlying water column. Pore-fluid DSi concentrations increase with depth at all sites, ranging from 130–255 μM in the top 0.25cm to 247–535 μM at 19cm depth and reaching an asymptote in most cases. Solid phase extractions reveal concentrations of reactive silica that are 6-40 times higher than other high-latitude environments. These reactive silica phases have distinct isotopic compositions, which are indicative of their source. Ongoing analysis of the Si isotope composition of pore-fluids will provide insights into the reactions occurring within the sediment, including the formation of secondary minerals. These data will be combined with a reaction-transport model to quantify fluxes of Si and alkalinity. Overall, this research emphasises the need to understand benthic nutrient cycling and reverse weathering to accurately constrain carbon drawdown from enhanced ocean alkalinity initiatives.