New adventures in marine silicon isotope studies

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Silicon is an important nutrient that is essential for the growth of diatoms, which form a major contribution to marine export production, in addition to other organisms across all ecosystems. Silicon isotope geochemistry provides key insights into the processes involved in silicon cycling in modern and past systems. Here, we will review some of the novel findings from our silicon isotope studies, and how these emerging ideas are impacting our understanding of marine silicon cycling.

Our new findings firstly highlight the role of chemical weathering on silicon isotope budgets. We show that both dissolved and amorphous silica phases in glacial outwash from Greenland are isotopically light, with temporal changes throughout the season. These light isotopic signatures are linked to dissolution of secondary weathering products in isolated subglacial waters. We also highlight the impact of chemical weathering on riverine silicon isotope composition in tectonically actives regions.

Secondly, we show that strong isotopic fractionation occurs across different clades of silicifying organisms that take up silicon via different mechanisms. For example, we show for the first time that silicification in hexactinellid sponges can result in isotopic fractionation of -5 to -6 per mil ($\Delta\delta^{30}Si$), even in relatively low silicic acid concentrations.

The case studies range from understanding the large scale role of chemical weathering under icesheets and across other weathering regimes, to the microscopic level of biomineralisation and silicification. Our ultimate aim is to understand the molecular processes that control silicon isotope fractionation in nature, how these processes influence the large scale inputs and outputs of silicon to a system, and how such budgets change through time.