An interrogation into subglacial processes to investigate the variation of silicon isotope composition of glacial meltwaters.

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Silicate mineral weathering is thought to be enhanced beneath ice sheets due to the long residence time of subglacial waters and high physical erosion, providing a key source of dissolved silicon - a important nutrient in terrestrial and marine systems. Silicon isotopes are a potentially useful tool for investigating the different chemical and physical reactions occurring in subglacial environments. However, relatively little is known about the silicon isotope composition (δ^{30}Si) of glacial meltwaters and what is driving the export of a relatively distinct δ^{30}Si compared to terrestrial rivers from glacial systems.

Our previous investigations of δ^{30}Si from Greenland Ice Sheet (GrIS) have shown dissolved and amorphous silica to be isotopically light (δ^{30}DSi and δ^{30}ASi respectively), with the lightest δ^{30}DSi coinciding with long residence time subglacial meltwaters. Subglacial hydrology and weathering regimes influence the δ^{30}DSi and δ^{30}ASi, and we hypothesise that light δ^{30}DSi is a result of the re-dissolution of fresh finely ground weathering crusts enriched in ^{28}Si.

To broaden the understanding of the drivers of, and variability in, the δ^{30}Si signatures of glacial runoff, we have undertaken a Pan-Arctic investigation of glacial δ^{30}DSi and δ^{30}ASi. We have measured the δ^{30}Si of runoff from 20 Arctic glaciers differing in size, lithology and hydrology and report a range of δ^{30}DSi from -0.58 to +1.01‰ and δ^{30}ASi from -0.86 to -0.05‰. This compares with a mean δ^{30}DSi typically reported for non-glacial rivers of +1.25 ± 0.69‰.

We have also completed laboratory batch experiments that mimic subglacial reactions. We investigated the impact of differing mineral surface areas and pH on δ^{30}DSi and δ^{30}ASi over time. Initial results are consistent with the hypothesis that the initial dissolution of the weathering crust is important in producing light δ^{30}DSi.

We will present a combination of our field observations and data from our laboratory experiments to provide a more comprehensive study into glacial δ^{30}Si, improving understanding of the subglacial weathering processes influencing glacial meltwaters and the global silicon cycle.