

## Silicate weathering and Si isotope fractionation in a glacial, granitic catchment

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Chemical weathering of silicate rocks consumes CO<sub>2</sub>, affecting climate on geological timescales, and it releases dissolved cations and silicon (Si). Stable isotope variations of such elements can now be used to investigate the processes controlling chemical weathering and subsequent cycling within ecosystems. Here we utilize the potential of stable Si isotopes to characterize the release of Si from granitic rocks under glacial conditions in a small mountainous catchment.

The Damma glacier in the central Swiss Alps erodes the Central Aar Granite massif, and the glacial retreat is known over the last 150 years, providing a chronosequence of soil development and vegetation growth. The soil and water chemistry has been extensively studied as part of a large multi-disciplinary investigation of the chronosequence (BigLink - <http://www.cces.ethz.ch/projects/clench/BigLink>). Soil samples collected along the chronosequence gradient have similar chemical compositions to the underlying lithology as little chemical weathering has occurred. Water sampling included biweekly sampling of the main streams in the snow-free summer months. Depositional inputs from snow and rain are negligible for Si. The dissolved stable Si isotope compositions were analyzed using a Nu Plasma 1700, after removal of the cation matrix.

Streamwater Si isotope compositions are much heavier (> 0.3‰ δ<sup>30</sup>Si) at all times of the year compared to the rocks and soils. The Si isotope compositions are lightest (closest to the granitic minerals) in summer when Si concentrations were at a minimum and discharge was fed by melt waters, and heaviest during autumn and winter, when flow was severely limited and Si concentrations were highest.

Significant Si isotope fractionation into the dissolved phase within the sub-glacial environment is clearly evident, even though the waters are undersaturated with respect to secondary clay minerals. These results are in agreement with similar results from rivers draining basaltic lithologies, and with the hypothesis that secondary clay formation during mineral dissolution, or adsorption onto iron oxides are the main causes of Si isotopic fractionation.

## Lithium and oxygen isotopes and oxidation state of lower oceanic crust: Atlantis Massif, 30°N

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The greatest proportion of oceanic crust is presently forming along slow-spreading centers (<55 mm/year full rate). Lower magma supply rates result in periods of non-magmatic extension, whereby faults extend deeper into the crust and provide extensive pathways for deep seawater circulation. Understanding the depth and degree of seafloor alteration is important in elemental flux calculations. Although upper oceanic crust has been well characterized, the lower oceanic crust remains somewhat enigmatic due to limited exposure in ophiolites and the rarity of lower crust sampled by deep-sea drilling projects. The Atlantis Massif, an oceanic core complex located at 30°N along the mid-Atlantic ridge represents a block of lower oceanic crust exposed at the seafloor by detachment faulting [1].

### Methods

For this study, 26 samples were selected from the lowermost 1000 m of IODP Hole U1309D drill core [2] for whole rock chemical characterization by ICP-OES and Fe<sup>3+</sup>/Fe<sup>2+</sup> determination by Mössbauer spectroscopy. Whole-rock oxygen (δ<sup>18</sup>O) and lithium (δ<sup>7</sup>Li) isotopic compositions were measured for a subset of 10 samples (2 diabases and 8 gabbros).

### Results

δ<sup>18</sup>O ranges from +1‰ to +5‰ (rel. to SMOW), with an average of +3.0‰. Most samples record δ<sup>7</sup>Li between -2.6‰ and +2.6‰, (rel. to LSVEC). Two samples record significantly heavier δ<sup>7</sup>Li values of +6.1‰ and +7.1‰. Percent Fe<sup>2+</sup>/ΣFe ranges from 73-94, with one sample yielding a value of 56. Downhole variation trends for δ<sup>18</sup>O, δ<sup>7</sup>Li, and Fe<sup>2+</sup>/ΣFe are remarkably similar; all three variables are positively correlated with one another. Discussion of these trends and further comparisons with bulk chemistry and petrography will be presented.

[1] Blackman *et al.* (2002) *Mar. Geophys. Res.* **23**, 443-469.

[2] Ildefonse *et al.* (2006) *Scientific Drilling* **3**, 4-11.