

$\delta^{44/40}\text{Ca}$ variability in igneous rocks

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We investigated the Ca isotope compositions of different igneous rocks. The sample set comprises the suite of the MPI-DING reference glasses, the USGS reference rock materials DTS-1, PCC-1, BCR-2, BHVO-2 and BIR-1, and various other rock materials (komatiites and carbonatites) covering a wide range of geological settings from felsic (rhyolite) to ultramafic rocks (dunite). The measurements were carried out by thermal ionization mass spectrometry using $^{43}\text{Ca}/^{48}\text{Ca}$ and $^{42}\text{Ca}/^{43}\text{Ca}$ double spike techniques. The results are reported relative to seawater. The analytical uncertainty is smaller than 0.2 ‰ (2sd). Different preparation methods in two laboratories were applied in order to ensure that no chemical artifacts are obscuring the data.

We demonstrate that the MPI-DING reference glasses are homogeneous in their Ca isotope compositions at the mm-scale and hence may be useful for *in situ* microanalyses of Ca isotope ratios. All of the investigated rock samples are in general agreement with the assumed $\delta^{44/40}\text{Ca}_{(\text{SW})}$ value for the Bulk Earth of -0.9 ± 0.2 ‰ [1, 2]. However, ultramafic rocks (dunite, peridotite and komatiite) are significantly heavier than the average value. The highest value measured belongs to the dunite DTS-1 with a $\delta^{44/40}\text{Ca}_{(\text{SW})}$ of -0.38 ± 0.06 ‰.

$\delta^{44/40}\text{Ca}_{(\text{SW})}$ values of the ultramafic rocks show a positive correlation with their corresponding Mg concentrations. This suggests that the implied isotope fractionation effect originates during partial melting and melt transport and likely involves diffusion and/or ion exchange processes. This is in line with experimental studies which have already shown diffusion-related Ca isotope fractionation effects between rhyolitic and basaltic melts [3]. Our findings extend the range of these effects to ultramafic rocks, and point to the deep oceanic crust and upper mantle as petrogenetic environments, where Ca isotope effects may be present and harnessed as a tool for refining petrogenetic models.

[1] Russell *et al.* (1978) *GCA* **42**, 1075-1090. [2] Skulan *et al.* (1997) *GCA* **61**(12), 2505-2510. [3] Richter *et al.* (2003) *GCA* **67**, 3905-3923.

Insights into interactive microbial and geochemical controls on bacterial surface reactions from SiO_2 uptake

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Microbial surface reactions are key to a number of geochemical processes such as reactive metal transport and biomineralization. Biomineralization commonly initiates through sorption processes at the microbial surface, thus an understanding of the fundamental mechanisms and controls involved can also apply to surface interactions with metals. In particular, the intimate spatial relationship of microbes and silica ($\text{SiO}_{2(\text{s})}$) has long been known to occur in both ancient and recent deposits. However, the mechanisms involved and whether microbes affect silica mineralization have been controversial, suggesting incomplete understanding of the process [1]. The objective of this work was to evaluate microbial SiO_2 immobilization under a set of geochemical conditions tailored to promote microbial biosilicification, while simultaneously considering the nature of the microbial surface. This work evaluated the effects of a matrix of geochemical parameters (i.e., pH, $[\text{SiO}_2]$, dissolved vs. colloidal silica) through both field survey and batch silicification experiments. Our results show that discernible microbial biosilicification can be promoted under a specific set of geochemical conditions. However, microbial surface characteristics superimpose perceptible effects upon these geochemical controls. This presentation will discuss observed results in the context of microbial surface reactivity, and both the microbial and geochemical factors involved.

[1] Amores & Warren (2007) *Chem. Geol.* **240**, 298-312.