

Si isotope fractionation during silica precipitation from hot spring waters, Geysir geothermal field, Iceland

S. GEILERT^{1*}, P. Z. VROON², N. S. KELLER³,
A. STEFÁNSSON³, S. GUDBRANDSSON³ AND
M. J. VAN BERGEN^{1*}

¹Department of Earth Science, Utrecht University, Utrecht, Netherlands, *M.J.vanBergen@uu.nl

²Faculty of Earth and Life Sciences, VU University, Amsterdam, Netherlands

³Institute of Earth Sciences, University of Iceland, Reykjavík, Iceland

*Present address: GEOMAR Helmholtz Centre for Ocean Research Kiel, Wischhofstr. 1-3, 24148 Kiel, Germany

Hot spring systems in the Geysir geothermal area, Iceland, have been studied for Si isotope fractionation in a natural setting where sinter deposits are actively formed. The silica concentrations in the spring and stream waters stay relatively constant downstream from the hot-spring outflow, irrespective of increased amorphous silica supersaturation associated with decreasing temperature ($\text{SiO}_{2(\text{aq})}$: 290 to 560ppm). Dissolved silica in the spring waters and outflowing streams had an average $\delta^{30}\text{Si}$ value of +0.2‰, in contrast with the siliceous sinters in the streambeds that had $\delta^{30}\text{Si}$ between -0.1‰ and -4.0‰. This is consistent with a preferred incorporation of the light Si isotope in the precipitate, whereby $\delta^{30}\text{Si}$ values decrease with decreasing temperature and increasing distance from the spring. The resulting magnitude of solid-water isotopic fractionation generally increases from -0.7‰ at 80°C to -3.7‰ at 20°C, which is qualitatively consistent with recent experimental evidence for the temperature dependence of Si isotope fractionation during silica precipitation from a flowing solution [1]. However, a relatively constant offset of ~2‰ between field and experimental fractionation values indicates that temperature alone cannot be responsible for the observed shifts. We infer that Si isotope fractionation is related to the precipitation rate, which itself is dependent on temperature, saturation state and solid-fluid interface area. The combined data sets suggest that Si isotope fractionation in aqueous environments is largely controlled by precipitation kinetics, whereby water-rock ratios, system geometry and fluid flow dynamics play a central role. Consequently, the fractionation behaviour during precipitation of silica from saturated solutions in natural environments should be regarded as a system-dependent feature.

[1] Geilert S., Vroon P.Z., Roerdink D.L., Van Cappellen P. and van Bergen, M.J. (2014). *GCA* **142**, 95-114.