

Terrestrial Titanium Stable Isotope Fractionation during Magmatic Processes

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Titanium is a highly refractory and fluid immobile element, playing a key role as a marker of petrogenetic and cosmochemical processes. Due to its incompatibility with the main mantle minerals, Ti is enriched in the Earth's crust relative to its mantle by partial melting. Partial melting of the mantle has a limited effect on the mass-dependent Ti isotope composition, but recent data sets [1,2] indicate the occurrence of Ti isotope fractionation during magmatic differentiation. To further evaluate the conditions under which Ti isotope fractionation occurs, we assess the mass-dependent Ti isotope composition of mantle rocks and a suite of well-characterized samples from two distinct differentiation sequences from (i) Heiðarsporður ridge, NE Iceland [3] and (ii) Mount St. Helens (WA, USA).

Our analytical techniques follow the double spike approach outlined in [1]. Enriched tracers of ⁴⁷Ti and ⁴⁹Ti are added to the samples. Subsequently, we separate and purify Ti by ion-exchange chromatography. All Ti isotope analyses are performed on a Neptune MC-ICP-MS at ETH Zurich and are reported relative to an in-house standard prepared from an Alfa Aesar ultra-pure Ti-wire. The long-term reproducibility (2 SD) obtained by repeated measurements (n= 14) of the USGS standard BHVO-2 is 22 ppm for $\delta^{49/47}\text{Ti}$.

The results of eight analyzed basalts and two peridotites fall within a very narrow range and yield an average $\delta^{49/47}\text{Ti}$ of -0.207 ± 0.052 , thus providing an isotopic baseline for the bulk silicate Earth (BSE). Resolvable, heavier Ti isotope signatures relative to the basalts occur in dacitic rocks from the Iceland and the Mount St. Helens differentiation sequences as well as the andesite AGV-2 from the Guano Valley (OR, USA). Overall, the Ti isotope composition tends towards heavier values with increasing SiO₂ and decreasing Mg and V concentrations. Taken together, this provides evidence that Ti is fractionated by the sequestration of isotopically light Ti into Ti-oxide phases as previously suggested by [2].

Reference: [1] Williams *et al.* (2013) *Meteorit. Soci. Meeting*, 5174. [2] Millet *et al.* (2015) *Goldschmidt conf.*, 2137. [3] Mancini *et al.* (2015) *J. Volcanol. Geoth. Res.* **301**, 116–127.