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Mass-dependent titanium isotope variations of global carbonatites

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Carbonatites are mantle-derived igneous rocks and their petrogenesis is explained by different models, such as (i) low-degree partial melting of carbonate-bearing peridotite or eclogite, (ii) extreme fractional crystallization of carbonated silicate magmas, and (iii) carbonate–silicate liquid immiscibility at crustal conditions [1, 2]. The origin of carbon in their mantle sources remains poorly constrained, but crustal recycling may present an important prerequisite for carbonatite magmatism [3]. Most carbonatites show strong depletions in Ti–Zr–Hf, indicating significant removal of HFSE-bearing phases from carbonate-rich magmas, or mineralogical control over the HFSE in the mantle source. As such, stable Ti isotope systematics are useful in addressing these observations, because they have proven to be excellent tracers of petrogenetic processes involving HFSE-rich phases [4–7]. Moreover, Ti is largely unaffected by fluid-meditated processes such as those that drive carbonatite metasomatism.

We present stable Ti isotope compositions (δ^{49}Ti relative to OL-Ti) for a set of carbonatites from various tectonic settings through time. Intermediate precision of ±0.050‰ is constrained by multiple digestions of international reference materials. Preliminary results reveal two carbonatite groups with mean δ^{49}Ti values of +0.11 ± 0.21‰ and +0.91 ± 0.55‰, which correspond to their different TiO_2 contents (~0.2 vs. ~0.2–0.5 wt.%). The first group is best interpreted to record partial melting control, whereas extreme fractional crystallization could be responsible for carbonatites that exhibit much larger Ti isotope fractionation.

[1] Yaxley et al. (2022) Ann. Rev. Earth Planet. Sci. 50, doi: 10.1146/annurev-earth-032320-104243. [2] Veksler et al. (1998) J Petrol 39, 2015-2031. [3] Walter et al. (2008) Nature 454, 622-625. [4] Aarons et al. (2020) Sci. Adv. 6, eabc9959. [5] Hoare et al. (2020) GCA 282, 38-54. [6] Johnson et al. (2019) GCA 264, 180-190. [7] Millet et al, (2016) EPSL 449, 197-205.

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