Magnesium isotopic compositions of carbonatites

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Magnesium isotope fractionation during magmatic processes is generally considered to be limited due to the high temperatures. However, studies on natrocabonatites and cogenetic silicate rocks from Oldoinyo Lengai (Tanzania) suggest that significant Mg isotope fractionation of up to 0.7 δ^{26}Mg unites may occur during both silicate-carbonatite liquid immiscibility and fractional crystallization of carbonatite melts [1]. Hence, Mg isotopes are a potential tracer of carbonatite magmatic processes. To further reveal the Mg isotopic characteristics of carbonatites, we report Mg isotopic data for a set of well-characterized carbonatites from Canada, East Africa, Finland, Germany and Greenland [2].

In contrast to the positive δ^{26}Mg values from +0.13 to +0.37‰ of natrocabonatite from Oldoinyo Lengai [1], the silico-, calcio- and ferro-carbonatites investigated here display negative δ^{26}Mg values ranging from -1.11 to -0.20‰. Among them, most have δ^{26}Mg values lower than the mantle (-0.25 ± 0.07‰, 2SD; [3]), which is consistent with the suggestion that light Mg isotopes are preferentially partitioned into carbonatite melts during silicate-carbonatite liquid immiscibility [1]. The highly variable δ^{26}Mg values of samples from the same locality confirm that significant Mg isotope fractionation may occur during carbonatite magma differentiation. However, there are no clear correlations betweens δ^{26}Mg values and the MgO and CaO contents or radiogenetic and stable isotopic compositions of the samples, thus detailed mechanisms responsible for the observed large Mg isotopic variation in carbonatites require further investigation.

[1] Li et al., EPSL 444 (2016) 26–33;
[2] Halama et al., EPSL 265 (2008) 726–742;
[3] Teng et al., GCA 74 (2010) 4150–4166.