Effect of aqueous organic ligands on Mg-isotope fractionation during magnesite precipitation

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Organic ligands are present in most Earth's surface environments and play a significant role on mineral formation and transformation. This study aims to illuminate the effect of the presence of these organic ligands on isotopic fractionation during mineral dissolution and growth.

Magnesite precipitation experiments were conducted in mixed flow reactors at 120 and 150 ºC following the methods described by Saldi *et al*. [1], in the reactive fluids containing various concentrations of aqueous oxalate and citrate. Supersaturation of the reactive fluid in the reactor was facilitated by the retrograde solubility of magnesite. Magnesite precipitation favored incorporation of isotopically lighter Mg into solid phase, as shown by enrichment of ^{26}Mg in the outlet solutions. Experiments conducted at 120 ºC show larger isotopic fractionation factors $\Delta^{26}Mg_{solid\text{-}solution}$ compared to those performed at 150 ºC indicating a temperature effect on isotopic fractionation. Furthermore, experiments performed in the presence of oxalate and citrate, exhibit lower $\Delta^{26}Mg_{solid\text{-}solution}$ values at similar precipitation rates compared to corresponding experiments performed in the absence of aqueous organic ligands. These observations suggest the preferential complexation of the heavier Mg isotopes by the organic ligands in aqueous solution.

Overall the observations obtained in this study demonstrate that $\Delta^{26}Mg_{solid\text{-}solution}$ during magnesite precipitation depends not only on precipitation rates, but also on the concentration of aqueous organic ligands. This result suggests that the presence of organic ligands may also effect the isotopic fractionation of a large number of other elements, and may be responsible, at least in part for the degree of isotopic fractionation observed in natural systems.

[1] Saldi *et al*. (2009) *Geochim. Cosmochim. Acta* **73**, 5646–5657.

^{146,147}Sm-^{142,143}Nd studies of komatiites from western Dharwar Craton, India: Implications for depleted mantle evolution in Early Archean

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Early Earth Differentiation

Variation of ^{142}Nd/^{144}Nd ratio in terrestrial samples compared to chondrites has now been demonstrated by several studies indicating an early global chemical differentiation of Bulk Silicate Earth (BSE). (see [1] for a recent review).

These studies, however, raised several outstanding questions related to nature of Early Enriched Reservoir (EER) and Early Depleted Mantle (EDM) and their subsequent evolution.

Results

We have carried out measurements of ^{142}Nd/^{144}Nd ratios, along with conventional ^{147}Sm-^{143}Nd studies, on well preserved komatiites with spinifex texture characterized by MgO > 20% that occur at Banasandra, in the western limb of Chitradurga greenstone belt of Dharwar craton in India.

^{142}Nd/^{144}Nd ratios of these komatiites are same as La Jolla and AMES standards within 10 ppm (2 σ) uncertainity. The ^{147}Sm-^{143}Nd whole rock isochron age as yielded by 9 samples is 3136 ± 200 Ma (MSWD =74) with initial ^{143}Nd/^{144}Nd =0.50872 ± 0.00033 corresponding to $\varepsilon_{Nd\ (t=3.15)}$=+ 3.5.

Discussion

We calculated time-integrated ^{147}Sm/^{144}Nd ratio of source of 3.15 Ga old komatiites of Dharwar craton with the constraints that it got differentiated at 4.2 Ga (No radiogenic ^{142}Nd/^{144}Nd anomaly) and that by 3.15 Ga ago it evolved to $\varepsilon_{Nd\ (t=3.15)}$=+ 3.5. The time-integrated ^{147}Sm/^{144}Nd ratio of the source, thus obtained, is significantly higher than what has been predicted by Blichert-toft and Puchtel [2] for the source of this age. These results can be explained if source of these komatiites is originated from a second differentiation of the EDM at 4.2 Ga. Further, these results also indicate that Archean depleted mantle has not been homogenous in time and space.

[1] Caro G (2011) *Annu. Rev. Earth Planet. Sci.* **39**, 31–58.
[2] Blichert-Toft & Puchtel (2010) *Earth & Planetary Science Letters* **297**, 598–606.