

Cadmium isotope composition of the Earth's mantle derived from mid-oceanic ridge basalts and komatiites

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This study presents Cd contents and isotope compositions of mid-oceanic ridge basalts (MORB) and komatiites to determine the Cd isotope composition of the Earth's mantle. The analyses were performed with a new ¹⁰⁶Cd-¹¹¹Cd double spike method using a Thermo Scientific Neptune MC-ICPMS. The accuracy of the method was assessed by analyzing various well characterized solutions and standard samples.

We analyzed 14 MORB glasses from the Atlantic, Indian, and Pacific oceans. They have homogeneous Cd isotope compositions except for one outlier. The new results are consistent with the published MORB data, providing a global mean of $\delta^{114/110}\text{Cd}_{\text{MORB}} = 0.09 \pm 0.11\%$ (2SD, N = 23). Although this value likely represents the isotope composition of the depleted MORBs mantle, the relatively low degree of melting during the generation of MORB magmas might lead to isotope fractionation during partial melting. To test this, we analyzed 15 samples of Archean komatiites (which were derived from high degrees of partial melting of the mantle), from five localities worldwide. Komatiite Cd isotope compositions range from -0.24 to 0.32%. Loss on Ignition (LOI) was used to evaluate the degree of alteration of the komatiites. A negative correlation was observed between LOI and Cd concentrations and isotope compositions. Samples with LOI > 5 wt.% tend to be significantly enriched in light isotopes, suggesting a loss of the heavier Cd isotopes to the fluid phase. A mean value for the least altered (LOI < 5 wt.%) komatiites, of $\delta^{114/110}\text{Cd}_{\text{Komatiites}} = 0.18 \pm 0.23\%$ (2SD, N = 7) was obtained. This value is identical to the MORB estimate and suggests that the Cd isotope composition of the mantle has not significantly changed since the Archean.

Finally, a new mantle isotope composition of $\delta^{114/110}\text{Cd}_{\text{Mantle}} = 0.15 \pm 0.11\%$ (2SD) was calculated as the mean isotope composition value for komatiites, MORB and ocean islands basalts (literature data) values. This estimate is slightly lighter than, but overlaps within error with, our measured isotope composition for Allende carbonaceous chondrite: $\delta^{114/110}\text{Cd}_{\text{Allende}} = 0.24 \pm 0.05\%$. This result indicates that the Cd isotopic composition of the Earth's mantle is close to that of