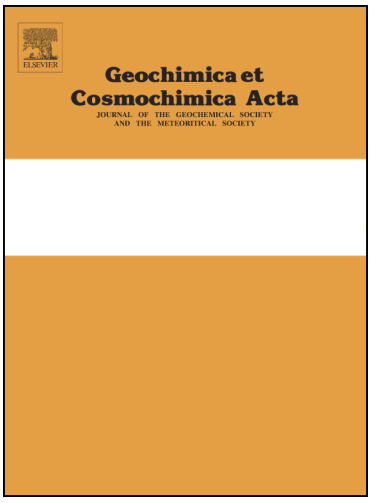

Mg isotope systematics during magmatic processes: inter-mineral fractionation in mafic to ultramafic Hawaiian xenoliths

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Mg isotope systematics during magmatic processes: inter-mineral fractionation in mafic to ultramafic Hawaiian xenoliths

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Abstract

Observed differences in Mg isotope ratios between bulk magmatic rocks are small, often on a sub per mill level. Inter–mineral differences in the $^{26}Mg/^{24}Mg$ ratio (expressed as $\delta^{26}Mg$) in plutonic rocks are on a similar scale, and have mostly been attributed to equilibrium isotope fractionation at magmatic temperatures. Here we report Mg isotope data on minerals in spinel peridotite and garnet pyroxenite xenoliths from the rejuvenated stage of volcanism on Oahu and Kauai, Hawaii. The new data are compared to literature data and to theoretical predictions to investigate the processes responsible for inter–mineral Mg isotope fractionation at magmatic temperatures. Theory predicts up to per mill level differences in $\delta^{26}Mg$ between olivine and spinel at magmatic temperatures and a general decrease in $\Delta^{26}Mg_{olivine\text{-}spinel}$ (= $\delta^{26}Mg_{olivine}$ - $\delta^{26}Mg_{spinel}$) with increasing temperature, but also with increasing Cr# in spinel. For peridotites with a simple petrogenetic history by melt depletion, where increasing depletion relates to increasing melting temperatures, $\Delta^{26}Mg_{olivine\text{-}spinel}$ should thus systematically decrease with increasing Cr# in spinel. However, most natural peridotites, including the Hawaiian spinel peridotites investigated in this study, are overprinted by variable extents of melt-rock reaction, which disturb the systematic primary temperature and compositionally related olivine–spinel Mg isotope systematics. Diffusion, subsolidus re-equilibration, or surface alteration may further affect the observed olivine–