

Crystal fractionation-induced magnesium isotope fractionation in basalts from Mauna Kea, Hawaii

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Fractionations of metal stable isotopes are controlled by both temperature and differences in bonding environments. Magnesium isotopic compositions of tholeiitic ocean island basalts are generally homogeneous and indistinguishable from that of the mantle ($\delta^{26/24}\text{Mg} = -0.25 \pm 0.04\text{‰}$). These initial observations led to the conclusion that fractional crystallization of silicate minerals does not fractionate Mg isotopes. However, analyses of alkalic basalts from Mauna Kea volcano, Hawaii have shown that their $\delta^{26}\text{Mg}$ varies to values both heavier and lighter (-0.10 to -0.40‰) than typical mantle values. These alkalic basalts are more evolved and have fractionated oxide mineral phases other than olivine, such as ilmenite and magnetite. There is no correlation between $\delta^{26}\text{Mg}$ and tracers of source heterogeneity, such as $^{87}\text{Sr}/^{86}\text{Sr}$. If the observed variation in $\delta^{26}\text{Mg}$ cannot be attributed to source heterogeneity, we hypothesize magmatic processes as a potential source of fractionation. Differences in Mg-O bonding environments between Fe-Ti oxides and silicates are a potential source of variability in measured samples. To understand the observed $\delta^{26}\text{Mg}$ variation in alkalic basalts, we model the fractional crystallization history of these alkalic basalts using MELTS software. Together with inter-mineral Mg isotope fractionation factors obtained from *ab initio* calculations, we explore different crystal fractionation models to explain both major element and metal isotopic variation in Mauna Kea post-shield lavas for a more complete understanding of the crystallization history of these samples.