Melt percolation in the mantle: the message from Mg isotopes

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To investigate the effect of melt percolation on magnesium fractionation and mantle Mg isotopic heterogeneity, two suites of well-characterized mantle peridotite xenoliths (magnesium-peridotite and Fe-rich peridotite) and individual minerals as well as associated alkaline basalts from Yangyuan, North China Craton were studied. The magnesium-peridotites (Mg# $>$ 89.5) have relatively homogeneous Mg isotopic compositions ($\delta^{26/24}$Mg = −0.26 to −0.28, with an average of −0.27 ± 0.02‰; 2SD, n = 3), identical to the normal mantle value [1], and they show equilibrium inter-mineral magnesium isotope fractionation between coexisting mantle minerals. By contrast, the Fe-rich peridotites (Mg# $<$ 88), which are strongly metasomatized and enriched in iron, have heterogeneous Mg isotopic compositions, with $\delta^{26/24}$Mg ranging from −0.38 to 0.03. Inter-mineral fractionations between co-existing olivine and pyroxene pairs ($\Delta^{26/24}Mg_{opx\text{-}ol}$ and $\Delta^{26/24}Mg_{opx\text{-}cpx}$) are negatively correlated with Mg/(Mg+Fe) of Opx in Fe-rich peridotite, hinting for a possible compositional effect. Our calculations show that kinetic isotopic fractionation caused by diffusion, probably during melt-peridotite reaction is responsible for negatively correlated Mg and Fe or Ca isotopic compositions in these peridotites [2-4].

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