Coupled extremely light calcium and iron isotopes in peridotites from Northern China

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Variations in non-traditional stable isotopes in oceanic basalts and peridotites provide important constraints on mantle dynamics. For example, lavas from Koolau volcano at Hawaii have Ca and Fe isotopes lighter than typical mantle values: the light Ca isotopic signature is attributed to recycled ancient carbonate and the light Fe to a recycled mafic component in the Hawaiian plume[1,2]. Here we report Ca and Fe isotopic compositions of mineral separates for two suites of mantle peridotite xenoliths (Mg-peridotites and Fe-rich peridotites) from Yangyuan, North China Craton.

The Mg-peridotites (Mg#=89.8 to 90.9) represent mantle melting residues with no or only moderate metasomatism, typical of global peridotites. Their $\delta^{57/54}$Fe ranges from 0.01 to 0.17), similar to that reported for typical mantle peridotites [3], and their $\delta^{44/40}$Ca from 0.86 to 0.92, similar to that reported for igneous rocks. In contract, the Fe-rich peridotites (Mg#=80.1 to 87.5) are strongly metasomatized. They have very light Fe and Ca isotopes, with $\delta^{57/54}$Fe as low as -0.64, among the lowest ever reported for igneous rocks[3], and $\delta^{44/40}$Ca as low as -0.09, compared to ~+1.0 for typical upper mantle value [1]. That is, these Yangyuan Fe-rich peridotites have the same Ca-Fe isotopic characteristics of Koolau lavas, but to a much larger extent. Unlike Koolau lavas, the coupled extremely light Ca-Fe isotopic signatures in these Fe-rich peridotites most likely reflect kinetic isotopic fractionation during melt-peridotite reaction.

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