Calcium isotope compositions of mantle pyroxenites and peridotites in Hannuoba, China: Insights into mantle Ca isotope heterogeneity

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Melt-peridotite interaction, caused by asthenosphere upwelling or recycling of crustal materials, could redistribute major elements such as Ca and form pyroxenites that produces a highly inhomogeneous mantle in chemical compositions. Whether and to which extent melt-peridotite reaction leads to heterogeneity in Ca isotopic compositions ($\delta^{44/40}$Ca) of the mantle rocks are unclear but important to understand the origins of considerable variation of $\delta^{44/40}$Ca in mantle-derived rocks. Here we report $\delta^{44/40}$Ca of diverse types of pyroxenite xenoliths (spinel pyroxenites, phlogopite-bearing spinel clinopyroxenites and garnet pyroxenites) and surrounding peridotites from Hannuoba, North China Craton. The spinel pyroxenites are cumulates of asthenosphere-derived silicate melts, and the garnet pyroxenites are the reaction product of peridotite with silicate melt derived from recycled crust material while Phl-bearing spinel clinopyroxenites were formed by metasomatism of peridotite with fluid-rich silicate melt. Each pair (N=8) of garnet pyroxenite and reactive lherzolite show no measurable difference in $\delta^{44/40}$Ca (0.86‰ to 0.98‰ versus 0.87‰ to 0.93‰), implying that addition of recycled silicate component could not fractionate Ca isotopes within the analytical uncertainty (0.14‰, 2sd). The spinel pyroxenites and Phl-bearing spinel clinopyroxenites have similar $\delta^{44/40}$Ca (0.90±0.06‰ and 0.96±0.05‰, respectively). The indistinguishable $\delta^{44/40}$Ca values among these different pyroxenites suggest no measurable Ca isotope variations during silicate melt-peridotite interaction and fractional crystallization, even if recycled silicate materials are involved. The results support the notion that mantle source irrespective of peridotites and pyroxenites typically show uniform $\delta^{44/40}$Ca. The observed Ca isotope variations in the mantle-derived rocks may result from other factors such as kinetic disequilibrium processes or carbonate components in the source.