Calcium isotopic composition of mantle olivines

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Olivine is the predominant mineral phase in the Earth's upper mantle. The olivine mode and composition variations in peritoditic xenoliths record mantle and lithospheric processes they experienced, which provide important constraints in understanding the evolution of lithospheric mantle. Calcium isotope compositions in mantle rocks and basalts have been used to understand mantle heterogeneity and lithospheric mantle evolution. Here, we present Ca isotopic study of olivines in a series of peridotitic xenoliths (Mg-peridotites and Fe-rich peridotites) from North China Craton (NCC), which have been studied for pyroxene Ca isotopes.

Calcium isotopic ratios were determined using a ^{42}Ca-^{43}Ca double spike technique on a Thermo Triton Thermal Ionzation Mass Spectrmetry in the Stake Key Labotatory of Isotope Geochemistry in China.

Our results show large $\delta^{44/40}$Ca variation (~1‰), ranging from 0.38 to 1.20 on the SRM 915a scale. For comparision, the BSE $\delta^{44/40}$Ca is estimated at 0.94±0.05. The olivine $\delta^{44/40}$Ca is positively correlated with large Fo variation, raning from 80 to 91. Olivines in the NCC Mg-peridotites (Fo=89.6 to 90.8) have $\delta^{44/40}$Ca ranging from 0.95 to 1.20, higher than the BSE estimate. In contrast, olivines (Fo=80 to 87.7) from the NCC Fe-rich peridotites have extremely low $\delta^{44/40}$Ca (0.38 to 0.83). Our previous study found positive $Mg^{\#}$-$\delta^{44/40}$Ca correlation in bulk peridotites, and interpreted this correlation as a result of isotopic fractionation caused by diffusion, probably during mantle metasomatism. The $\delta^{44/40}$Ca heterogeneity measured in mantle olivine suggests that Ca isotopic fractionations produced by processes of mantle metasomatism are also preserved on mantle olivine scale. Calcium isotope composition in mantle olivines provides a new method for investigating processes in the mantle.

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