

Application of Ca isotope systematics in studies of carbonatites

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Calcium stable isotopes may provide insights into the nature of source and magmatic processes for mantle-derived igneous rocks, but rare studies have been done on carbonatites, the origin of which remains largely unknown. To determine the Ca isotope composition of carbonatites, much effort has been spent on methodology and a refined Ca(-Sr) isotope analytical protocol using SSB-MC-ICPMS method has been developed, with the reliability of the analytical data reinforced by repeating analysis of several samples using DS-TIMS method. Worldwide carbonatite and associated silicate rocks were analyzed for $\delta^{44/42}\text{Ca}$. Different from most data previously reported, our results show that primary carbonatite and associated silicate rocks are rather homogeneous in $\delta^{44/42}\text{Ca}$ values that are comparable to those of basalts, while non-primary carbonatites show detectable $\delta^{44/42}\text{Ca}$ variation that are correlated to $\delta^{13}\text{C}$ values. Our finding suggests that Ca isotopes fractionate during late stages of carbonatite evolution and that carbonatite is sourced from a mantle source without requiring the involvement of recycled carbonates. This means that Ca isotopes are useful for tracing carbonatite source and evolution.