

The triple oxygen isotope composition of carbonatites

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We present triple oxygen isotope data of carbonates in carbonatites sampled from different localities worldwide in order to assess mass-dependent fractionation during the formation of mantle rocks. We consider the mineralogical differences in the mantle-derived carbonatites in our evaluation and constrain further the triple oxygen isotopic composition of the mantle. The analytical approach follows the acid digestion of sample carbonates to release CO₂ that is further processed through catalytic exchange with O₂. Through robust standardisation and calibration routines, the triple oxygen isotope composition ($\Delta^{17}\text{O}$) of the carbonate is derived from the processed CO₂. Our results show that $\Delta^{17}\text{O}$ signatures of calcite and dolomite carbonatites are independent of mineralogy, suggesting the compositional variation (0.005‰) and isotopic fractionation associated with the different carbonate phases, at magmatic temperatures is negligible. The determined average $\Delta^{17}\text{O}$ composition of the carbonatites, assumed to reflect that of the mantle is $-0.052 \pm 0.006\text{‰}$ (vs. VSMOW; $\lambda=0.528$, $n=25$), indicating the mantle has a relatively homogenous isotopic composition. Ferrocarnatites and lapilli tuffs have distinctively low $\Delta^{17}\text{O}$ values (-0.160 to -0.106‰) consistent with their high $\delta^{18}\text{O}$ and clumped-isotope (Δ_{47}) signatures. These results suggest diagenetic reactions facilitated by low-temperature fluid-rock interaction, and the mixing of carbonate sources induce alterations in primary mantle signatures that are detectable in both triple oxygen and clumped isotope compositions of the rocks.