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Coupled $^{88/86}Sr$ and $^{87}Sr/^{86}Sr$ of the global carbonatites: implications for crustal recycling

SOUMYAROOP BHATTACHARYA[1] AND **RAMANANDA CHAKRABARTI**[2]

[1]Indian Institute of Science, Bangalore
[2]Indian Institute of Science
Presenting Author: ramananda@iisc.ac.in

Carbonatites are mantle-derived igneous rocks with >50% modal abundances of carbonate minerals. Calcium [1] and Boron [2] stable isotopic compositions of young (<200 Ma) global carbonatites indicate crustal carbonate recycling into the mantle. However, a lack of correlation between $^{44/40}Ca$ and ^{11}B [1], measured on the same carbonatite samples suggests that the phases hosting Ca and B in the recycled lithosphere are different. Radiogenic strontium isotopes ($^{87}Sr/^{86}Sr$) are a powerful source tracer while stable isotopes of Sr ($^{88/86}Sr$) can track different processes. We report $^{88/86}Sr$ and $^{87}Sr/^{86}Sr$ of twenty-one whole rock global carbonatites, whose ages range from Proterozoic to recent. All measurements were performed using thermal ionization mass spectrometry (TIMS, Thermo Triton Plus) at the Centre for Earth Sciences, IISc. The analytical uncertainties for $^{88/86}Sr$, measured using an ^{84}Sr-^{87}Sr double-spike technique [3], are <0.05 ‰ (2SD), based on multiple analyses of NIST SRM 987 (n=6).

Majority of the carbonatites show $^{88/86}Sr$ compositions (0.215-0.329 ‰) which broadly overlap with the estimated value of the bulk silicate Earth (BSE, 0.27 ‰) [4] while three carbonatites from Ambadongar, India, linked with eruption of the Deccan Traps, show higher $^{88/86}Sr$ (0.355-0.451 ‰). Calcite separates from carbonatites also show $^{88/86}Sr$ values (0.261-0.307 ‰, n = 3) overlapping with BSE, except one sample from Panda hills, Tanzania (0.380 ‰) whereas a fluorspar from Ambadongar (1.125 ‰) is heavier than BSE. While the high $^{88/86}Sr$ of the Ambadongar carbonatites can be explained by hydrothermal processes, a mixing model using $^{88/86}Sr$ and $^{87}Sr/^{86}Sr$ suggests that the younger global carbonatites (<200 Ma) display contributions of up to 15% Phanerozoic carbonates and up to 20 % altered oceanic crust into the mantle.

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