Significant variation in stable Ca isotopic (δ^{44/40}Ca) composition of global carbonatites: role of mantle mineralogy and subducted carbonate

ANUPAM BANERJEE^1 & RAMANANDA CHAKRABARTI^1

^1Centre for Earth Sciences, Indian Institute of Science (IISc), Bangalore, India 560012. (anupamb@ceas.iisc.ernet.in; ramananda@ceas.iisc.ernet.in)

Stable calcium isotopic composition (δ^{44/40}Ca) of silicate rock standards show limited variability [c.f., 1] although, fractionation between co-existing ortho- and clinopyroxenes have been reported [2]. Variability in δ^{44/40}Ca in Hawaiian shield stage tholeiites have been interpreted as evidence of subducted ancient marine carbonates, with very low δ^{44/40}Ca, into the Hawaiian plume [3]. Carbonatites are unique mantle-derived carbonate-bearing igneous rocks with limited spatial but wide temporal occurrences. Few available measurements (n=5) of δ^{44/40}Ca in whole rock and leached carbonatites show a 0.2 ‰ range but broadly overlapping values with mantle-derived silicate rocks from different tectonic settings [1,4]. However, boron isotopic composition of global carbonatites suggest the contribution of subducted crustal component to the mantle source of relatively young carbonatites (<300 Ma old) [5], a signature which should potentially be traceable using Ca isotopes.

We report δ^{44/40}Ca of global carbonatites ranging in age from Proterozoic to recent. The samples were analyzed using a ^43Ca-^48Ca double spike on a Thermo Fischer Triton Plus Thermal Ionization Mass Spectrometer (TIMS) at IISc. δ^{44/40}Ca in the carbonatites (n = 11) range from 0.47 - 0.97 ‰ (w.r.t. SRM 915a). Our external reproducibility, estimated from multiple analyses of NIST standards SRM 915a, SRM 915b and seawater (NASS6), is better than 0.1 ‰ (2SD). δ^{44/40}Ca of the ~65 Ma old Ambadongar carbonatites of India, associated with eruption of the Deccan Traps, show correlations with Nb/Yb, K/Rb as well as with Sr/Nb, Sr/Zr. These variations suggest the role of phlogopite versus amphibole in the mantle source as well as subducted carbonates in controlling the δ^{44/40}Ca of these carbonatites.