Geochemical and Nd-Sr-Ca isotopic compositions of carbonatites and alkaline igneous rocks from the Deccan igneous province: role of recycled carbonates, crustal assimilation and plume heterogeneity

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Carbonatites and associated alkaline silicate rocks from the Ambadongar province of Western India are spatially and temporally linked to the peak-volcanism of Deccan basalts which erupted ~65 Ma ago[1]. Nd, Sr, C and O isotopic compositions of these carbonatites indicate their mantle-origin[2] while high $\delta^{11}B$ of one carbonatite sample from this location has been explained by the presence of recycled components in the mantle-source of these rocks [3]. Signatures of recycled crustal components, if present, should be potentially traceable using $\delta^{44/40}Ca$ compositions of these rocks as crustal carbonates typically show lower $\delta^{44/40}Ca$ than the BSE [4].

We investigate the petrogenesis of these carbonatites and the associated silicate rocks using their stable Ca isotopic ($\delta^{44/40}Ca_{NISTSRM915a}$) and radiogenic Nd and Sr isotopic compositions as well as major and trace element compositions. The $\delta^{44/40}Ca$ of the carbonatites range from 0.58-1.1‰ (n=7) while the associated silicate rocks show a range from 0.50-0.92‰ (n=14). Based on co-variations in plots of $\delta^{44/40}Ca$ versus $^{87}Sr/^{86}Sr$ and $^{144}Nd/^{143}Nd$, the variability in $\delta^{44/40}Ca$ of the carbonatites is explained by the presence of ~160 Ma old recycled carbonates in the Deccan plume-mantle source. Our model calculations suggest upto 20% contribution of the recycled carbonates which is heterogeneously distributed in the plume-mantle source. The large variability in $\delta^{44/40}Ca$ values in the associated alkaline silicate rocks can be explained by upto 20% assimilation of the Precambrian granite gneiss basement ($\delta^{44/40}Ca$ =-1.35‰). The co-variation of $\delta^{44/40}Ca$ versus K/Rb in the carbonatites and alkaline igneous rocks are explained by derivation of carbonatite and silicate melts from different depths, both within the mantle-plume source.

[1] Ray and Pande, 1999, *Geophy. Res. Lett.*, 26(13), 1917–1920; [2] Simonetti et al., 1995, *Chem. Geol.*, 122(1-4), 185–198; [3] Hulett et al., 2016, *Nat. Geosc.,* 9(12), 904; [4] Huang et al., 2011, *Geochim. Cosmochim. Acta*, 75(17), 4987–4997.