Whole-rock Nd, Sr and multiple S isotopic compositions of carbonatites and alkaline silicate rocks from the Phalaborwa complex, South Africa

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Carbonatites and associated alkaline silicate rocks generally have much higher concentration of Sr, Nd as well S than any other terrestrial igneous rocks[1, 2]. Therefore, the isotopic signatures of these rocks are not easily perturbed by crustal contamination and are ideal to trace crust-mantle interaction through recycling. For example, a recent study, based on *insitu* S and Pb isotopic compositions of sulfide minerals from three different carbonatites from the ~2.06 Ga old Phalaborwa complex of South Africa, has suggested possible recycled components in its mantle source region[3]. A multi-isotopic investigation on more number of samples would better reflect the petrogenetic history of these alkaline rocks and reinstate the crust-mantle recycling.

In the present study, we report a combined whole rock Nd, Sr and S isotopic compositions of multiple (n=10) carbonatites and associated alkaline silicate rocks from this carbonatite complex. Initial $\varepsilon_{Nd(t)}$ and $^{87}Sr/^{86}Sr_{(t)}$ of most of the samples suggest a possible enriched mantle like source region for this igneous rock suite. A significantly broad range in $\delta^{34}S$ (w.r.t. CDT) is observed for both carbonatites (-0.8 to 4.2‰) and alkaline silicate rocks (-4 to 12‰). Further, these samples also exhibit mass independent fractionation (MIF) of S isotopes, represented by the positive values of $\Delta^{33}S$. Based on such observations, we suggest that the enrichment of the mantle source region of this complex must have happened by crustal recycling prior to the Global Oxidation Event at ~2.4Ga. In contrast to the previous observatons, two alkaline rocks from this complex show extremely non-radiogenic $^{87}Sr/^{86}Sr_{(t)}$ and CHUR like $\varepsilon_{Nd(t)}$ values and lack significant MIF S isotopes. These observations could likely indicate a more complex evolutionary history of this province than previously thought. Subsequent analyses of $\delta^{13}C$ and $\delta^{18}O$ of these samples would further define the possible peterogenetic evolution of this complex.

References:

[1] Hutchinson et al. (2019) *Nature Comm.* **10**(1), 1-12; [2] Jones et al. (2013) *Rev. Mineral. Geochem.* **75**(1), 289-322; [3] Bolhar et al. (2020) *Earth Planet. Sc. Lett.*, **530**, 115939.