

Highly siderophile element and Re-Os isotope systematics of mantle-derived carbonatites

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Carbonatites are mantle-derived igneous rocks not just representing an economic source of REE (e.g., Bayan Obo deposit contains more than 70% of world reserves; [1]), but they also provide important insights to the CO₂-rich mantle sources, extent of crustal recycling and possible constraints on the carbonatitic mantle metasomatism. This is due to their unique physical properties as low melt temperature and viscosity permit fast and efficient transport at the mantle conditions and during melt ascent to the surface.

We present first extensive dataset of highly siderophile element (HSE) concentrations as well as their Re–Os isotope compositions paralleled by Sr–Nd–Pb isotope systematic for mantle-derived carbonatites and Si-rich carbonatites spanning in the age from ~2.1 Ga to present occurring in different geotectonic settings [2]. The samples were collected or gathered from 3 different sites: East Africa (Oldoinyo Dili, Sukulu, Panda Hill), India (Deccan Traps – Amba Dongar, Sung Valley, Samalpatti, Sevattur, Newania), Norway (Fen Complex) and South Africa (Phalaborwa).

In general, carbonatites are largely depleted in all analyzed HSE with Σ HSE ranging from 11 ppt to 1500 ppt. Osmium, Ir and Ru yield 1–40 ppt while Re, Pt, Pd reach mostly up to tens or hundreds of ppt at maximum.. This high variability can be the result of the early separation of sulfide melts (S in analyzed carbonatites reach 1 wt. % at maximum) and/or parental carbonatite melt sources already largely replenished in HSE. The Os_N/Ir_N ratios are in the most cases greater than 1.0, that might be caused by capability of carbonatites to selectively concentrate Os over other IPGE (Os, Ir, Ru). The ¹⁸⁷Os/¹⁸⁸Os ratios vary from unradiogenic (~0.121) up to highly radiogenic (~10) and as Re-Os systematics is a sensitive tracer of recycled crust addition, these largely variable values might reflect different proportions of recycled material (e.g., eclogite, pyroxenite) in the carbonatite sources.

[1] Guangchi T. and Kaiyi W. (1997) Proc. 30th Int. Geol. Congr., 9, 83-90. [2] Woolley A. R. and Kjarsgaard B.A. (2008) Natural History.