Lu–Hf isotope systematics of carbonatites

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Carbonatites are igneous intrusive/effusive rocks, probably of mantle origin, and are often considered as an important economic source of REE and other critical metals (e.g, Bayan Obo, Phalaborwa, etc.). Their unique properties such as low melt temperature and viscosity permit their fast and efficient ascent from the mantle making them resistant to melt modification. In this respect, carbonatitic magmas provide direct insight into mantle sources. Additionally, carbonatitic magmas are thought of as efficient agent of mantle metasomatism and formation of dunite–wehrlite lithologies.

Lu–Hf system is a powerful petrogenetic tracer to study carbonatite sources due to their variable and large Lu/Hf fractionations that result in extreme radiogenic $^{176}Hf/^{177}Hf$ signatures [1]. We analyzed Sm-Nd and Lu–Hf systematics in whole-rock samples and their silicate/carbonate fractions of >40 carbonatites, silicocarbonatites and silicified carbonatites. These samples encompass a range of ages, tectonic settings, and associated alkalic rocks.

The Hf contents in carbonatites vary by three orders of magnitude (from few ppb to several ppm) and are usually higher in silicocarbonatites and silicified carbonatites, consistent with the incompatibility of Hf in carbonate. Their εHf_i values vary broadly from −30 to +30. Carbonatites associated with the East African Rift, show distinctively different εHf values for a given εNd despite close geographic proximity (Ol Doinyo Dili/Sukulu vs. Tororo), indicating crustal modification of the Lu–Hf system. Samples from sites like Lemitar Mountain or Fen Carbonatite Complex plot bellow and at the same time above the Hf–Nd mantle array, suggesting the different levels of contamination.

[1] Bizimis et al. (2003) *Contrib. Mineral. Petrol.* **145**, 281-300.