Major, trace element and Nd, Sr isotopic study of the carbonate and non-carbonate components of carbonatites

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Carbonatites are unique magmatic rocks with more than 50% modal carbonate minerals, enrichments in LREEs, and superchondritic whole-rock Nb/Ta (~35) and Zr/Hf ratios (~ 60) [1]. Trace element, isotopic studies and models based on experimental petrology have provided insights into the genesis of carbonatites and suggest that these rocks are formed either by partial melting of a metasomatised mantle, liquid immiscibility, or crystal fractionation of a carbonated parental melt [2]. It has also been proposed that the trace element and isotopic compositions of the carbonate fraction better represent the original carbonatite magma composition [3]. To obtain deeper insights into the origin of carbonatites, we analyzed major, trace element compositions as well as Nd, Sr isotopic compositions of whole-rock, as well as the carbonate and non-carbonate fractions of carbonatites of different ages (Paleoproterozoic to recent).

We experimented with different acids (10% acetic acid, 1N HCl and 2.5N HCl) to separate the carbonate component; our results suggest that acetic acid is best suited for extraction of the carbonates as HCl also leaches out some of the non-carbonates (e.g. oxides) in carbonatites. REE concentrations are much higher in the non-carbonate component, which also shows more LREE fractionated patterens in chondrite-normalized plots compared to the carbonate component. In primitive-mantle normalized multi-element plots, the carbonates show overall lower concentrations of elements with relative enrichments in Ba, U, and Sr and depletions in Th, Nb, Ta, Zr, and Hf. In contrast, the non-carbonate component shows relative depletions in Sr and Pb. Zr/Hf is relatively high in the non-carbonate fraction (close to bulk-rock values) while Nb/Ta is very high in the carbonate fraction (~200). The Rb/Sr and Sm/Nd ratios are strikingly different between the carbonates and non-carbonates. However, the measured $^{87}Sr/^{86}Sr$ and $^{143}Nd/^{144}Nd$ ratios of bulk rock, carbonate and non-carbonate fractions do not show any isotopic differences which is in contrast to an earlier study [3].

[1] Chakhmouradian, (2006) *Chem Geol*. **235**, 138-160. [2] Bell & Tilton, (2001) *J. Petrol*. **42**, 1927-1945. [3] Bizmis et al., *CMP*. **145**, 281-300.