Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.12058

Constraints on the chlorine and fluorine inventory of carbonatites

TOMÁŠ MAGNA[1], JAIME D. BARNES[2], VLADISLAV RAPPRICH[1] AND R. JOHANNES GIEBEL[3,4]

[1]Czech Geological Survey
[2]Department of Geological Sciences, University of Texas at Austin
[3]Technische Universität Berlin
[4]University of the Free State

Presenting Author: tomas.magna@geology.cz

The current knowledge on the elemental and isotope systematics of Cl in carbonatites is constrained to a handful of data showing a modest $\delta^{37}Cl$ variability from -0.8 to +0.1‰ [1, 2]. It has also been implied that magmas parental to carbonatite melts may be enriched in Cl and Na [3]. Because carbonatites are thought to originate in the mantle and owing to their rapid mobility, they may preserve the signature of their mantle sources, assuming little degassing of carbonatite magmas. However, there is a lack of concensus regarding the Cl isotope composition of the Earth's mantle [4]. Therefore, linking carbonatites and corresponding mantle can provide new constraints on the Cl isotope systematics of pristine mantle-derived magmas and their degassing histories.

We have measured F and Cl contents, along with stable Cl isotope compositions ($\delta^{37}Cl_{SMOC}$), in carbonatites from nine carbonatite bodies, including two twinned occurrences (Sevattur–Samalpatti, India; Sukulu–Tororo, Uganda) to provide new constraints on the element/isotope systematics of volatile species in carbonatites. Also, apatite was analyzed separately for several samples.

Carbonatites from continental rifts (Sukulu, Tororo, Lemitar Mts., Magnet Cove, Kaiserstuhl) have generally low Cl and conversely high F contents (F/Cl of up to ~350), whereas those from shear zones (Phalaborwa, Sevattur, Samalpatti) generally have elevated Cl contents with low F/Cl (down to ~5). The lowest Cl contents of few ppm were found for carbonatites associated with trap basalts (Amba Dongar), for which strongly degassed mantle can be expected. Apatite contains 2–16× more Cl than bulk samples. Total $\delta^{37}Cl$ variation is ~3‰ (from -1.3 to +1.6‰). Silicate rocks in Sevattur are isotopically much lighter ($\delta^{37}Cl$ as low as -0.9‰) than associated carbonatites. Within-locality variations in $\delta^{37}Cl$ often exceed ~1‰, making an estimate of Cl isotope composition of global carbonatites and, by inference, their mantle sources less reliable.

[1] Eggenkamp & Koster van Goos (1997) ChG 140, 137-143. [2] Sharp et al. (2007) Nature 1062-1065. [3] Kamenetsky et al. (2015) Geology 43, 687-690. [4] Pinti et al. (2020) GCA 276, 14-30.

Funded by the Czech Science Foundation project 19-29124X.