

## **Mantle metasomatism and crustal contamination in carbonatites the East African Rift – A case study of Sukulu and Tororo (Uganda)**

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The world-class apatite deposits of Sukulu and Tororo carbonatite complexes (SE Uganda; Paleogene to Neogene age) are magmatic–hydrothermal products of the East African rift system. Noble gas (He, Ne, Ar) and H isotope analysis, as well as microthermometry measurements on fluid inclusions hosted by calciocarbonatites, combined with bulk-sample  $\delta^{18}\text{O}$ ,  $\delta^{13}\text{C}$  analysis and trace element measurements, have been carried out to constrain the source regions, formation and post-emplacement processes, and evaluate economic potential of the strategic metals (e.g. REE, Nb).

The primary two-phase aqueous liquid + vapour fluid inclusions in apatite display homogenization temperatures between 270–350°C and 250–300°C for the Sukulu and Tororo, respectively. The observed low temperatures and relatively high salinities (13–18 NaCl equiv. wt%) of the fluids imply that the carbonatites are hydrothermal (or strongly hydrothermally overprinted) in origin and can be classified in terms of their origin as carbohydrothermal.

The  $^3\text{He}/^4\text{He}$  ratios ranging from 6.5 to 9.3  $R_A$ , Ne isotope ratios ( $^{20}\text{Ne}/^{22}\text{Ne} = 9.4\text{--}11.8$ ;  $^{21}\text{Ne}/^{20}\text{Ne} = 0.028\text{--}0.041$ ), as well as stable C–O isotopes ( $\delta^{18}\text{O} = 7.5\text{--}8.9\%$ ,  $\delta^{13}\text{C} = -3.85$  to  $-1.07\%$ ) indicate that the carbonatites originated ultimately from a ‘MORB-like’ mantle source. Barium concentrations, Nb/Y ratios as well as the total REE vs. Sr/Ba inter-relations imply only a limited contamination of the primary mantle derived fertile magma with REE-enriched subcontinental mantle lithosphere.

The more radiogenic noble gas compositions, higher Ba and  $\Sigma\text{REE}$  concentrations, and lower homogenization temperatures of the Tororo complex imply extended crustal interaction for the fluids and/or contamination of the parent magma with a metasomatized subcontinental mantle lithosphere.

*Supported by the Czech Science Foundation (19-29124X).*