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Controls on rare earth element dynamics during low- and high-temperature fluid-rock interactions in carbonatites

DR. HAMED POURKHORSANDI[1], VINCIANE DEBAILLE[1], SOPHIE DECRÉE[2], CÉDRIC SIMONET[3] AND STEVEN GODERIS[4]

[1]Université Libre de Bruxelles
[2]Royal Belgian Institute of Natural Sciences
[3]Altona Rare Earths PLC
[4]AMGC, Vrije Universiteit Brussel

Presenting Author: hpkhorsandi@gmail.com

Rare Earth Elements (REE) are a group of metals with unique chemical characteristics which are used widely in advancing technologies. The REE are mainly extracted from carbonatites, magmatic rocks with carbonate mineral >50 vol.%. Late-stage hydrothermal fluids play an important role in the formation of REE-rich mineral phases in carbonatites [1,2]. In addition to carbonatites, more than 90% of the global supply of heavy REE, the most critical and relatively rare REE, are sourced from supergene deposits in south-eastern China, known as regolith-hosted REE deposits formed as a result of intense chemical weathering of granites [3]. The enrichment of REE in these two different geological environments highlights the importance of fluid-rock interactions, including relatively high-temperature hydrothermal fluids and lower temperature weathering (meteoric) fluids, in controlling REE behavior.

To better understand the behavior of REE during fluid-rock interactions related to hydrothermal activity and chemical weathering in carbonatites and to investigate their differences and similarities, as well as their roles in REE ore formation, we studied drill core and soil samples from the Monte Muambe carbonatite complex in northern Mozambique [4].

Here, we will present our preliminary data on the bulk rock and in-situ geochemical compositions observed in carbonatite samples with varying degrees of alteration, and we will discuss the mineralogical and chemical factors that control REE behavior during fluid-rock interactions.

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