

Heavy rare earth element (HREE) enrichment in carbonatites: A case study from a xenotime-bearing carbonatite REE deposit in Bachu, Xinjiang of China

Wenlei Song^{1,2*}, Cheng Xu³, Jindrich Kynicky², Martin Smith⁴

¹*Department of Geology, Northwest University, 710069, Xi'an, China; wlsong99@nwu.edu.cn*

²*BIC Brno, Technology Innovation Transfer Chamber, 61200, Brno, Czech Republic*

³*School of Earth and Space Sciences, Peking University, 100871, Beijing, China*

⁴*University of Brighton, Brighton, BN2 4GJ, United Kingdom*

The Bachu carbonatite is located in the northwestern Tarim Large Igneous Province, Xinjiang, China, and hosts economic REE resources. The rocks occur as dike swarms covering ca. 5 km². The carbonatitic magma evolved from dolomite- to a calcite-dominated composition and with subsequent hydrothermal REE mineralization. During this process, the HREE/LREE ratios of the whole-rock and corresponding carbonates and apatites have remarkably increased, and large amounts of xenotimes occurred in the later calcite carbonatites. Note that the fluorite was not observed in all the samples investigated, and the xenotimes are closely associated with the sulfates (e.g., Barite and celestite). Also, the C-O-Sr-Nd isotopic data suggest a mantle-derived magmatic-hydrothermal system without any contributions from the crust. Therefore, we suggest that the different LREE/HREE compatibility of the calcite and dolomite (HREE are much compatible in calcite) during the carbonatitic magmatic stage and the indistinguishable LREE/HREE migration capabilities of the sulfate-complexes, as well as a fluorine-depleted source, control the HREE enrichment in carbonatites. Sulfate-rich but F-poor mineralogy may be a potential indicator for the presence of HREE mineralization in carbonatites.