REE and HFSE Fractionation and Mobility in the Tapira and Salitre Carbonatite Complexes Southeast, Brazil

Jo Hannah Asetre[1,2], Ignacio Gonzalez-Alvarez[1,3], Siyu Hu[1], Claudio Gerheim Porto[4]
[1]CSIRO, Mineral Resources, Kensington, Australia, [2]Macquarie University, Macquarie Park, Australia, [3]University of Western Australia, Perth, Australia, [4]Federal University of Rio de Janeiro, Rio de Janeiro, Brazil

Brazil produces ~90% of the global niobium (Nb), which is primarily used in high-strength steel and superconductor production. Globally, most Nb and rare earth elements (REE; ~80%) deposits are associated with carbonatites.

The Alto Paranaíba Igneous Province (APIP) in southeastern Brazil hosts several alkaline-silicate and carbonatite complexes known for their exceptional concentrations of niobium (Nb), phosphorus (P), titanium (Ti), and REE. Among these, the Araxá complex is the world's primary Nb source. Other key localities, such as Tapira and Salitre, contribute significantly to P extraction and remain relatively underexplored, despite their recognised potential for Ti, Nb, and REE.

This study is a preliminary assessment of REE and HFSE mobility within the bedrock and weathering profiles of the Tapira and Salitre complexes. Through integrated petrological and geochemical analyses, key elemental gains and losses across the weathering gradient are identified and linked to the mineralogical transformations that shape these geochemical signatures.

Our results reveal REE enrichment in the Cover from ΣREE ~0.03 wt% to 1.1 wt% in fresh rocks vs. 0.37 to 2.4 wt% in the saprolite. Reprecipitation of secondary phosphates (e.g., crandallite, monazite) in the weathered profile led to LREE enrichment of up to 2.0 wt% (relative to 0.13-1.4 wt% in the primary apatites). Titanium oxide contents significantly increased from 0.2-7 wt% in the fresh rocks to 19-28 wt% in the saprolite associated with anatase formation. Whole rock Nb concentrations can reach up to 0.4 wt% in the lower saprolite, which is consistent with the preservation of trace pyrochlore and perovskite (up to 1 vol% and 5 vol%, respectively).

Tapira and Salitre provide a compelling case for understanding REE and HFSE (particularly Nb) mobility and fractionation under intense, deep weathering. These deposits serve as references for similar geological-weathering contexts associated with carbonatites in West Africa, India, and Australia.