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REE enrichment in the karst bauxites of Sierra de Bahoruco (Dominican Republic)

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Karst bauxites from Sierra de Bahoruco (SW Dominican Republic) are classified as Fe-rich with a high degree of laterisation. Bauxite samples are composed primarily of gibbsite and contain minor proportions of hematite, boehmite, Al-goethite, Fe-Mn oxyhydroxides (asbolane), Ti oxides, zircon, apatite, quartz, calcite, and Cr-spinel; some samples contain kaolinite. All the studied deposits yield high REE contents (average ∑REE ~ 1,900 ppm, ∑REY ~ 3,066 ppm; maximum ∑REE ~ 14,000 ppm, ∑REY ~29,000 ppm). REE contents are positively correlated with MnO, P_2O_5, Ni, Co, and Cu. They are also rich in other critical metals like Sc, Ga, V, Ti, Zr and Nb.

Most deposits are enriched in LREE (La, Ce, Nd), while a few are enriched in HREE (Y, Gd, Dy). Chondrite-normalised REE patterns show two different trends: a) enriched 50-1200 times, with negative slopes between LREE and MREE and flat segments between MREE and HREE; b) enriched 800-10,000 times, with negative Ce anomalies, slight positive slopes for LREE and flat MREE-HREE segments. The identified REE-bearing minerals include primary (LREE-monazite) and secondary (Y, Gd, Dy, Sm, Yb-rhabdophane, churchite, and florencite) phosphates, carbonates (Gd, Nd, Sm-bastnäsite and tengerite), and oxyhydroxides.

Geochemical stability plots reveal that dominant REE solid phase depends on the total concentration of carbonate and/or phosphate in the solution. Phosphates are the most stable solid phases for Nd, Gd and Sm, at $[CO_3^{2-}]_{total}/[PO_4^{3-}]_{total} \leq 2$, while carbonates and hydroxide solid phases are clearly the dominant ones when total aqueous carbonate concentration is two orders of magnitude higher than that of phosphate. Carbonates appear at circumneutral pH, whereas hydroxides are stable at more alkaline pH.