

SEG 2026 Conference in Salt Lake City, United States

Critical Mineral Potential of the Velasco Alkaline Complex and Cerro Manomó Ferrocarbonatite Complex

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Global demand for critical minerals has renewed focus on alkaline and carbonatite systems as key sources of rare earth elements (REEs). In eastern Bolivia, the Velasco Alkaline Complex (VAC; ~440 km²) and the Cerro Manomó Ferrocarbonatite Complex (~20 km²) represent underexplored components of the southwestern Amazonian Craton with poorly constrained economic potential. This study evaluates the critical mineral prospectivity of these systems, with emphasis on light rare earth elements (LREEs), through reinterpretation of existing petrographic, geochemical, and isotopic datasets within a modern economic geology framework. Structural controls, hydrothermal alteration, and lateritic development are assessed using remote sensing, literature synthesis, and targeted field observations. Results indicate that Cerro Manomó is the most prospective system, with enrichment in Ce, La, Nd, and Pr hosted in bastnäsite and monazite within silicified ferrocarbonatites and overlying lateritic profiles. These relationships highlight the role of supergene processes in upgrading primary mineralization. In contrast, only a subset of the fourteen plutons within the VAC demonstrate meaningful prospectivity for LREE and corundum mineralization. Fertility is linked to magmatic evolution pathways capable of generating carbonatitic or pegmatitic systems. These results define key controls on REE enrichment and establish an exploration framework integrating magmatic fertility, structural architecture, and supergene modification to prioritize targets across both complexes.