Mineralization of the Mianning–Dechang REE belt, Sichuan Province, southwest China

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The Himalayan Mianning–Dechang (MD) REE belt in western Sichuan Province, SW China, is approximately 270 km long and 15 km wide, and contains total reserves of 3 Mt of light rare earth elements (LREE), mainly including one giant (Maoniuping), one large (Dalucao), small REE deposits (Muluozhai and Lizhuang) and occurrences. The REE mineralization within this belt is associated with carbonatite–alkaline complexes that contain alkaline syenite stocks and associated carbonatitic sills or dikes. SHRIMP U–Pb zircon dating indicates the formation of the Maoniuping, Lizhuang, and Muluozhai alkali complexes at 27–22 Ma in the northern part of the belt, and the formation of the Dalucao complex at 12–11 Ma in the southern part.

The No. 3 orebody within the Dalucao and Lizhuang complexes is characterized by fenitization associated with the intrusion of carbonatite. The REE mineralization within the belt is present as complex vein systems that contain veinlet, stringer, stockwork, and brecciated pipe type mineralization. The ores within the deposits range from coarse-grained (Maoniuping and Diaoloushan deposits) to brecciated (Dalucao and Lizhuang deposits), and stringer (stockwork) and weathered ores (Maoniuping and Dalucao deposits) that mainly contain a fluorite + barite + celestite + calcite + pyrite mineral assemblage. Petrographic and field-based research on the ores indicate that bastnäsite and other REE minerals formed during the final stages of the evolution of the magmato-hydrothermal systems in this region.

The chemical composition of the syenite and carbonatite units in this area indicates that the REE were transported as chloride species within hydrothermal fluids, and the presence of bastnäsite and parisite indicates that the REE precipitated as fluorocarbonates. The alteration, petrographic, and geochemical data presented here, combined with our analysis of the ore types present within these deposits, suggests that the giant or large REE deposits within the MD belt are related to voluminous carbonatite–syenite complexes, similar ore-forming fluids, significant alteration, multiple stages of REE mineralization, and tectonic activity in this area.