

Lithium Mineralization Potential of Evolved Granites and LCT Pegmatites in the Brasília Orogen, Brazil

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The global expansion of low-carbon technologies has intensified demand for lithium. The Brasília Orogen (Tocantins Province), a Neoproterozoic belt formed during Gondwana's amalgamation (640–500 Ma), hosts peraluminous granitic-pegmatitic systems with potential for critical mineral mineralization. This study aims to characterize the metallogenetic potential of three suites: Mata Azul, Aurumina, and São Domingos. Methods included mapping 15 outcrops, sampling 6 drill cores, petrography (n=47), whole-rock geochemistry (ICP-OES/MS), and mineral chemistry via EPMA-WDS. All three suites exhibit a peraluminous character (A/CNK 1.07–1.68), consistent with evolved magmatism. The Mata Azul Suite (560–520 Ma) displays five pegmatitic facies, ranging to albite-lepidolite facies with whole-rock Li up to 12,729 ppm. Zonation is well-developed, with pods enriched in lepidolite and rubellite. Lepidolite yields high Li₂O (~4.7–6.1 wt.%), F (up to 10.3 wt.%), and Rb (up to 1.1 wt. % Rb₂O). Garnets are spessartine-rich (Sps_{44–68}), and tourmalines evolve from schorl to elbaite. The Aurumina Suite (2.16–2.11 Ga) comprises syenogranites, albitites, and pegmatites with lepidolite and Li contents up to 8,555 ppm. Mylonitic granites host spodumene porphyroclasts. Nb-Ta-Ti oxides evolve to ferrotitanowodginite, while Li-Al phosphates correspond to the amblygonite-montebbrasite series. This suite exhibits the highest degree of fractionation, with Be up to 258 ppm, Cs up to 1,351 ppm, and Ta up to 176 ppm. The São Domingos Suite (2.1–2.0 Ga) consists of albite-rich pegmatites hosting cassiterite and montebbrasite, and is enriched in P (up to 1.29 wt.% P₂O₅), with Li contents reaching 993 ppm. The occurrence of lithium-bearing minerals, predominantly lepidolite, associated with highly fractionated geochemical signatures (low K/Rb and high Be, Cs, Ta, and Li contents), indicates lithium potential in the studied suites, consistent with LCT-type systems, but distinct from classical spodumene-dominated systems that represent the main exploration targets.