Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.33725

Geochemical constraints on melt evolution and lithium enrichment in LCT pegmatites of the Assam–Meghalaya Gneissic Complex, northeast India

AMRITA DUTT[1], DEBAJYOTI PAUL[1], VINEET GOSWAMI[2], DWIJESH RAY[3] AND JITENDRA KUMAR DASH[1]

[1]Indian Institute of Technology, Kanpur

[2]Physical Research Laboratory

[3]Planetary Science Division, Physical Research Laboratory, Ahmedabad, India

Lithium-rich pegmatites are the most evolved products of crustal melting and magmatic fractionation, yet their geochemical signatures can record melt histories inherited long before pegmatite emplacement. Here, we investigate the evolution of a rare Lithium-Cesium-Tantalum (LCT)-pegmatite within the Meso-Neoproterozoic Assam-Meghalaya Gneissic Complex (AMGC), northeast India, of the Indian shield. These pegmatites showed extremely alkaline (K_2O = 8.7 wt.%) peraluminous (A/CNK >2.5) character. They are enriched in Li (≤18,000 ppm), Rb (up to 10,367 ppm), Cs (up to 2198 ppm), and Ta (up to 656 ppm). The pegmatites have strongly fractionated rare earth element (REE) patterns (La_N/Yb_N = ≤173) but have low total REE concentrations (SREE = 0.04-11.2), suggesting REE removal during early crystallization of accessory phases (e.g., monazite) and selective HREE partitioning into the garnets of associated barren pegmatites. The LCT-pegmatites comprise lepidolite (60%) as the Li-bearing phase along with quartz (35%) and Li-muscovite (5%). The lepidolites and Li-muscovites have high F content (up to 8 wt.%), which shows a strong positive correlation with Li (R^2 = 0.99). This signature, along with a whole-rock tetrad effect of ≤1.1 indicate Li incorporation in lepidolite by continued solid solution during magmatic differentiation rather than discreet hydrothermal replacement. Partial melting and fractional crystallization modelling using trace element concentrations suggest that Li-rich pegmatites can form from sediments having Upper Continental crust (UCC) like Li abundance. However, they require high F activity to retain Li in the evolving fluid, and rapid crystallization of the pegmatites that limits Li diffusion into surrounding host rocks. The high radiogenic Sr isotopic composition ($^{87}Sr/^{86}Sr$ >64) of the LCT-pegmatites suggest that they were derived from partial melting of mica-rich sediments accumulated from the weathering of old felsic crust. Contrary to existing genetic models of LCT-pegmatites that require Li-rich protolith or multi-stage melting, this work indicates that LCT-pegmatites can form from a UCC-like crust given favourable volatile budgets and melt evolution.