Lithium Enrichment in Granites and Pegmatites: a Reflection of their Crustal Source

Bence Horányi[1], Jérémie Melleton*[1,2], Eric Gloaguen[1,3], Fabrice Gaillard[1], Austin Gion[1,4], Alexis Plunder[1,3], Alban Moradell-Casellas[1,3], Josselyn Garde[1], Saskia Erdmann[1], and Ida Di Carlo[1]

[1]Institut des Sciences de la Terre d'Orléans - UMR7327 – Bureau de Recherches Géologiques et Minières, Institut National des Sciences de l'Univers, Université d'Orléans, Centre National de la Recherche Scientifique – France

[2]Bureau de Recherches Géologiques et Minières – Bureau de Recherches Géologiques et Minières (BRGM) – France

[3]Bureau de Recherches Géologiques et Minières – BRGM – France

[4]Department of Earth Sciences, University of Oxford – Royaume-Uni

Résumé

Lithium is a high-demand, critical metal that is primarily sourced from rare-metal granites and pegmatites (RMGPs). In order to meet the rising demand of lithium for modern-day technologies, it is imperative to better understand the petrogenetic model of granite-related ore deposits. The enrichment of rare metals in felsic melts has been historically associated with high-degree fractional crystallization; however, recent studies have demonstrated that this mechanism alone is unlikely to produce melts that are consistent with economic-grade deposits (> 5000 ppm; e.g., Koopmans et al., 2023). Alternatively, lithium may become enriched during the partial melting of crustal rocks; however, the anatectic source of RMGPs remains poorly explored. In order to test the anatectic origin of RMGPs, partial melting experiments were performed on variably enriched metasedimentary rocks (100-800 ppm lithium) in a piston-cylinder apparatus at 750-800oC and 400-1000 MPa. The experiments produced felsic melts with up to 2200 ppm lithium which is comparable to weakly enriched RMGPs. To further explore the enrichment of lithium during crustal anatexis, trace element modelling was performed using newly constrained mineral-melt partition coefficients. Experimental and modelled results demonstrate that RMGPs are unlikely to be sourced from conventional metasedimentary deposits (< 200 ppm lithium). Instead, RMGPs are interpreted to form by the partial melting of enriched crustal rocks (300-600 ppm lithium), followed by the moderate fractional crystallization of the extracted melts. Alternatively, the partial melting of unconventional metasedimentary deposits (_˜1000 ppm lithium) can produce felsic melts that may crystallize to form economic-grade RMGPs (> 5000 ppm lithium). Koopmans et al. (2023). Geology, 52, 7-11.

Mots-Clés: Granites à métaux rares, pegmatites, lithium, fusion partielle

*Intervenant