Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.26875

Lithium enrichment during the magmatic-hydrothermal evolution of the Weilasituo deposit, Inner Mongolia, China

TIANCI HUANG[1,2], XINBIAO LV[1], CHAO CHEN[1] AND ZHOU ZHOU[2]

[1]Institute of Geological Survey, China University of Geosciences, Wuhan 430074, China
[2]The Seventh Geological Brigade of Hubei Geological Bureau, Yichang 443100, China

Granite-related lithium deposits are typically formed through highly fractionated magmatic-hydrothermal processes. The Weilasituo large rare metal deposit, located in the southern Great Hinggan Range, exhibits significant enrichment of Li, Rb, and Sn. This deposit features an “upper vein-lower body” mineralization structure, comprising three principal ore types: (1) granite type Sn-Zn-Li-Rb ore bodies, (2) crypto-explosive breccia pipe type Li-Rb ore bodies, and (3) quartz vein type Sn polymetallic ore bodies. U-Pb dating of cassiterite from the breccia pipe (138.4±1.9 Ma) and the quartz vein (139.1±2.3 Ma) reveals a close temporal correspondence with the zircon U-Pb age of the mineralized granite (139.3±1.4 Ma), indicating consistent ages for diagenesis and mineralization. The deep-seated alkali feldspar granite, characterized by amazonite, zinnwaldite, albite, and topaz, represents the terminal product of fractional crystallization with initial Li enrichment. Continued magma fractionation during its upward migration results in the predominance of anhydrous feldspar, driving the residual melt to volatile saturation. Systematic variations are observed in the shallow parts of the granite: (1) widespread miarolitic cavities; (2) increasing albite content coupled with decreasing zinnwaldite content and Li concentrations; (3) development of feldspar-rich lithologies; (4) fluid inclusion-rich quartz rims; (5) intense metasomatism (albitization and topazization) associated with snowball quartz formation; and (6) enhanced tetrad effects accompanied by reduced Nb/Ta ratios (<5). These features collectively indicate extensive magmatic fluid exsolution during late-stage fractionation. Zinnwaldite serves as the primary Li-bearing mineral across all mineralization types. Lithium concentrations in zinnwaldite show spatial variations, averaging 17,951 ppm in deep granite, 15,540 ppm in shallow granite, 19,655 ppm in breccia pipe, and 20,504 ppm in quartz vein, exhibiting positive correlation with F content. Systematic δ^{7}Li depletion in zinnwaldite from deep to shallow granite (2.63‰ to 2.23‰) indicates fluid-induced alteration of pre-existing zinnwaldite in the granite, with preferential incorporation of ^{7}Li into exsolved fluids. These findings highlight that Li extraction by fractionation-derived hydrothermal fluids plays a critical role in Li enrichment and mineralization.