Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.37052

Lithium enrichment in geothermal brines: Mineralogical characterization and batch dissolution experiments

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Predictive geochemical characterization of geothermal fluids during early exploration stages requires improved understanding of deep paleofluid circulation and fluid–rock interactions. Geothermal fluids originate from long-term high-temperature hydrothermal leaching processes that mobilize chemical species, including valuable metals such as Li, Pb, Zn, and Mn, as well as corrosive components like CO_2 and H_2S. These elements may be transported over tens of kilometers, trapped by geological structures, or redistributed through precipitation, ion exchange, and adsorption. Accurate modeling of geothermal fluid chemistry therefore depends on reconstructing paleofluid pathways, P–T evolution, thermodynamic properties, and reaction kinetics of aqueous, mineral, and gaseous species (Dezayes & Lerouge, 2019; Boschetti, 2023). However, a major limitation in modeling Li distribution in geothermal brines is the scarcity of kinetic data for dissolution of lithium-bearing minerals, particularly natural phases, which constrains reactive transport simulations.

To address this issue, controlled batch dissolution experiments were conducted on Li-bearing biotites to obtain new kinetic data. The experiments were parameterized using geochemical simulations and performed under various temperatures (75, 90, and 150 °C), pH conditions (acidic and neutral), water-to-mineral ratios (5 and 100), and reactive surface areas. Preliminary results obtained over one month, using grain sizes between 80 and 100 µm, a water-to-mineral ratio of 100, and distilled water, show a progressive increase in lithium concentration in solution. The obtained results were used to estimate the kinetics constant and will be used in future reactive transport models for fluid–rock interactions of Li dissolution from biotites.

References

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