

Experimental Investigation of Lithium Release Into Low Temperature Brines, Applications for the Great Basin, Utah

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Brines are important unconventional sources of Li, and the geological conditions of the Great Basin makes it a promising target for Li development. There is a need to refine models of lithium sources and mobility in closed-basins that will inform future resource assessments or lithium regeneration strategies.

This project investigates the leaching behavior of Li from lab-made rhyolitic glass under low temperature hydrothermal conditions that simulate shallow subsurface environments in and around the Great Salt Lake, Utah. A series of batch experiments were conducted using powdered synthetic rhyolitic glass (~77% SiO₂), with representative concentrations of Al₂O₃, Na₂O, K₂O, and network modifiers such as Fe, Mg, and Ca. The experiments were run in sealed Teflon-lined vessels at elevated temperatures (~90°C). Solutions of varying chloride concentrations were meant to mimic natural groundwater and warm spring conditions, ranging from deionized water to 100,000 ppm Cl⁻.

Results show that Li release occurs rapidly in the early stages of water–rock interaction, followed by a gradual tapering in release rates over time. This pattern is consistent with a shift from surface-exchange-controlled to transport-limited mechanisms. Solutions rich in Cl⁻ accelerated Li release compared to DI water, which is interpreted as the effect of chloride lowering Li⁺ activity via outer-sphere complexation, thereby sustaining a chemical gradient that drives continued diffusion through an altered glass layer. The Mg/Li trends indicate secondary mineral precipitation affecting mostly Mg. SEM and XRD analysis of filters and experimental products show the formation of alteration layers, including amorphous silica gels and potential secondary minerals.

The study offers conceptual insight into the geochemical processes that may regulate Li mobility in the Great Basin and saline lake systems in other locations. It also establishes a controlled experimental framework for testing how fluid composition influences Li flux from volcanic materials at a known, constant temperature.