Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.17251

Water Quality and Legacy Lithium Mining in North Carolina: Insights on the Impacts of Future Lithium Mining

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Lithium is playing a central role in the green energy transition through its use in battery technologies for many clean energy applications. Historically, North Carolina was a leading producer of lithium from the lithium-rich pegmatite of the Tin-Spodumene Belt (TSB) with lithium processing facilities and open pit mines. Plans to reignite lithium mining in the region are underway, and therefore, an evaluation of the environmental effects of legacy operations are important for evaluating and predicting the potential impacts of future lithium mining in the region.

The environmental assessment was conducted through (1) chemical and radiological analyses of the original spodumene ore and residual materials after lithium extraction; (2) leaching experiments; and (3) field measurements of surface water near and away from the lithium mine. Analysis of six whole rock TSB samples show that trace metal and Ra nuclide levels are low (95 Bq/kg Total Ra) compared to other ore rocks (280 Bq/kg in Appalachian Coals) and the upper continental crust, yet some contaminants such as V, Cr, Co, As, Sr, Th, and U were highly extractable during DI water and 1N HCL leaching tests. Stream waters associated with mine and the lithium operation site had elevated overall salinity (TDS=329 mg/L) and lithium concentrations (mean=831 µg/L; n=4) relative to background stream waters within the TSB watershed (TDS=80 mg/L; Li=25 µg/L; n=5). The impacted waters also had high Li/TDS ($2.6x10^{-3}$) relative to background waters ($0.3x10^{-3}$). Our data suggest that the historic operations are causing an increase in lithium concentrations in impacted streams downstream of historical operations. The concentrations of other contaminants such as As, V, U, and Cr in the impacted water were low (e.g., As=1.1 µg/L; n=4), suggest that mining of in the TSB could affect stream water quality, however, aside from lithium, it is not likely to lead to elevated levels of common contaminants.