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Data Resources and Machine Learning Approaches to Identify Lithium and Other Critical Mineral Potential in U.S. Geothermal Waters

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The surging demand for critical minerals to support manufacturing of advanced technology has stimulated renewed interest in their development and extraction from non-traditional sources. The demand for lithium (Li) has grown as the market for batteries to support expanded adoption of electric vehicles, smart-technology consumer products, applications of drones and other autonomous vehicles, and long-duration energy storage for emergency grid operations increases. The availability of other critical minerals (i.e., Mg, Al, B) used in chip manufacture, computing technology, and related devices, as well as data center expansion, is also under pressure worldwide. Geothermal fluids represent a possible non-traditional source. Extraction of lithium from geothermal waters is not a new concept [1]. Although there has been considerable work on the estimation of, and search for, geothermal resources, there has been less focus on assessing critical minerals in geothermal fluids. Efforts to link critical mineral prospectivity to additional geographic areas where geothermal development is favorable, have been limited. The Salton Sea region of the United States has received notable attention with Li concentrations in geothermal fluids upwards of 200 mg/L but there are other regions of the country where geothermal resources exist, yet critical mineral potential remains understudied and geochemical data are sparse. In this presentation, we catalog the existing U.S. data resources pertaining to Li and other critical minerals in geothermal waters and present a framework for employing machine learning techniques to identify, classify, and estimate the critical mineral resource extent. The four machine learning algorithms employed in this study include Random Forest, Gradient Boosting Trees (GBT), Extreme Boosting (XGBoost), and Deep Neural Networks (DNN). Our approach expands on earlier work on machine learning approaches to identify and predict Li concentrations in oil and gas produced water [2].

References

1. Schulte, L.E., Bauer, D.J. (1984). Recovering lithium chloride from a geothermal brine. Report of Investigations 8883, U.S. Department of the Interior, Bureau of Mines.
2. Attanasi, E., McDevitt, B., Freeman, P., & Coburn, T. (2026). Evaluating Machine Learning Approaches to Identify and Predict Oil and Gas Produced Water Lithium Concentrations. *Data Science in Science*, *5*:2624195.