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Geochemical Proxies Through the Life Cycle of Critical Minerals

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Critical minerals (CMs) are essential for the U.S. and global energy transition and economy, and thus the demand for CMs is rising across all economic sectors is increasingly. The extraction of CMs is limited to specific geological domains due to their abundance in only a few countries and varying degrees of governance over extraction practices. Recent estimates suggest that by 2030 the global demands for essential CMs will exceed the current supplies by 20-30%, which would likely further exacerbate shortages in the supply chains and increase the U.S. dependence on overseas CMs sources. Realization of the sustainability of CMs extraction of conventional and unconventional resources (e.g., wastes), processing, and recycling requires integration and cross-disciplinary investigations beyond sole economic resources assessments. This presentation will highlight the role of geochemical proxies for studying the occurrence and sources of CM resources, potential environmental impacts associated with mining and processing of CMs, and the ability to track CM sources along the supply chains. One example is the utilization of strontium isotopes as a sensitive tracer coupled with other geochemical indicators that can be used to detect the occurrence of subsurface lithium pegmatites by measuring the strontium isotope ratio in overlying soil, elucidate the sources of inflows into the lithium-rich surficial brines into closed basins (salars) in the Lithium Triangle of South America, identify the source of groundwater contamination in areas of lithium mining, and be used, combined with lithium isotopes, as a proxy for reconstructing the sources of lithium carbonate materials in the global supply chains.