

SEG 2026 Conference in Salt Lake City, United States

What Happens in the Basin, Stays in the Basin: Lithium in the Miocene Barstow Formation, California

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The Miocene Barstow Formation in the Mojave Desert, California, was recently recognized as a prospective volcano-sedimentary (VS) lithium system, adding to a growing list of similar deposits across the western United States. We conducted the first regional field-based investigation of lithium mineralization in the Barstow Formation targeting areas of significant data gaps to characterize its distribution, geochemistry, and stratigraphic context. This project aims to refine mappable criteria for VS lithium systems to better identify new areas with potential for undiscovered deposits.

With support from the USGS Earth Mapping Resources Initiative (Earth MRI), we integrated regional and site-specific datasets, including geochemical sampling, qualitative field screening for lithium using a portable laser-induced breakdown spectroscopy (pLIBS) analyzer, new 1:24,000 geologic mapping, airborne electromagnetic (AEM) surveys, and AVIRIS-3 hyperspectral mineral mapping to refine the geologic framework and identify potential controls on lithium mineralization.

Our observations support previous interpretations that the Barstow Formation comprises mixed-clay lithologies hosted within an extensional fault-bounded basin, characteristic of other VS lithium deposits. Field mapping and trace element analyses indicate that lithium is preferentially concentrated in lacustrine mudstones, claystones, and tuff beds. Screening geochemical samples with pLIBS, using site-specific calibration, provides a reliable qualitative field indicator of lithium mineralization, although quantitative assessment requires laboratory geochemistry. Mg-rich clays mapped using AVIRIS-3 data show consistent spatial associations with high lithium samples. AEM profiles assist with subsurface interpretation for mapping and vectoring of the fine-grained Barstow Formation sediments typically shown as laterally continuous conductive horizons.

This combined dataset improves our understanding of the regional lithostratigraphic distribution of lithium within the Barstow Formation and proposes mappable criteria for exploration targeting VS lithium systems. Ongoing work includes evaluating the regional continuity of lithium-rich horizons, characterizing potential lithium sources from older volcanic units, and assessing the economic potential of co-occurring lithium and borate mineralization.