

Critical Mineral Behavior Across the Salton Sea Geothermal Field

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The Salton Sea Geothermal Field (SSGF) in Southern California hosts a suite of critical minerals (i.e. Li, Zn, Mn, Rb, Sr) in a hot, hypersaline, metalliferous brine and its associated reservoir rocks. Here, we characterize the distribution and mobility of these elements as recorded by the reservoir rocks as a function of depth, brine temperature, and mineral composition.

The California State 2-14 scientific drill core contains records of distinct metamorphic zones: calcite-chlorite at depths shallower than 2480 meters, biotite from 2480 to 3000 meters, and amphibole below 3000 meters. The primary mineral host in calcite-chlorite and biotite zones for Li and Zn is chlorite, for Mn and Sr is epidote, and for Rb is biotite. As depth increases, Li and Zn decrease in concentration in chlorite, Mn increases and Sr decreases in concentration in epidote, and Rb decreases in concentration in biotite.

Rocks from the bottom-most portions of 10 commercially drilled wells distributed up to 8.5 km south and 6 km west of the California State 2-14 scientific drill core have also been analyzed; five are in the calcite-chlorite zone, three are in the biotite zone, and two are in the amphibole zone. Primary mineral hosts for Li, Zn, Mn, Sr, and Rb are the same as in California State 2-14. In wells that reach amphibole metamorphic zones, actinolite becomes the primary mineral host for Mn (while Li, Zn, Rb, and Sr concentrations remain low in actinolite). The transition from chlorite-biotite to biotite-only does not change Li and Zn abundances in biotite. Driving mechanisms for variations of these elements in their primary mineral hosts will be assessed as a function of pressure, temperature, and mineral composition across the SSGF.