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A Mineral Systems Approach to the Classification of Lithium Deposits

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A mineral systems approach to classifying lithium deposits needs to consider the sources of Li, tectonic setting, magmatic processes, transport and emplacement of magma, hydrothermal processes, weathering, and preservation. Mantle processes exert little direct control on the formation of Li deposits. The source of lithium is the crust, where it is concentrated via partial melting, fractional crystallization, then once magmas are exposed at surface, through weathering and enrichment of Li in clay minerals. The tectonic environment is in collisional settings and initial Li enrichment is in late syn-tectonic to early post-tectonic melts. Li is a moderately incompatible element, and melting of pelitic sedimentary rocks and intermediate to felsic plutonic rocks produces Li-bearing peraluminous melts. During the crystallization of these melts, Li is initially concentrated in micas, and with enough crystallization, a Li ore mineral crystallizes. Structures at terrane boundaries are important as conduits for the emplacement of magma at higher crustal levels. After the emplacement of peraluminous magma, extension and subsidence can form closed basins, in which brine deposits can develop.

Li deposits can be broadly classified into those associated with intrusive rocks and those associated with extrusive rocks, with some overlap between the two classes. The intrusive class consists of pegmatite deposits, which can be either zoned or poorly zoned, and granites, which can contain disseminated mineralization or Li-bearing veins. The source of the Li in at least some of the brine deposits is from remobilization from granites, and the host can either be in sedimentary basins or in granites. This potentially includes Jadar-type deposits. The extrusive class consists of Li in geysers and volcanic glasses. This Li can be remobilized into evaporite-associated or geothermal brines. Similarly, the re-distribution of Li from Li-rich volcanic rocks can generate clay deposits. Lastly, bauxite-hosted Li deposits form in weathered environments.