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The role of post-collisional processes in the Li resource cycle

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The most widely exploited Li resource is currently LCT pegmatites. However, there remain significant gaps in our understanding of the chain of geologic processes that culminates in the formation of this resource. Here, we consider the role of post-collisional magmatism, salt-lake formation and anatexis of Li-rich borate deposits in the formation of L-rich pegmatites, using the Miocene volcano-sedimentary sequences of Western Anatolia as a potential type-example. Following continental collision between the African and Asia plates, slab roll-back led to the eruption of boron- and lithium-rich ultrapotassic volcanic rocks. Interaction of geothermal fluids with these rocks, pooling of the fluids in post-collisional extensional basins, and subsequent evaporation in the arid Miocene climate of the region led to the formation of the world's largest borate deposits. The thick layers of borates are also interlayered with Li-rich clays (hectorite). Oxygen isotope analyses and sedimentological evidence from the Bigadiç borate deposit indicates that this Li enrichment occurred via evaporative concentration of salar-type brines and adsorption of Li by smectite formed by the alteration of tuff layers within the basins. Li isotope modelling suggests that approximately one third of the Li originally contained within the brines was incorporated into the clay minerals. The deposit was subsequently sealed by a volcano-sedimentary cap and essentially forms a giant Li-, B- and water-rich XRF bead. Comparison with experimental studies of the macusanite obsidian leads us to hypothesise that this deposit could undergo anatectic melting at a temperature of approximately 450 C to form a partial melt that is saturated with respect to tourmaline and Li-rich pegmatite minerals such as spodumene. The elevated geothermal gradient in Western Anatolia could potentially lead to anatectic melting and pegmatite emplacement occurring at depths as shallow as 7 to 3 km. Such a process not only has implications for mineral exploration in Turkey but may also help explain the formation of Himalayan Li-rich pegmatite systems, such as the giant Jiajika deposit.