Lithium recycling: From mantle melting to surficial mineralization

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Lithium brines are the primary economical sources of Li. They are mainly distributed in arid lacustrine basins in Altiplano in South America, Tibetan Plateau, and Great Basin region of the western United States[1]. Using a large geochemical database compiled from global volcanic arcs, we examined Li concentration as a function of SiO2 content in igneous rocks from different arcs, ranging from island arcs to continental arcs. We show that there is no systematic difference in these differentiation trends in different arcs, which indicates that mantle source has limited influence on Li enrichment in arc lavas. We suggest that other factors, such as elevation, crustal thickness, climate and volcanic activity may play more important roles. With increasing crustal thickness, arc magmas become more differentiated and hence more silicic, as evidenced by strong correlations between silica content of erupted lavas with elevation and crustal thickness[2]. Because Li behaves incompatibly, more progressive differentiation results in Li enrichment[3], such that magmas in thick arcs are most enriched in Li. Importantly, thick magmatic arcs, while formed by a combination of high magmatic flux and tectonic compression, are characterized by local extension, resulting in high elevation intermontane basins, many with internal drainage. We suggest that andesitic and rhyolitic lavas, enriched in Li, serve as Li source rocks. Weathering of such source rocks, particularly of volcanic ash, may result in extensive leaching of Li, which is then transported and concentrated into the intermontane basin. Continental arcs, coupled with appropriate climate conditions, may become the primary sites of Li mineralization.

[1]Kesler *et al*. (2012) *Ore Geology Reviews*, **48**, 55-69.[2] Farner & Lee (2017) *EPSL* **470**, 96-107.[3] Benson *et al*. (2017) *Nature Communications* **8**, 270.