Lithium systematics in arc magmas: implications for Li mineralization

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The increasing development of electric vehicle industry is highlighting the critical and strategic demand of Lithium (Li), as the primary ingredient of lithium-ion batteries. Lithium brines, associated with local volcanism, provide approximately three-fourths of the global production[1]. Exactly which factors, magma source, differentiation or weathering, primarily dominate Li mineralization is unclear. Here, we show that primary arcs have identical Li contents and Li/Y to mid-ocean ridge, indicating that magma source has limited influence on mineralization. During differentiation, there are similar systematical Li enrichment trends in different arcs due to Li incompatible behavior[2]. We show that thick magmatic arcs, formed by a combination of high magmatic flux and tectonic compression, have volumes of more silicic and hence Li-enriched lavas and ashes[3]. Weathering of such rocks, particularly of volcanic ash, could result in extensive leaching of Li, which is then transported and concentrated into the intermontane basin formed at extension settings of continental arcs. Continental arcs, coupled with appropriate climate conditions, are the primary sites of Li mineralization.

[1] Kesler S E, *et al*. Global lithium resources: Relative importance of pegmatite, brine and other deposits. *Ore Geology Reviews*, 2012, **48**: 55-69. [2] Benson T R, *et al*. Lithium enrichment in intracontinental rhyolite magmas leads to Li deposits in caldera basins. *Nature communications*, 2017, **8(1)**: 270. [3] Farner M J, Lee C T. Effects of crustal thickness on magmatic differentiation in subduction zone volcanism: A global study. *Earth and Planetary Science Letters*, 2017, **470**: 96-107.