Lithium Isotopes and Light Element Behavior in the Subarc Mantle:
A Multiple-Arc Study

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A growing body of Li isotope data from multiple magmatic arcs worldwide suggests buildup of heavy Li in the subarc mantle, which differs from the interpretations previously put forth. The range in δ^7Li of a total of 38 samples from the Kurile, Sunda, Central American (Panama), and Aleutian arcs is only 3.5‰ (+2.1 to +5.6). By comparison, normal and depleted MORB have δ^7Li of +1.5 to +4.7. The samples analyzed represent lavas with broad ranges in bulk composition (SiO_2 = 44 to 75 wt.%) and trace element contents (B/Be = 1.4 to 79). Available data support enrichment in ^{7}Li in slab-derived fluids (e.g., Benton et al., 1999: *EOS*). If Li and B fluid-mantle partitioning were identical, lavas with high B/Be would show δ^7Li > MORB. This relationship holds for the Izu arc and parts of the Central American arc (Moriguti and Nakamura, 1998: *EPSL*; Chan et al., 1999: *Chem Geol*), but why do the samples from the four arcs of this study not show similar correlation of δ^7Li and B/Be? The data from Panama may hold the key. There, normal arc lavas with high B/Be show MORB-like δ^7Li, whereas lavas with MORB-like (low) B/Be show variable and high δ^7Li, reaching values as great as +11.2. Panamanian adakites show low δ^7Li associated with low B/Be ratios, in this case suggestive of the melting of devolatilized ocean crust. Slab-derived Li appears to be retained in the Panama subarc mantle, preserving the δ^7Li signatures of past slab inputs. Boron has strong affinity for fluids and has virtually no residence time in the subarc mantle, so arc lavas reflect only the most recent slab fluid B inputs. Decoupling of B from Li as a result of chromatographic effects in the subarc mantle thus may be responsible for the lack of heavy Li signatures of high B/Be lavas from the other arcs. Perhaps in these arcs the lack of thermal perturbations may result in long-term sequestering of Li in the subarc mantle. Regardless of the specific mechanism, these data imply that regions of the upper mantle have become strongly enriched in ^{7}Li over Earth history as a direct consequence of the subduction process.

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