Declines in B and both of downdragged forearc mantle materials with high B and diverse combined with high Li diffusion rates result in exceptionally slab, such that the releases at shallow depths indicate isotopic “lightening” of the δB. Removal from slabs by metamorphism, and depleted B and elevated in most large-ion lithophiles (Savov et al 2005). Declines in B and δ11B across volcanic arcs point to continued removal from slabs by metamorphism, and depleted B and δ11B in ocean island lavas suggest deeply recycled slabs are stripped of boron. B isotopic variations in forearc point to extensive boron removal at low temperatures, as the δ11B of slab materials (~0 to -3‰ on average) are substantially lower than that of Mariana forearc serpentinites (+13 - +18‰: Benton et al 2004) or of B-enriched arc lavas. High δ11B releases at shallow depths indicate isotopic “lightening” of the slab, such that the δ11B systematics in arc lavas require inputs both of downdragged forearc mantle materials with high B and δ11B, and of a B depleted, low δ11B slab component.

Li isotopic variations in the forearc mantle are divergent, with serpentinite muds showing uniform δLi indicating equilibrium with high δLi porefluids, while entrained ultramafic clasts record highly variable δLi. Relatively high Dli for mafic minerals (especially Mg-rich sheet silicates) combined with high Li diffusion rates result in exceptionally diverse δLi in mantle-derived ultramafic samples. However, δLi in young volcanic rocks from all tectonic settings are remarkably uniform, ranging from +3‰ to +6‰, indicating buffering by a uniform, Li-rich upper mantle reservoir, and/or limited Li isotopic change due to subduction zone chemical processing, despite evidence for Li and δLi depletion in eclogitic rocks (Zack et al 2003). Interestingly, substantial δLi changes can occur over time in lavas from “dying” subduction systems, suggesting that such changes may only be observed when processes that homogenize the mantle (i.e., wedge convection) shut down.

References