The role of the forearc in fluid-mobile elemental cycling through subduction zones

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Lithium, boron, and the halogens (Cl, F, Br, I) are all highly fluid-mobile elements. Their incompatibility in minerals limits modification by fluid-rock interaction, thereby making them reliable tracers of fluid source. Due to their hydrophilic nature, elemental ratios (e.g., Cl/Nb, Br/Cl, I/Cl, Li/B, B/Cl) as well as the isotopes of Li, B, and Cl have been used as a fluid tracer in subduction zones or to trace recycled crustal material in the upper mantle. Recent work has focused on defining the elemental concentration and isotopic composition of inputs (e.g., sediments, altered oceanic crust, serpentinites) into the subduction zone, as well as, outputs from the volcanic front (e.g., gases, lava, melt inclusions). Although the cycling of Li, B, and halogens through the arc volcanic front is now reasonably well understood, their overall budgets remain uncertain because additional output pathways are likely but to date have been poorly quantified. Four possible, yet largely unquantified outputs/reservoirs are: 1) loss through or sequestration in the forearc via cold and thermal spring systems; 2) sequestration in the crust due to magma ponding; 3) deeply subducted residue and input into the deep mantle, and 4) sequestration in the sub-continental lithospheric mantle. Here I will present previous and ongoing work in subaerial forearc springs from Cascadia, New Zealand, and Costa Rica which can be used to evaluate fluid sources and elemental loss through the forearc.