Slab dehydration beneath the southern Cascade arc inferred from B and H isotopes

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Slab dehydration reactions in subduction zones fractionate H and B isotopes. As a result, values of these ratios in magmas can be used to investigate dehydration processes beneath arcs. Here, we present volatile, trace element, δD and $\delta^{11}B$ analyses of olivine-hosted (Fo 84-90) melt inclusions from 6 cinder cones (calc-alkaline and calc-alkaline transitional basalts) in the Lassen region of the Cascades, an arc with an unusually hot subducted plate.

Initial δD values, corrected for post-entrapment H loss, range from -61 to -92‰. These values are isotopically lighter than those of melt inclusions from the Marianas (-55 to -12‰)[1], suggesting a more dehydrated subducted plate source. Using temperatures predicted for the subducted plate from geodynamic models, we modeled the δD values of fluids released from the plate as a function of depth. The model predicts that waning dehydration of the last 5-15% of bound H_2O within the slab interior occurs beneath the arc, and the predicted δD values closely match those of the melt inclusions. Because the upper, completely dehydrated portions of the plate are likely at or above the MORB + H_2O and sediment + H_2O solidi (based on geochemical and geodynamic models), dehydration of the deeper parts of the slab should cause partial melting of the slab top. Our results are consistent with published evidence [2] for a slab component with MORB-like isotopic composition.

The $\delta^{11}B$ values from the Lassen region (-9.8 to -2.6‰) overlap with values from the southern Washington Cascades (-9 to -0.4‰) [3]. These values are isotopically lighter than other arcs (e.g., Marianas (+2.8 to 5.7‰)) [4] and similar to MORB. Waning dehydration of the lower parts of the slab provides a small flux of isotopically light B, contributing little to the $\delta^{11}B$ signature of the magmas, which appear to be dominated by mantle-derived B. These results are consistent with those from δD and highlight extensive dehydration of the slab and the possibility of partial melting of the slab top beneath the Cascades.

[1] Shaw (2008) *EPSL* **275**, 138-145.[2] Borg (1997) *Can. Min.* **35**, 425-452. [3] Leeman (2004), *Chem.Geol.* **212,** 101-124. [4] Ishikawa & Tera (1999) *Geology* **27**, 23-26.