The effect of slab-derived sulfur on the sulfur content, metal content, and oxidation state of primitive magmas in the Southern Cascades

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Arc magmas are oxidized relative to mid-ocean ridge basalts, but the causes of this oxidized signature are uncertain. It may be that magmas at arcs become oxidized during crustal differentiation. Alternatively, the presence of an oxidized, slab-derived component in mantle source regions may drive arc magmas toward higher oxidation states. This study uses primitive olivine-hosted melt inclusions from the tephra of basaltic cinder cones in the Southern Cascades to investigate the role of slab-dervied sulfur in the oxidation state, sulfur content, and chalcophile element behavior of primitive arc magmas. We integrate evidence for a hydrous slab component in Lassen primitive magmas from previous work [1] with evidence from major element, trace element, and chalcophile element concentrations in addition to fO_2 values from XANES analysis.

Sulfur concentrations in individual melt inclusions range from 883 to 2043 ppm. Cu, Zn, and Sn concentrations in individual melt inclusions range from 17 to 167 ppm, 65 to 124 ppm, and 0.5 to 1.5 ppm, respectively. Minimum fO_2 values inferred from S XANES range from QFM + 0.8 to QFM + 1.5. The fO_2 values for the different cinder cones correlate with S/Dy and Sr/Nd values and are consistent with the addition of oxidized, sulfur-carrying slab material to the Lassen sub-arc mantle.

Cu/Sc values approach average MORB values and are similar between cinder cones despite significant differences in fO_2 and sulfur concentrations. This suggests that chalcophile element behavior is moderated by the presence of a residual sulfide phase during melting within the Lassen sub-arc mantle. A subset of low average fO_2 melt inclusions contain small immiscible sulfide blebs. The sulfur contents of melt inclusions from these samples, regardless of the presence of a sulfide bleb, are close to sulfur concentrations predicted by sulfur solubility models [2,3], indicating the melts were near or at sulfide saturation during entrapment.

[1] Walowski *et al*. (2016) *EPSL* **446,** 100-112. [2] Fortin *et al*. (2015) *GCA* **160,** 100-116. [3] Jugo *et al*. (2010) *GCA* **74,** 5926-5938.