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Mafic lineage to voluminous basaltic andesites of the central Oregon High Cascades

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The dominant lava type of Quaternary volcanism in the central Oregon High Cascades (CHC) is basaltic andesite. Despite this, the petrogenetic lineage from the range in primitive basalt compositions identified for the Oregon Cascades (Bacon et al., 1997; Conrey et al., 1997; Leeman et al., 2005) to basaltic andesites is not well understood regionally. Constraining this relationship, however, is critical to understand the crustal processing to generate basaltic andesites from basalt. The CHC encompasses prominent basaltic andesite volcanoes such as the North Sister, Three Fingered Jack, Black Butte, and hundreds of smaller mafic composite volcanoes and scoria cones. Here, we present new major and trace element data for mafic vents throughout the CHC, including analyses both by XRF and ICP-MS. Previously published datasets including the full suite of REE and other trace elements are limited to a few discrete volcanic centers, hence our new analyses significantly increase the spatial distribution of high quality and complete data of mafic CHC lavas.

Basaltic andesites in the CHC are subalkaline and mostly relatively primitive (Mg# 50–60), yet range widely from tholeiitic to calcalkaline, and from low to higher incompatible element concentrations by up to a factor of two or three-fold at the same Mg# or wt.% SiO_2. Within this range of basaltic andesite compositions, the details of inter-elemental variations are complex. Most CHC basaltic andesites have ‘arc-like’ HFSE depletions (e.g., moderate to elevated Th/Nb and negative Ti anomaly on PM-normalized diagrams) which are found in both calcalkaline and tholeiitic basalts. Higher Th/Nb correlates with lower MgO, suggesting a crustal signal rather than changes in basaltic parent. Conversely, lower La/Yb in basaltic andesites as compared to basalts at the same wt.% MgO could not be explained by crystal fractionation from that basalt. These more depleted basaltic andesites may therefore have been derived from parents more akin to primitive low-K tholeiites, yet more fractionated tholeiites are needed for basaltic andesites with similar La/Yb but higher overall concentrations. These examples illustrate the details that emerge with high quality compositional data yet underscore the challenges in pinpointing the mafic lineage of basaltic andesites of the CHC.