

Variable Mixing of Subduction and Basin and Range Magmas in the Lassen Volcano Area, California

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Lassen volcano is a large (3,187 m elevation) dome volcano in northern California that last erupted in 1914-1917. Lassen is the southernmost large volcano in the Cascades arc, which extends to the north along the Pacific coast to southwest Canada. Like the other Cascade volcanoes, Lassen is the product of subduction beneath North America from the west. The broader Lassen area is also host to northwest-trending normal faults that result from regional continental extension and thinning associated with the Basin and Range. Surrounding the central Lassen edifice in the arc, forearc, and backarc is a broad (about 30 km wide) region of diffuse volcanism featuring hundreds of lava flows from dozens of smaller vents, many of which align along the normal fault trends. Previous studies of basalts from this distributed field [1 and references therein] have revealed a range of calc-alkaline and tholeiitic compositions erupted in close proximity. In this study, we hypothesize that calc-alkaline magmas generated by subduction and tholeiites generated by regional extension can interact and variably mix beneath the Lassen region, producing the range of observed hybrid compositions. In 2021 and 2022 we sampled 30 flows in the backarc and analyzed their major and trace element compositions via XRF and ICP-MS, and Sr, Nd, and Pb isotope ratios via MC-ICP-MS. We have also analyzed melt inclusion major element compositions in phenocrysts via electron microprobe, to seek the mixing endmember compositions in hybrid samples. Our new geochemical data and the results of modelling with Magma Chamber Simulator software are consistent with variable mixing trends between the two magma types, evidence that the two have interacted and mixed in the shallow mantle or crust beneath the Lassen area.

References: [1] Clynne and Muffler, U.S. Geological Survey, 2010