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Petrogenesis of Cone Building Andesites & Dacites at South Sister Volcano, Oregon Cascades

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In 2018, the USGS awarded ten Cascade Arc volcanoes their highest threat ranking ("very high threat") based on the severity of volcanic hazards and their potential impacts on people, property, and infrastructure. Despite this, relatively little data on the magma processes and storage conditions preceding past eruptions has been collected for many of these volcanoes, as much of the data is concentrated in a few heavily studied systems (e.g., Mount St. Helens). South Sister, ranked the 7th highest threat volcano in the United States, remains significantly understudied despite showing signs of unrest attributed to magma intrusion since 2020. Here we combine petrologic tools including crystal population analysis and thermobarometry to determine the magmatic processes giving rise to eight key cone-building andesite and dacite lavas erupted between ~34 - 24 ka at South Sister. Preliminary results suggest that the andesites and dacites are not purely the product of partial melting of a mafic source and show fairly pervasive evidence of late-stage magma mixing, with an eruption initiation mechanism primarily consisting of felsic rejuvenation. Clinopyroxene-only barometry yields mean storage depths for the eight units spanning 1.7-2.2 kbar, with an interunit variance of 0.26 - 0.86 kbar (Model RMSE = ±1.9 kbar). Clinopyroxene-only thermometry and iterative plagioclase-liquid thermometry and hygrometry yields mean post-mixing (i.e., rim) temperatures of 993 - 1074°C ($1\sigma^{interunit}$ = 2 - 23°C; Model RMSE = ±109.6°C, ±81.0°C) and average water contents of 1.9 - 2.8% H_2O ($1\sigma^{interunit}$ = 0.02 - 0.1%; Model RMSE = ±1.8% H_2O). In addition, the compositions of the phenocryst rims record changes in the mixing components and conditions over time such that the eight eruptions appear not to have all originated from the same batch of magma mush. In the future, we plan to conduct a series of phase equilibria experiments on dacite compositions with the least amount of mixing to further constrain pre-eruptive storage conditions, amphibole stability, and oxygen fugacity. This work provides important context for interpreting future monitoring signals, forecasting eruptive behavior, and assessing volcanic hazards at South Sister.