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Mineral records from estranged sibling volcanoes, Three Sisters, Oregon, USA

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Situated at the convergence of subduction, extension, and intraplate volcanism, the Three Sisters (Klah Klahnee) volcanic cluster (TSVC) in the High Cascades of central Oregon, USA, is a locus of frequent, young (<400 ka) volcanism ranging from mafic shields and cones to compositionally varied stratovolcanoes and silicic domes. The three prominent stratovolcanoes of the TSVC generally are younger and more evolved trending southward from North Sister (NS; mostly 200–50 ka, mafic) to Middle Sister (MS; <50 ka, mafic-intermediate) to South Sister (SS; <40 ka, intermediate-felsic). Since MS and SS are adjacent (<5 km), coincided in frequent activity ca. 27–22 ka, and have some overlap in composition, this study aims to understand magma petrogenesis and storage at these sibling volcanoes in an effort to develop an interpretive model of the magma pathways beneath them. This work is based on textures, compositions, and clotting relationships of major mineral phases in concert with comprehensive whole rock data. Findings thus far indicate largely discrete transcrustal systems feeding the northern (NS, MS) versus southern (SS) conduits. Specifically, conditions at MS are more reduced (ΔNNO$\approx$-0.5 based on Fe-Ti oxides) and have higher alkali contents (trachyte), while SS products are more oxidized (ΔNNO$\approx$+0.5) and dacitic. Differences are also noted in mafic phases present in basaltic andesites and andesites where, at SS, low-Ni olivine indicates fractionation from depleted mantle melts. In contrast, at MS, high-Ni olivine indicate origins similar to those proposed for the previously studied neighboring NS, where mantle-derived mafic melts stall and incorporate silicic lower crust melts. These trends are reversed for pyroxene whereby MS pyroxenes are Ni-depleted relative to SS pyroxenes. Notably, the majority of eruptions studied herein exhibit a simple phenocrystic cargo, albeit it remains unclear whether this cargo is antecrystic or autocrystic. Regardless, in the less common lavas that carry more complex crystal populations (based on phases and compositions), the compositional differences between MS-type (high-Ni olivine, low-Ni pyroxene, reduced) versus SS-type (low-Ni olivine, high-Ni pyroxene, oxidized) permit discrimination between interactions of the MS- and SS-type sources versus a more complex magmatic history within a discrete magma system.