Understanding potential reservoir interconnectivity between two contemporaneous volcanoes during the onset of cone-building activity, Middle Sister and South Sister, Central Oregon

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Klah Klanee or The Three Sisters Volcanic Complex (TSVC) is a compositionally diverse volcanic field in the Central Cascades near Bend, Oregon. This volcanic field lies within a locally complex tectonic region bordered by the Blue Mountains, High Lava Plains, and the High Cascades physiographic provinces. The TSVC consists of multiple stratovolcanoes and an extensive mafic periphery of cones and vents. Eruptive products vary in composition from basaltic andesite to rhyolite. The youngest and largely contemporaneous stratovolcanoes in the complex, Middle Sister and South Sister, share a semi-alternating and episodic eruptive history. This parallel history largely suggests a complicated and interconnected transcrustal magmatic system between the major peaks.

Whole rock chemistry, mineral chemistry and petrography were utilized to compare two temporally related andesites erupted on the west flanks of Middle Sister and South Sister. The andesites, andesite of Lost Creek Glacier (alg) and andesite of Linton Creek (alc), erupted ca. 27 ka and have nearly identical whole rock chemistry, mineral types, and mineral abundances. Origins of these andesites were determined using mineral populations based on mineral textures and chemistry. This detailed mineral-base study revealed that South Sister unit alg and Middle Sister unit alc both contains multiple populations of plagioclase, clinopyroxene, and orthopyroxene, which indicate the involvement of multiple magmatic components. The lithic fragments were also identified in alc and consist of an olivine and plagioclase-bearing type and orthopyroxene and plagioclase bearing-type. Each of these types carries its own unique crystal cargo not found in the host, alc, indicating they were entrained during eruption and did not interact with the host lava. The andesites, alc and alg, appear to share some plagioclase, clinopyroxene, and orthopyroxene populations. Several mineral populations found in alg commonly have fine reaction rims that are not present in the equivalent alc populations. This slight variation indicates alg experienced a final stage of growth prior to eruption.

Comparison of plagioclase mineral chemistry from each unit suggest that the andesites erupted on the west flanks of these two volcanoes share two sources, one at depth (higher An plagioclase) and a second, shallower source (moderate An plagioclase). Pyroxene mineral populations failed to clearly constrain potential sourcing due to significant overlap in compositions; further trace element analysis is required. Overall, alg and alc contain many of the same populations with similar chemistry and textures, indicating these magmas likely share a magmatic source(s). However, unit alg contains a much more complicated crystal cargo with more complex clots and increased mineral populations across every phase. It is likely that prior to eruption alg interacted with an additional magma reservoir(s) (e.g., mush) that alc did not encounter.