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# Using crystal zoning, thermobarometry, and MELTS to elucidate Koma Kulshan's (Mt. Baker) transcrustal magma storage system, northern Cascade arc

**BRENDAN GARVEY** AND SUSAN DEBARI

Western Washington University

Presenting Author: garveyb@wwu.edu

Combining mineral chemistry from complexly zoned crystals with thermobarometry and thermodynamic modeling (MELTS) is a powerful way to provide constraints on magmatic processes beneath an active volcano. Up to 4 populations each of pyroxene, plagioclase, and olivine occur as phenocrysts and crystal clusters in Koma Kulshan's youngest (9.8 ka) lava flow, representing 4 co-crystallizing assemblages derived from distinct parental magmas. Each assemblage is uniquely identifiable by petrography and mineral chemistry (An, Fo, Mg#, trace elements, isotopes). Their host lava flow (Sulphur Creek) is zoned from basalt at the toe to basaltic andesite up flow. The basaltic toe carries 3 co-crystallizing assemblages derived from a) a calc-alkaline basalt (B3), b) a dacite (D1), and c) a high-Mg basalt (B2). The up-flow basaltic andesite hosts a distinct basaltic andesite assemblage (BA3), plus cryptic evidence of the D1 and B2 assemblages. The textures and compositions of the co-crystallizing assemblages in the calc-alkaline basalt suggest entrainment of the D1 and B2 assemblages as liquid poor mush. In contrast, the co-crystallizing assemblages in the basaltic andesite coupled with observed magma mingling textures suggest more-extensive mixing of B3 and D1 parental liquids to generate a hybridized basaltic andesite. The D1 and B2 assemblages have been previously identified in lavas flows that span the last 100 ka of Koma Kulshan's eruptive history, suggestive of long-lived crystal mushes beneath the volcano. Clinopyroxene thermobarometry and olivine thermometry combined with Rhyolite-MELTS models provide quantitative bounds. The B3 assemblage is native to its host basalt and crystallized shallowly at 0-1.5 kbar. The BA3 assemblage is in equilibrium with its host basaltic andesite and displays evidence for 3 distinct episodes of cooling and crystallization within the crust at 0-1.5 kbar, ~3 kbar, and ~5 kbar. In summary, the most recent quantitative snapshot of Koma Kulshan's transcrustal magma storage system suggests complex open-system processes that culminated in eruption of two distinct magma pulses, one derived from a shallow basaltic system (0-4.5 km) and one derived from more complex multi-crustal-level mixing of the same basalt and a dacite at 0-4.5 km, 10 km, and 16 km to produce a hybridized basaltic andesite.