Geochronology and geochemistry of North Sister volcano, Oregon Cascade Range, USA

MARIEK E. SCHMIDT[1], ANITA L. GRUNDER[1], AND JOHN T. CHESLEY[2]

[1]Department of Geoscience, Oregon State University Corvallis, OR 97331 schmidtm@geo.oregonstate.edu and grundera@geo.oregonstate.edu

[2]Department of Geosciencess, University of Arizona, Tuscon, AZ 85721

North Sister Volcano is the oldest and most mafic of the Three Sisters Volcanoes within the actively extending Central Oregon Cascade Range. It was built during 4 eruptive stages that are compositionally distinct in major elements: the early shield (weighted mean $^{40}Ar/^{39}Ar$ age of 320 ± 66 ka), the interfingered palagonitic tuff and lava stage of subglacial origin ($^{40}Ar/^{39}Ar$ arge range 191.2 ± 28.7 ka and 105.2 ± 38.6 ka), the upper shield stage, and the stratocone stage ($^{40}Ar/^{39}Ar$ age range 71.7 ± 39.6 ka and 57.2 ± 36.8 ka). The Matthieu Lakes Fissure (53 to 60% SiO_2) is a >11 km-long, N-striking series of thick, dike-fed lavas and scoria cones that transects North Sister and has an $^{40}Ar/^{39}Ar$ age range 75.8 ± 31.0 ka and 15.1 ± 11.5 ka.

North Sister's seemingly monotonous basaltic andesite yields trends of decreasing incompatible elements (e.g. La, Ba) with decreasing compatible elements (Mg, Ni). Isotopic variations at North Sister are small, but systematic and reveal that $^{87}Sr/^{86}Sr$ decreases (0.70356 to 0.70369) and $^{144}Nd/^{143}Nd$ (0.51285 to 0.51292) increases with a 2% decrease in MgO. $^{187}Os/^{188}Os$ at North Sister is higher than regional basalts (0.18 vs. 0.14), indicating the magma assimilated a mafic crust. Petrologic modeling to replicate the uncommon compositional and isotopic trends points to a silicic contaminant, depleted in incompatible elements, itself derived by dehydration melting of an amphibole-bearing gabbroic to ultramafic cumulate in the deep crust.

High-precision argon dating at young arc volcanoes: Understanding the past 40 kyr at Middle Sister, OR

A.T. CALVERT, J. FIERSTEIN AND W. HILDRETH

USGS Volcano Hazards Team, 345 Middlefield Rd., MS-910, Menlo Park, CA 94025 (acalvert@usgs.gov)

Precise geochronology of latest Pleistocene (<40 ka) arc volcanoes is difficult because of low radiogenic yields on Ar analyses and limited ^{14}C material high on ice-clad volcanoes, but careful $^{40}Ar/^{39}Ar$ work can produce reliable results. The Three Sisters volcanic cluster in the Oregon Cascades consists of mafic to intermediate (+ minor dacite) stratovolcanoes surrounded by mafic to silicic flows and domes. Growth of Middle Sister (MS) and South Sister (SS) overlap in Late Pleistocene time; North Sister (NS) is middle Pleistocene in age. Abundant Holocene, Late Pleistocene, and older vents flank all Three Sisters. Mapping and geochronology of silicic flank eruptions adjacent to MS are used to resolve precise ages of major eruptive periods.

MS is a 3062m (10,047') Late Pleistocene composite cone with an andesitic base, a 300-500m thick basalt summit cone with no apparent unconformities, and intercalated dacites that issued from lateral vents at high and low elevations. Detailed $^{40}Ar/^{39}Ar$ incremental heating experiments on groundmass from carefully selected lavas yield precise ages on stratigraphically constrained units on and around MS. Young portions of the andesitic base are dated directly on the east and south flanks at 37±9 ka and 23±16 ka and the cone basalt at 21±19 ka; however, the analytical errors (all 1σ) are large due to low-K and difficult groundmass textures. Analytical errors of 1.9 - 2.2 ka on three thick dacite flows (SiO_2 64.0 - 65.4%wt.; K_2O 1.7 - 2.3%wt.) exposed on the flanks of MS bracket the growth of the volcano with far better precision. A distinctive dacite agglutinate unit (26±2 ka) that underlies all MS south-flank andesite and basalt lavas erupted near Chambers Lakes in the MS/SS saddle. To the west of MS, a sub-glacial protrusion of dacite that fed Lane Plateau (21±2 ka) intrudes older andesites, but is overlain by flows of MS summit cone basalt. A thick dacite flow (18±2 ka) that vented from the saddle between MS/NS overlies the MS summit basalts. In sum, laterally-vented silicic flows on the south, west and north flanks of MS bracket the eruption of the basalt cone that built the upper half of MS as younger than 21±2 ka and older than 18±2 ka. A silicic unit on the south flank also constrains the youngest basal andesite package as post-26±2 ka.