Magma storage and ascent at Mount Rainier from 2600 to 2200 ybp

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Mt. Rainier erupted much more frequently in the Holocene than is recorded by its 11 pumiceous tephras. During the 2600-2200 ybp Summerland eruptive period, 6 groups of thin (1-5 mm) Sparsely Vesicular Glassy (SVG) ash layers were deposited, followed by the 0.3 km^3 pumiceous C-tephra at 2200 ybp (Mullineaux 1974). Some SVG groups preserve up to 5 separate ash layers. Two lava groups and one block-and-ash flow (2500 ybp) are known from the Summerland period (any other effusive products are concealed by ice). SVG ash grains have blocky-to-fluidal shapes, are variably rich in plagioclase microlites, and their glasses are high-SiO_2 (66-78%) and low-Al_2O_3 (15-11%). MELTS models and phase equilibrium experiments yield apparent equilibration pressures <75MPa for SVG liquids. Low pressures and vesicle-poor microlitic grains indicate that SVG magmas largely degassed and partially crystallized during slow ascent to shallow levels. SVG ashes probably result from hydromagmatic explosions in the upper-edifice hydrothermal system during lava eruptions. Rare pumice lapilli were codeposited with 3 SVG ash groups and have homogeneous, microlite-free dacitic glasses, one with nonreacted hbl phenocrysts. These pumice result from very small batches of magma that ascended rapidly from reservoir depths, synchronous with or closely between effusive eruptions. The culminating C tephra has 4 juvenile components: dominant porphyritic andesite pumice, crystal-poor andesite scoria, blebs of vesicular white dacite in pumice & scoria, and poorly-inflated crystal-rich dacite (Venezky & Rutherford 1997). Melt inclusions from andesite pumice are dacitic with dissolved H_2O 3.6±0.4% & CO_2 <50ppm (FTIR, n=12), indicating ~100MPa if vapor-saturated, which may represent the top of the magma reservoir. Melt inclusions from white dacite blebs are rhyolitic with variable H_2O 1.9-3.7% & CO_2 150-<50 ppm (n=7), indicating vapor saturation pressures as low as 50MPa. The white dacite probably formed as segregations of interstitial liquid in the conduit, with CO_2 provided by passive degassing of the deeper magmatic system.

References

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Eruptive history of Mount St. Helens, Washington – A summary with new data

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Many previous investigators, using geologic mapping, tephrastratigraphy, radiocarbon geochronology, dendrochronology, and paleomagnetics, established the general eruptive history of Mount St. Helens (MSH). New geologic mapping and radiometric age data allow us to refine and extend their framework. The eruptive history of MSH is strongly episodic and dominated by a variety of hypersthene-hornblende dacites. Four stages of intermittent activity separated by hiatuses are recognized: Ape Canyon (300–35 ka), Cougar (21–18 ka), Swift Creek (13–10.5 ka) and Spirit Lake (4–0 ka). During the Ape Canyon stage, dacite domes characterized by quartz, and in many rocks biotite, erupted west of the present edifice, and an extensive hydrothermal system was present. During the Cougar stage, a debris avalanche was accompanied by voluminous pyroclastic flows, dacite domes and a 0.75 km^3 px andesite lava flow. During the Swift Creek stage, 3 extensive fans of fragmental debris were emplaced from dacite domes. The bulk of the pre-1980 edifice was constructed during the Spirit Lake stage, which is subdivided into the Smith Creek (4–3.3 ka), Pine Creek (3–2.6 ka), Castle Creek (2.6–1.9 ka), Sugarbowl (1,150 years BP), Kalama (1480 to 1725 CE), and Goat Rocks (1800 to 1857 CE) periods. The most voluminous pyroclastic eruption in MSH history, about 4 km^3 (DRE), took place during the Smith Creek period; dacite domes also erupted. The Pine Creek period included emplacement of extensive fans of fragmental material from dacite domes and debris avalanches. The Castle Creek period produced a diverse array of px and ol andesite lava flows, px dacite domes and pyroclastic flows, and ol basalt lava flows. During the Sugarbowl period, dacite domes erupted on the W, N and E flanks. A large pyroclastic eruption initiated the Kalama period and was followed by dacitic pyroclastic flows, domes and lahars, px andesite lava flows, and a large dacite dome. The Goat Rocks period produced a px andesite lava flow, dacite dome and a pyroclastic fan.