Compositional and Eruptive Evolution of Fisher Caldera, Alaska

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Fisher Caldera, the largest of 12 Holocene calderas in Alaska, is on Unimak Island, the easternmost island in the Aleutians. Just prior to the caldera forming eruption 9,120 years ago (Miller and Smith, 1977), the Fisher volcanic system consisted of a cluster of at least seven, small- to medium-sized (4 to 8 km^3) stratocones, and likely several more. These pre-caldera vents, concentrated in the western and northwestern portions of the caldera, were independently active between 40 ka and 9.1 ka Several large packages of lavas outside the caldera may represent even older activity. Fisher Caldera formed through a single eruption of compositionally zoned magma, deposited as a thick pyroclastic fall and overlying ignimbrite, which forms the Fisher Tuff. New thickness and grain-size data indicate that the fall deposit was dispersed primarily to the east, whereas the ignimbrite traveled almost exclusively to the north.

After the cataclysmic eruption, a lake filled much of the caldera for a significant quiescent period, as indicated by more than 6 meters of clay deposits. Volcanic activity from intracaldera vents gradually resumed, producing thick successions of scoria fall interbedded with lake sediments. The increase in minor explosive activity roughly coincided with the draining of the lake through a breech in the southwest wall. The western intracaldera vent "Turquoise Mountain" has had numerous lava effusions, ranging from basalt (48 wt% SiO_2) to dacite (66 wt% SiO_2), a compositional range that equals that of the Fisher Tuff. These lavas formed a dam that separated the northern and southern portions of the caldera, leaving the current intracaldera lakes in the north. At some point, Turquoise Mountain partially collapsed, which allowed the formation of Turquoise Lake. After the collapse of the Turquoise Mountain vent, two large, chemically invariant, polygenetic cones developed in the central portion of the caldera. Evidence suggests that the most recent eruptions of Fisher Caldera emanated from these two centers. Accretionary lapilli-bearing deposits from an intracaldera maar cap much of the eastern portion of the caldera. Initial estimates of post-caldera eruptive rates suggest ~$6x10^4$ m^3 per year per kilometer.

Current activity is largely hydrothermal, with active hot springs and fumaroles in the caldera and the Turquoise Lake is actively overturning. New turquoise-colored plumes have appeared in the western lake within the past year, suggesting that the hydrothermal system is either expanding or migrating.