Post-caldera Eruptions at Okmok Volcano, Umnak Island, Aleutians, Alaska

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Okmok Volcano is among the most active arc caldera systems in the world. Many eruptions have been recorded in historic time, including 11 in the last century (Miller et al., 1998). Eruption reporting has been dependent primarily on observations from passing boats or planes; thus there may have been other eruptions that have gone unnoticed. Okmok is essentially a basaltic/andesitic shield, ~30 km in diameter at sea level, that has undergone two cycles of ~10-km-diameter caldera formation in Holocene time (Byers, 1959). These nearly coincident calderas may have formed astride a narrow zone of intense dike emplacement approximately parallel to the direction of plate convergence. The first caldera, formed ~8200 b.p. (Black, 1975), was subsequently filled by basalt flows. The second caldera-forming eruption occurred ~2000 b.p. (Miller and Smith, 1987), and the new caldera is in the process of filling now. Landforms in the caldera are dominated by numerous cinder cones and associated lava flows, but also include alluvial fans, flow-dammed lakes, eroded ridges that are maar remnants, and a small dune field. There is a general trend from early phreatomagmatic eruptions, presumably associated with the now emptied caldera-wide lake, to later magmatic activity, although exceptions are apparent. The most recent activity, in probable order, includes: 1) a lava flow, scoria eruption, explosion sequence at a southwestern cone (E), which excavated a crater 900 m wide and 300 m deep; 2) lavas and scoria from a northeastern cone (B) and adjacent wall fissure that produced short flows and draped the nearby caldera rim with basaltic tephra; and 3) construction of a southwestern cone (A) and its extensive lava delta. A small explosion at a southern cone (C) and a line of maars near cone B are also believed to be fairly recent events.

Most, if not all, of the intracaldera activity in the past 100 years has occurred at Cone A. Eruptions in 1945, 1958 and 1997 produced lava flows that have covered about a third of the caldera floor. The latter two resulted in dramatic changes in the topography from what was previously mapped, including the formation of new lakes. The 1958 flow may have been the first post-caldera lava to completely traverse the caldera floor. Preliminary analysis of flow volumes appears to indicate an increasing rate of lava effusion over time, though more data will be needed to confirm this. Output averaged over the 20th century, which appears associated with deflation and inflation of a very shallow caldera-centered source (Lu et al., 2000), is 3 x 10^6 m^3/yr of basaltic magma. No significant reappearance of dacitic magma, apparently exhausted in the recent caldera eruption, is recognized.