The July-August 2008 hydrovolcanic eruption of Okmok Volcano, Umnak Island, Alaska

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Okmok Volcano, dominated by a 10-km-diameter, late-Holocene caldera on Umnak Island in the eastern Aleutian arc, erupted suddenly and violently on July 12, 2008. The eruption began only hours after a subtle onset of increased earthquake activity, sending a tephra- and gas-rich column to 15 km above sea level. This opening explosion was followed within an hour by a more water-vapor-rich eruption column to 16 km. For the next 5 weeks, the eruption waxed and waned in intensity of ash production from multiple vents on the caldera floor. The eruption was dominantly hydrovolcanic in character as abundant water from lakes and shallow groundwater inside the caldera interacted with rising magma to generate powerful, steam-rich explosions that produced tephra fall and base surges, roiling ash and steam from new explosion craters, and a tuff cone. Accumulation of many tens of meters of fine-grained tephra has significantly altered the Okmok landscape (Fig 1). Coalescing explosion and adjacent collapse craters eventually filled with groundwater and surface runoff to form a new lake 0.6 km^2 in area. A 250 to 300-m-high tuff cone grew at the longest-lived 2008 vent on the northwest flank of pre-existing Cone D in the north-central portion of the caldera. We suggest that rapid and voluminous withdrawal of groundwater during the eruption caused formation of a field of collapse craters that pock the 2008-tephra mantled surface of the 1958 lava flow north of the vent cluster. Early in the eruption, lahars were generated as heavy rain rapidly eroded new tephra deposits on the flanks of the volcano. Lahars traveled across the upper slopes of the volcano and down all major drainages; several of which received enough material to create significant—although likely ephemeral—deltas at the shoreline.

The bulk composition of the 2008 tephra is slightly more silicic (~55-57% SiO_2)

than most basaltic andesites erupted at Okmok in the last 2,000 years. The 2008 eruption was also a significant departure in style from the most recent historical eruptions, all of which occurred at Cone A, a 240-m-high cinder and spatter cone, in the topographically higher southwestern sector of the caldera. Eruptions from Cone A in 1945, 1958, and most recently in 1997, involved lava fountaining, ash clouds as high as 6 km above sea level, and basaltic-andesite ‘a‘a lava flows across the caldera floor. The 2008 eruption in contrast was far more explosive, produced more fine-grained tephra, and lacked a lava flow, all characteristics consistent with eruption through a much wetter, near-surface regime compared to 20th century eruptions. The 2008 eruption is similar to the opening phase of the 1817 Okmok eruption, which involved hydrovolcanic explosions from an arcuate fissure at the base of the north caldera wall. Fieldwork planned for 2009 and beyond will allow us to examine in detail the complex sequence of pyroclastic fall, surge, and other deposits from the 2008 eruption, the first dominantly hydrovolcanic eruption in the United States since the Ukinrek Maars formed on the Alaska Peninsula in 1977.

Impacts from the 2008 Okmok eruption were most severe in several Aleutian communities that were effectively cut off from air travel for many weeks due to nearly constant ash production and contamination of flight routes in the region. Unalaska/Dutch Harbor was dusted with ash on several occasions and air traffic into the Dutch Harbor airport was briefly halted at the start of the eruption. The ash, gas, and aerosol cloud from the July 12 event temporarily disrupted air traffic across the North Pacific and was visible to pilots in the lower 48 states several days later. With assistance from a fishing vessel, the Fort Glenn ranch caretaker family on Umnak Island escaped unharmed during the hours following the eruption onset. As of mid-September, cattle and reindeer populations on the island appeared unharmed; however, reduced forage due to burial by ash may increase winter mortality. AVO received some interesting accounts from fishermen of drastically altered seafloor conditions several miles from Crater Creek on the northeast coastline of Umnak Island, which is likely explained by submarine mass-flowage events triggered in the offshore fronts of lahar deltas .

The Okmok eruption of 2008 is striking for its abrupt onset. Despite the volcano being well-instrumented with real-time seismic and geodetic networks, AVO learned of the eruption from the U.S. Coast Guard, who had been contacted by the Fort Glenn family fleeing the ash fall. These same monitoring networks, however, in combination with AVO’s satellite remote sensing program and geologic understanding of Okmok’s eruptive history, enabled AVO to carefully track and interpret the protracted event in support of public safety until the eruption ceased on August 19.

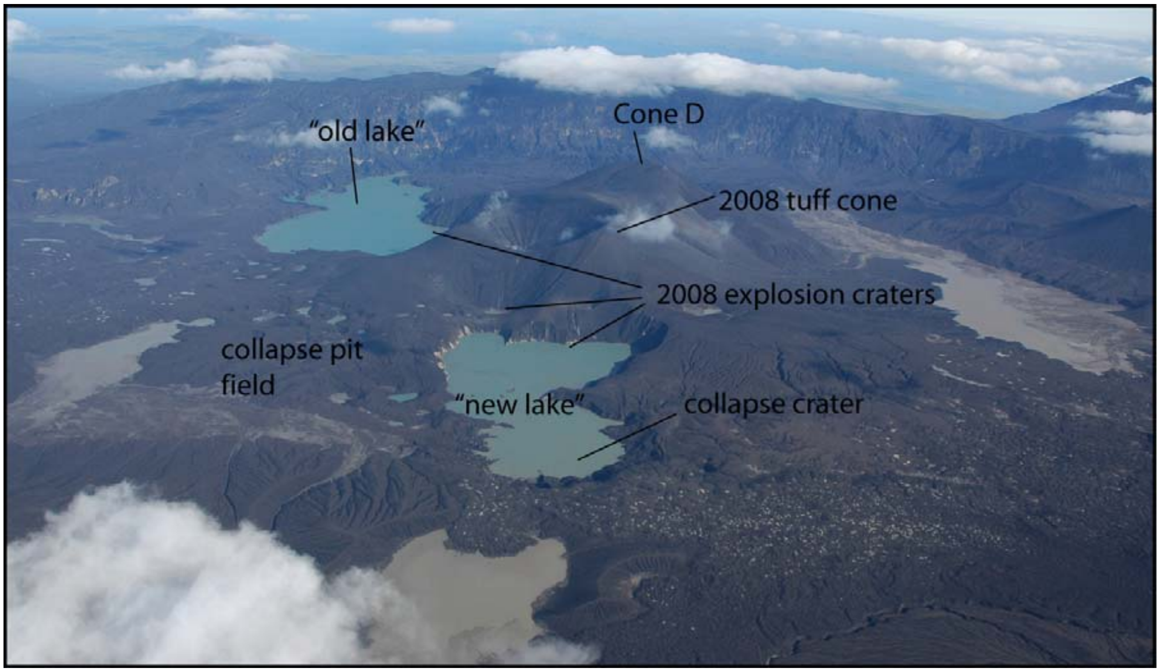

Figure 1. Post-eruption oblique aerial photograph of Okmok Caldera, looking southeast. Principal landforms created during the 2008 eruption are labeled. The summit crater of the 2008 tuff cone is 750-800 m in diameter. Cone D is a pre-eruption spatter cone that has not erupted for hundreds of years. The speckled terrain at lower right is created by small ponds of water atop the very fine-grained ash fall that mantles the rough surface of the 1997 ‘a‘a lava flow. USGS photo by C. Neal, September 14, 2008.