Dynamics of Water-volcano Interactions

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The presence and circulation of aqueous fluids profoundly affect volcanic processes and landforms. Eruption styles and cycles are influenced by volatiles dissolved in magmas and by pressure- temperature-fluid saturation conditions in the surrounding rock. Magma and magmatic volatiles in turn influence groundwater pressures, temperatures, and chemistry. Advective heat and mass transport by aqueous fluids affect and locally dominate the thermal and chemical regimes of volcanos. Linkages between fluid flow and mechanical deformation are suggested by observations that subaerial volcanoes deform in response to changes in water-table elevation and that microseismicity can be related to boiling. We will highlight some of these processes using examples from (1) the repeating phreatic eruptions at Ontake and Tokachidake, Japan; (2) the dynamics of a 2014 episode of volcanic unrest at Lassen, California, that involved an earthquake swarm accompanied by a rarely observed outburst of hydrothermal fluids; and (3) more broadly, the possible causes of the distal, high-frequency (dVT) seismicity that typically precedes eruption at long-dormant volcanoes by days to years, occurring before the proximal, low-frequency seismicity that takes place nearer the time of eruption. This dVT seismicity originates at distances of one to tens of kilometers laterally from the site of the eventual eruption and may occur where small magma-induced fluid-pressure pulses intercept critically stressed faults.