U.S. Department of the Interior
U.S. Geological Survey

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Plate 1

VOLCANO HAZARDS ASSESSMENT FOR MEDICINE LAKE VOLCANO, NORTHERN CALIFORNIA

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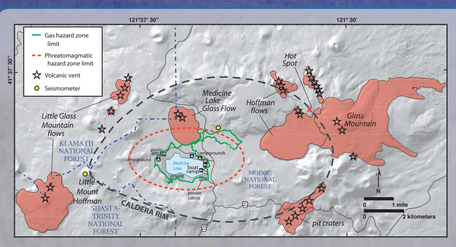
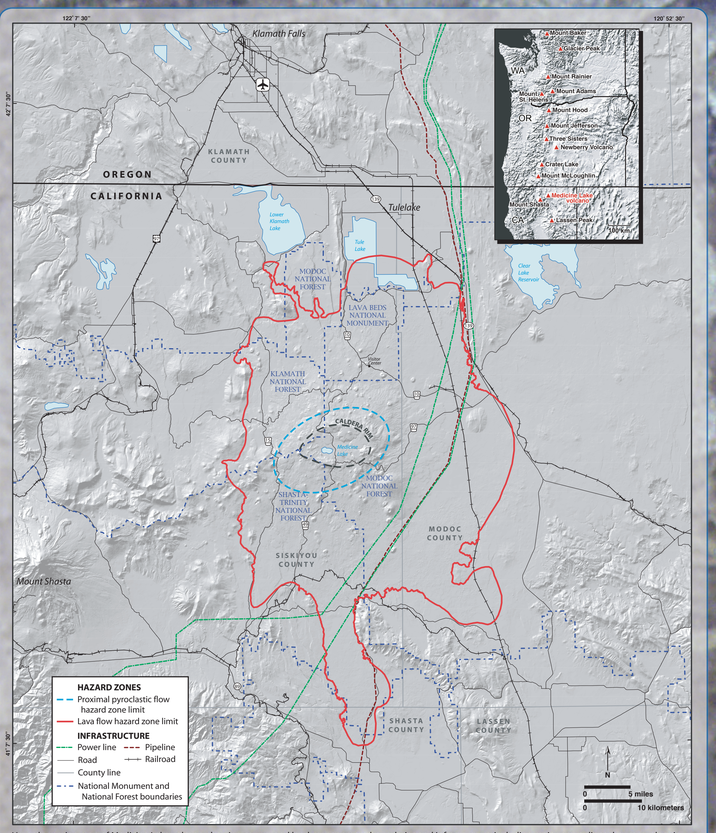
2007



Map showing caldera features and caldera-related hazards at Medicine Lake volcano. Green line (gas hazard zone limit) indicates elevation contour that defines the closed basin within the caldera, including Medicine Lake. This is the area within which volcanic gases heavier than air could accumulate and potentially result in asphyxiation for anyone within the zone. Orange dashed line (phreatomagmatic hazard zone limit) indicates likely extent of phreatomagmatic deposits of hot volcanic mud should a volcanic vent open under the lake. Lava flows shown in red are 5,200 years old and younger. Hot Spot (red "x") is site of the volcano's only fumarole.



Hazard zonation map of Medicine Lake volcano, showing county and land-management boundaries and infrastructure, including major power lines that carry electric power between the Pacific Northwest and California and the major pipeline that carries natural gas from Canada to California. Inset map shows major Cascade Range volcanoes (red triangles).

About Medicine Lake Volcano

Medicine Lake volcano (MLV) is a very large shield-shaped volcano located in northern California, where it forms part of the southern Cascade Range of volcanoes. It has erupted hundreds of times during its half-million-year history, including nine times during the past 5,200 years, most recently about 950 years ago. This record, which represents one of the highest eruptive frequencies among Cascade volcanoes, includes a wide variety of different types of lava flows and at least two explosive eruptions that produced widespread fallout of ash. Compared to those of a typical Cascade stratovolcano, eruptive vents at MLV are widely distributed, extending 55 km north-south and 40 km east-west. The total area covered by MLV lavas is >2,000 km^2, about 10 times the area of Mount St. Helens, Washington. Judging from its long eruptive history and its frequent eruptions in recent geologic time, MLV will erupt again. Although the probability of an eruption is very small in the next year (one chance in 3,600), the consequences of some types of possible eruptions could be severe. Furthermore, the documented episodic behavior of the volcano indicates that, once it becomes active, the volcano could continue to erupt for decades, or even erupt intermittently for centuries, and very likely from multiple vents scattered across the edifice.

Owing to its frequent eruptions, explosive nature, and proximity to regional infrastructure, MLV has been designated a "high threat volcano" by the U.S. Geological Survey (USGS) National Volcano Early Warning System assessment. Volcanic eruptions are typically preceded by seismic activity, but with only two seismometers located high on the volcano and no other USGS monitoring equipment in place, MLV is at present among the most poorly monitored Cascade volcanoes.

Summary of Major Volcano-Related Hazards

Lava Flows and Domes

The most likely future eruption at MLV would be a small basaltic lava flow a few kilometers in length on the flank of the volcano, accompanied by local near-vent explosive activity that would build a cinder cone or spatter cone. Hazards would include violent ejection of hot blocks of lava on ballistic trajectories near the vent, as well as intermittent explosive pyroclastic eruptions that could send ash clouds several kilometers into the air and deposit local accumulations of ash. Also possible, but much less likely, would be eruption of fluid basalt flows that extend tens of kilometers from the vent area, cover as much as a few hundred square kilometers, and could continue for decades. Eruption of silicic lavas, including rhyolite and dacite, would likely be confined to the upper parts of the volcano. Such events probably would begin with explosive eruptions sending tephra many kilometers into the atmosphere, as well as generating local pyroclastic flows and surges. Growing lava domes could collapse to form local avalanches of hot rock, although silicic domes and lava flows themselves are not likely to extend more than a few kilometers from their vents.

Caldera-Related Hazards

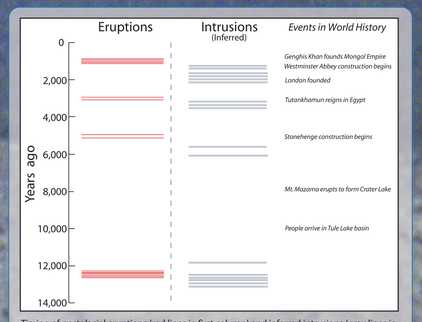
Five of the nine eruptions of MLV in the past 5,200 years have taken place within or at the margin of the summit caldera. Located at the center of the volcano, the 7x12-km caldera contains the namesake Medicine Lake, a 1x2-km body of water bordered by campgrounds and private cabins. In the unlikely event of an eruption through the lake, the mixing of water and magma could produce phreatomagmatic explosions. The immediate area of the lake, including the campgrounds and cabins, would be blanketed by muddy, possibly hot tephra. Eruptions of lava flows or domes in or near the caldera would probably be preceded by explosive eruptions that could deposit many meters of pumice near the vents. Any such flows would advance slowly, but if they reached the lake, local explosive activity might occur. Small pyroclastic flows could be generated by the collapse of steep silicic flow fronts. Before and during magmatic intrusions and eruptions, gases, including carbon dioxide, sulfur dioxide, and hydrogen sulfide, can be transported to the surface. The closed topography formed by the caldera rim around Medicine Lake could allow toxic gases to pond during extended periods of calm wind conditions, potentially resulting in asphyxiation.

Airborne Ash

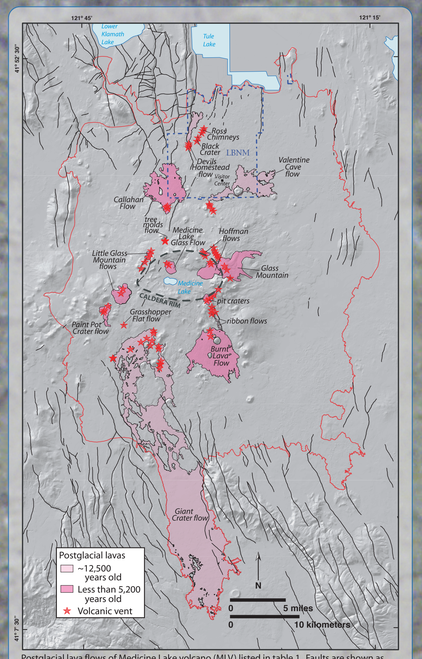
Although only a few tephra layers are recorded among the documented products of MLV eruptions, two rhyolite eruptions that took place about 1,000 years ago generated significant tephras that extended tens of kilometers from the vents and likely were blown high into the atmosphere to levels that today could affect air travel. A similar eruption in the future could potentially affect the largest nearby city, Klamath Falls, Oregon, if winds were from the south. Smaller ash eruptions accompanying the construction of cinder cones would affect much smaller near-vent areas, but these also could interfere with low-flying aircraft. Volcanic ash and coarser debris also can induce respiratory problems, cause hazardous driving conditions, interfere with communications, short out power lines, contaminate feed for livestock, and damage any electronic or motorized equipment. Once dry, volcanic ash deposits can be remobilized by wind and remain troublesome long after an eruption ceases.

View of Medicine Lake volcano from the northeast. Numerous cinder cones are scattered across its surface. Lava Beds National Monument is located on the lower northern flank of the volcano.

This seismometer installation on the upper west side of Medicine Lake volcano at Little Mount Hoffman is one of only two seismic instruments that are located on the volcano. View is southwest across the Little Glass Mountain flow that erupted about 1,000 years ago. Mount Shasta is on the horizon.



Timing of postglacial eruptions (red lines in first column) and inferred intrusions (gray lines in second column) at Medicine Lake volcano. Intrusive events are inferred from the presence of quenched magmatic inclusions in erupted lavas or from petrologic studies. Events in world and regional history are shown for comparison.



Postglacial lava flows of Medicine Lake volcano (MLV) listed in table 1. Faults are shown as thin black lines. LBNM is Lava Beds National Monument. Outline of MLV is shown in red.

Background image: Aerial view looking west across Medicine Lake caldera. Medicine Lake is near the center of the visible image. Mount Shasta is on the left horizon. The gray, treeless rhyolite dome of Glass Mountain, the most recently erupted lava at Medicine Lake volcano (at about 950 years), is in the foreground.

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