**Communicating low-probability, high-consequence volcano** hazards by comparing relative eruptive histories to support community planning for volcano risk management

## Lava dome hazards at Mount St. Helens and Mount Hood

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Mount St. Helens Eruption 2004 – 08 Lava Dome Building and Collapse



Lava Dome Growth and Collapse Hazards **Pyroclastic Flows and Lahars** 



Mount Hood Lava Dome Hazards **Past Eruptions and Future Threat** 



The 2004-2005 eruption was benign compared to the May 1980, eruption. With over three years of lava dome building inside of the crater, this eruption did not pose a serious threat to the surrounding undeveloped natural area. The dome was quite stable since it was growing on the gently sloping crater floor, although there was a serious near-field risk from ballistic blocks<sup>4</sup>.



Mount St. Helen's crater, February 22, 2005 – View to the southeast with a whaleback-shaped extrusion of new lava forming a spine-like dome. As it grows its edges fracture and crumble, creating a broad apron of blocky debris. Dome height is about 400 m above the surrounding glacier. Eruption rate during the middle part of eruption was about 0.7 cubic meters per second<sup>2</sup>.

ash-cloud surge pyroclastic-flow deposi

Diagrams of a dome collapse showing: **A**, Thick lava oozes onto the crater floor and is perched on a steep slope; **B**, Part of the lava dome collapses, forming a hot avalanche of lava blocks; **C**, The avalanche becomes a fast-moving mixture of shattered lava fragments, volcanic gas and air, called a pyroclastic flow; and **D**, The ash cloud surge travels beyond the pyroclastic flow, where it can rush up nearby hillslopes and overtop ridges<sup>1</sup>.

**Crater Rock** 



**Mount Hood Topographic Profile:** Distance traveled by pyroclastic flows and ash-cloud surges from lava dome at Crater Rock. Plot is inferred from pre-historic deposits<sup>1</sup>.

Mount Hood (MH) comparison of erupted lava volumes with Mount St. Helens dome (MSH) MSH dome volume (2004-08) 95 millions cubic meters<sup>4</sup> MH Old Maid eruption volume (~15 yrs)<sup>6</sup>, 150-300 million cubic meters<sup>4</sup> MH Timberline eruption volume (~several decades to >100 yrs)<sup>6</sup> 640-1,300 million cubic meters<sup>4</sup>



About 1,500 (Timberline eruption) and 230 (Old Maid eruption) years ago, debris from hundreds of lava dome collapses at the site of the Crater Rock dome created the broad smooth slope of the volcano's southwestern flank that is a popular recreation area<sup>5</sup>.



Crater Rock stands about 100 m above the sloping crater floor and warm fumaroles along its base emit sulfur gases. Most skiers, climbers, and visitors at Timberline Lodge do not realize that Crater Rock is a volcanic lava dome only 230 years old<sup>1</sup>. Threatappropriate volcano monitoring is required to provide advanced notification for exposed populations within proximal (near-field) zone, like Timberline Lodge and Government Camp, and distal hazard zones like Welches, Wemme, and Wildwood (see USGS Hazard Zonation map below).



Lahars originating from Mount St. Helens after the 1980 eruption destroyed more than 200 homes and over 185 miles (300 kilometers) of roads. Pictured here is a damaged home along the South Fork Toutle River. Lahar hazards can continue for years to decades following pyroclastic flows.



Mount Unzen volcano, Japan, June 8, 1991 – Collapse of a lava dome generates a fast moving pyroclastic flow racing downslope. Billowing ash rises convectively from the incendiary leading edge destroying everything in its path<sup>1</sup>.

Arts. Entertainment, and Recre

Accommodation and Food Ser

Other Services (except Public Admin

**Government Camp Community** 

Public Administra

actions for public safety.



Little Zigzag Canyon on the southwest side of Mount Hood - These interbedded deposits of pyroclastic flows and lahars were formed about 1,500 year ago from a series of dome collapses at the site of Crater Rock. Exposed deposits are 15-25 m thick and extend to an unknown depth below the valley floor<sup>6</sup>.

## Mount Hood Volcano Emergency Planning **Population Exposure and Risk Communication**







**Population Exposure** A volcanic event at Mount Hood could directly impact up to 60 percent of residents in their homes and 87 percent of employees at their workplaces<sup>3</sup>.

Exposure **Volcanic Threa Volcanic Hazard** Courtesy of www.MtHoodTerritory.com

## **References:**

<sup>1</sup>Brantley, S. R., and Scott, W. E., 1993, The danger of collapsing lava domes: lessons for Mount Hood, Oregon: *Earthquakes and Volcanoes*, v. 24, n. 6. <sup>2</sup>Dzurisin, D., Driedger, C. & Faust, L. M. (2013). Mount St. Helens, 1980 to now—what's going on?. U.S. Geological Survey Fact Sheet, 2013-3014. <sup>3</sup>Mathie, A.M., and Wood, N., 2013, Residential and service-population exposure to multiple natural hazards in the Mount Hood region of Clackamas County, Oregon: U.S. Geological Survey Open-File Report 2013–1073

<sup>4</sup>Scott. W. E., Written communication, 2023

- <sup>5</sup>Scott, W. E., Pierson, T., Schilling, S. P., Costa, J., Gardner, C., Vallance, J. W. & Major, J. (1997). Volcano hazards in the Mount Hood region, Oregon. U.S. Geological Survey Open-File Report, 97-89.
- <sup>6</sup>Scott, W. E. & Gardner, C. (2017). Field-trip guide to Mount Hood, Oregon, highlighting eruptive history and hazards. U.S. Geological Survey Scientific Investigations Report, 2017-5022-G.