

# Glacier Peak — History and Hazards of a Cascade Volcano

**G**lacier Peak is the most remote of the five active volcanoes in Washington State. It is not prominently visible from any major population center, and so its attractions, as well as its hazards, tend to be overlooked. Yet since the end of the last ice age, Glacier Peak has produced some of the largest and most explosive eruptions in the state. During this time period, Glacier Peak has erupted multiple times during at least six separate episodes, most recently about 300 years ago. What were these eruptions like? Could similar ones affect us today? Scientists from the U.S. Geological Survey (USGS) are working to answer these questions and help prepare for future activity.

The stunning snow-capped volcanoes of Washington State have long been recognized by Native Americans in their language and legends, and they immediately caught the eyes of U.S. and European explorers in the late 18th and early 19th centuries. By the 1790's, Mounts Baker, Rainier, and St. Helens were noted and named in the first written descriptions of the Columbia River and Puget Sound regions. In 1805 Lewis and Clark noted Mount Adams. By the mid-19th century each of these four volcanoes had their place on a published map.

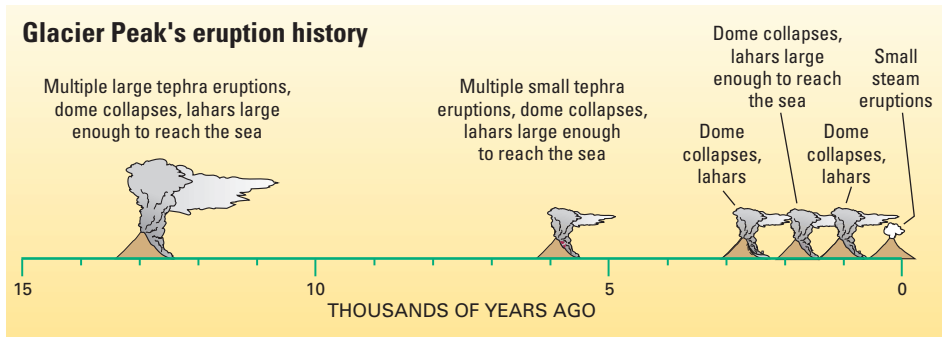
Glacier Peak wasn't known by settlers to be a volcano until the 1850's, when Native Americans mentioned to naturalist George Gibbs that "another smaller peak to the north of Mount Rainier once smoked." Not until 1898 did Glacier Peak appear on a published map under its current name.



Glacier Peak lies in Washington State's North Cascade Mountains, in the heart of a wilderness area bearing its name. Its past eruptions have melted snow and ice to inundate downstream valleys with rocks, mud, and debris. Large eruptions from Glacier Peak have deposited ash throughout much of the western United States and southwestern Canada. Photo by D.R. Mullineaux, USGS.

Glacier Peak lies only 70 miles northeast of Seattle—closer to that city than any volcano except Mount Rainier. But unlike Mount Rainier, it rises only a few thousand feet above neighboring peaks, and from coastal communities it appears merely as a high point along a snowy saw-toothed skyline. Yet Glacier Peak has been one of the most active and explosive of Washington's volcanoes.

Since the continental ice sheets receded from the region, Glacier Peak has erupted repeatedly during at least six episodes. Two of these eruptions were among the largest in Washington during the past 15,000 years. These pages describe some of the effects of past eruptions and possible consequences of future activity.



Known eruptive episodes at Glacier Peak during the past 15,000 years. Each episode (depicted by a single icon) represents many individual eruptions. The ages of these episodes, in calendar years before present are corrected from dates based on a radiocarbon time scale. The uncorrected radiocarbon ages for these episodes, which appear in some publications, are 11,200, 5,100, 2,800, 1,800, 1,100, and 300 years before present.



Eruption column from Mount St. Helens on May 18, 1980. Rock fragments (tephra) give the column the gray color. Tephra from the eruption fell as far away as Colorado. About 13,100 years ago, an explosive eruption from Glacier Peak generated a sequence of tephra eruptions, the largest of which ejected more than five times as much tephra as the May 18, 1980 eruption of Mount St. Helens. Photo by Austin Post, USGS.

## During Past Eruptions . . .

### Tephra Covered the Landscape

Glacier Peak and Mount St. Helens are the only volcanoes in Washington State that have generated large, explosive eruptions in the past 15,000 years. Their violent behavior results from the type of molten rock (magma) they produce. Dacite, the typical magma type of Mount St. Helens and Glacier Peak, is too viscous to flow easily out of the eruptive vent; it must be pressed out under high pressure. As it approaches the surface, expanding gas bubbles within the magma burst and break it into countless

fragments. These fragments are collectively known as tephra; the smallest are called ash.

About 13,100 years ago, Glacier Peak generated a sequence of nine tephra eruptions within a period of less than a few hundred years. The largest ejected more than five times as much tephra as the May 18, 1980, eruption of Mount St. Helens and was one of the largest in the Cascade Range since the end of the last ice age.

Some of the tephra from these eruptions fell back onto the volcano and avalanched down its flanks. Much of the rest rose high into the atmosphere and drifted hundreds to thousands of miles downwind. Deposits from these eruptions are more than a foot thick near Chelan, Washington, and an inch thick in western Montana.

Since these events, Glacier Peak has produced several tephra eruptions, all of much smaller volume.

### Lava Domes Collapsed onto the Volcano's Flanks

During most of Glacier Peak's eruptive episodes, lava domes have extruded onto the volcano's summit or steep flanks. Parts of these domes collapsed repeatedly to produce pyroclastic flows and ash clouds. The remnants of prehistoric lava domes make up Glacier Peak's main summit as well as its "false summit" known as Disappointment Peak. Pyroclastic-flow deposits cover the valley floors east and west of the volcano. Ridges east of the summit are mantled by deposits from ash clouds.

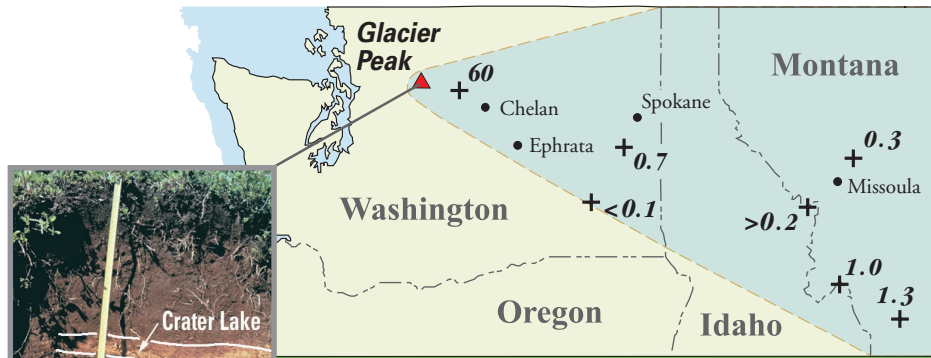


Glacier Peak from the east, showing the main summit and Disappointment Peak, which are remnants of prehistoric lava domes. Photo by Austin Post, USGS.

### Lahars Inundated River Valleys

Past eruptions have severely affected river valleys that head on Glacier Peak. Pyroclastic flows mixed with melted snow and glacial ice to form rapidly flowing slurries of rock and mud known as lahars.

About 13,100 years ago, dozens of eruption-generated lahars churned down



(TOP) Total thickness of tephra (inches) erupted from Glacier Peak during a series of large eruptions about 13,100 years ago. Light blue indicates approximate area covered by ash during these eruption.

(LEFT) Tephra deposit from a Glacier Peak eruption 13,100 years ago, at a site about 10 miles south of Glacier Peak. Overlying this deposit is an ash bed from an eruption at Crater Lake, Oreg., 7,800 years ago. Photo by R.B. Waitt, USGS.

## How do lava domes collapse and generate pyroclastic flows?

**Growing lava dome**

When gas is not abundant enough to drive explosive eruptions, lava oozes out of a vent and accumulates as a thick, viscous dome.

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**Dome collapsing**

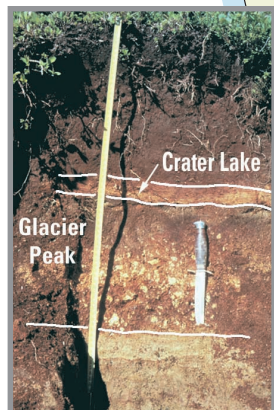
On steep slopes, sections of the dome may break away and disintegrate into hot avalanches of debris known as pyroclastic flows.

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Pyroclastic flows cascade downhill, crushing or incinerating everything in their path, and come to rest in nearby river valleys. Behind the front of the pyroclastic flow, ash clouds separate from the coarse debris, rise vertically in buoyant plumes, and drift downwind for many miles.

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Pyroclastic flows fill river valleys with tens to hundreds of feet of loose debris that chokes rivers and is readily transported by water.





A collapsing lava dome generates a pyroclastic flow and ash cloud at Colima Volcano, Mexico, November 22, 1998. Photo by Abel Cortes, ©1998, University of Colima.

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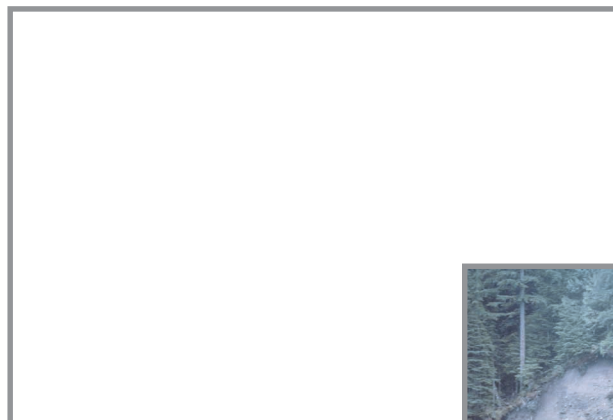
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### During Future Eruptions . . .

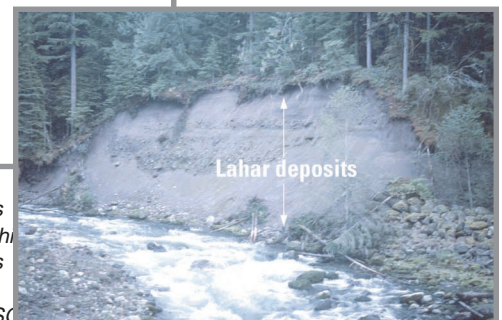
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More than 200 homes and over 120 miles of roads were destroyed by the 1980 lahars at Mount St. Helens. Pictured is a damaged home along the South Fork Toutle River. Photo by Lyn Topinka, USGS.



A few hundred yards upstream from its confluence with the Sauk River, the White Chuck River erodes into lahar deposits produced by prehistoric eruptions of Glacier Peak. Photo by R.B. Waitt, USGS.