(200)
R290
NO.88-459

USGS LIBRARY RESTON
3 1818 00014248 7

WATER FACT SHEET

U.S. GEOLOGICAL SURVEY, DEPARTMENT OF THE INTERIOR

GEOLOGY IN ACTION—JÖKULHLAUPS ON MOUNT RAINIER

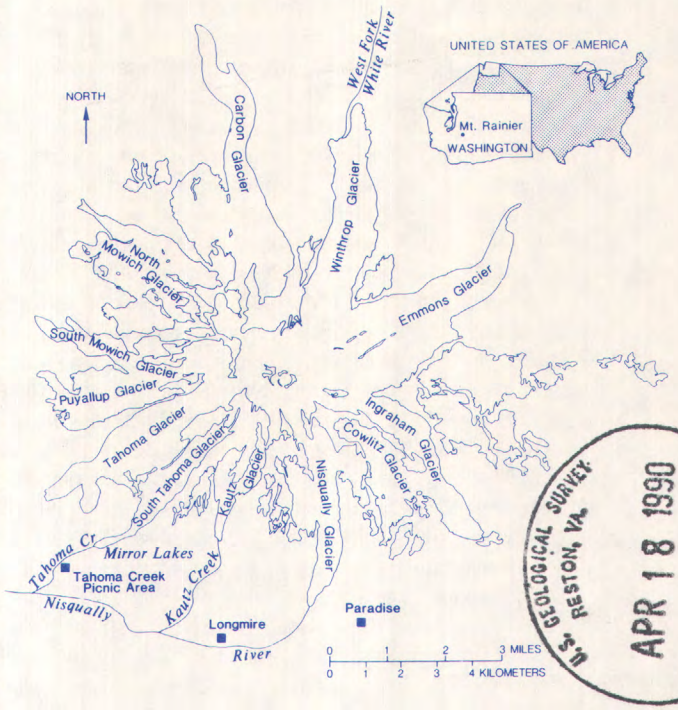
Open-file report
Geological Survey
(U.S.)

Jökulhlaups (pronounced "yo-kul-h-loips" and sometimes called glacier outburst floods) are flash floods of water that burst from glaciers and race down valleys moving trees, boulders, and other objects lying within their paths. In their wake, jökulhlaups may leave narrow, but total, paths of destruction. Jökulhlaups are common to the world's temperate glaciers, especially in Iceland, where the term jökulhlaup originated. There, floods from Icelandic glaciers sometimes rival the Amazon River in discharge.

At Mount Rainier, jökulhlaups occur on a smaller scale, yet still leave a legacy of twisted highway bridges amid boulder-strewn streambeds. Fortunately, at Mount Rainier, these events are usually confined to the back country, where they may roar down the narrow valleys for several miles. They can affect human activity, however, where trails or roads cross the stream valleys and where the streams spill over wider flood plains.

Four glaciers on Mount Rainier are known to produce jökulhlaups—the Nisqually, Kautz, South Tahoma, and Winthrop Glaciers. At least three other glaciers—the Carbon, South Mowich, and Emmons—are suspect.

Those who have witnessed jökulhlaups at Mount Rainier tell of an experience long remembered. The jökulhlaup flood wave is a noisy, tumbling, churning mass of mud and rocks that is sometimes accompanied by local winds, thick dust clouds, and the smell of freshly crushed vegetation. It sounds like a freight train as it travels down-valley at speeds of 10 miles per hour or more. Witnesses close to the flood plain report that little more than 2 minutes may elapse between the time the thundering sound of a jökulhlaup is first heard and the time that it roars by the observer. It moves faster than a person can run to escape from the center of its path in a boulder-strewn valley. The almost deafening noise is caused by the impact of rocks and boulders, some the size of large automobiles, as they strike one another or immobile rocks on the bed and banks. The ground near the flow path shakes violently from the impacts. On the steep slopes, the flow scours valley bottoms, often to a depth of several feet. Along the middle slopes the flow is a thick, muddy slurry-like wet concrete that plasters the flow path. On the lesser slopes of the lower valley, the flow deposits most of its muddy load and, at the mouth of the valley, the only evidence of the event might be a small but noticeable increase in sediment concentration and water level. Within several hours of the event, much water has drained from the saturated sediment. Stream channels may change locations, and the forest floor appears marbleized with fresh flows of mud and rocks. Sometimes levees remain as remnants of the flood flow pattern.



U.S. GEOLOGICAL SURVEY
RESTON, VA.
APR 18 1990
LIBRARY

Schematic diagram of major glaciers on Mt. Rainier.

Jökulhlaups originate from water stored in ice marginal ponds, cavities within the ice, or at the glacier bed. In Alaska, jökulhlaup water is often stored in ice marginal lakes and, in Iceland, the water is stored in subglacial lakes produced by volcanic heat. At Mount Rainier, few surface ponds are observed and there is no evidence that volcanic heating produces subglacial meltwater lakes. It is likely that jökulhlaup water at Mount Rainier originates from snow and ice melt and from liquid precipitation that is stored in cavities within or at the bed of the glacier until ice movement deforms the cavities and releases it.

Jökulhlaups occur most often during late summer and fall, and in late afternoon and evening hours, perhaps owing to water storage cavities that have been "topped off" by periods of increased melting. Richardson (1968) suggested that jökulhlaups occurred within the park at a rate of once every 3 to 10 years. Between 1985 and 1987, however, nine jökulhlaups occurred from the Nisqually, Kautz, South Tahoma, and Winthrop Glaciers, suggesting that the events may be more frequent now than during earlier periods. It is unclear whether the increase in frequency represents a change in glacier behavior, a change

USGS LIBRARY RESTON
3 1818 00014248 7

in the hydrologic environment, or an increase in human attention to the floods.

Remnants of jökulhlaups are relatively easy to recognize. Visitors can observe some of these features by visiting the following areas:

KAUTZ CREEK—The largest jökulhlaup event since the establishment of the park occurred on October 2nd and 3rd, 1947, when it is believed that heavy rains triggered a jökulhlaup on Kautz Creek. The lower section of Kautz Glacier was bisected and the Entrance Highway was engulfed with debris 5.5 miles downstream. Witnesses say that about 50 million cubic yards of material was moved; some of the rocks carried in the flow were 13 feet in diameter. Stop at the parking lot beside Kautz Creek to observe dead trees and flood deposits. The old road was buried by 28 feet of mud and debris. Since then, smaller floods in 1961, 1985, 1986, and perhaps at other times have deposited sediment in the streambed.

From Longmire, hike the Wonderland Trail about 2 miles to where it crosses Kautz Creek. There, a boulder-strewn valley is evidence that recent floodwaters moved the debris down-valley. Note the splintered trees that once lined a former creek bed. In addition, some older trees lay buried horizontally in flows perhaps hundreds of years old. Above the boulder-strewn region and amid the trees, look for moss-covered logs downed by jökulhlaups in centuries past.

NISQUALLY RIVER—At Mount Rainier, jökulhlaups from the Nisqually Glacier damaged or destroyed highway bridges during 1926, 1932, 1934, and 1955 before the present high bridge was built. Since then, smaller floods during 1968, 1970, 1972, 1985, and on other occasions have rearranged the streambed, although manmade features have been unaffected. At the Glacier Bridge over the Nisqually River, observe the levees constructed by floods in the 1930's and 1950's. Buckled rebar and weathered concrete are all that remain of the 1930's-era bridge foundation seen several hundred feet upstream.

TAHOMA CREEK—South Tahoma Glacier's reputation for spawning frequent floods is well deserved. During 1967, 1971, 1973, 1986, 1987, and 1988, debris flows mobilized by jökulhlaups engulfed trail bridges and a campground-picnic area. Tahoma Creek was the center of jökulhlaup activity in the park during 1987 and 1988. At the Wonderland Trail bridge, five floods flushed through the valley between October 1986 and September 1987, raised the water level by about 30 feet, and scoured the valley bottom upstream to a depth of 6 feet or more. Similar floods occurred again on July 14 and 26, 1988.

On July 14 and 26, 1988, jökulhlaups on Tahoma Creek mobilized loose volcanic debris into a debris flow that traveled 8 kilometers, or more, down-valley before attenuating at a break in slope. On July 14, boulders 1/2 meter in diameter covered the Westside Road near Fish Creek. About 150 yards of road was covered.

Down-valley, lobes of sediment buried tables, signs, and a parking lot by 3 feet or more at the Tahoma Creek picnic area and trailhead. This area is now closed to visitors, although it is visible from the Westside Road.

South Tahoma Glacier and the paths of the jökulhlaups can be viewed from Mirror Lakes near Indian Henry's Hunting Ground. At the Entrance Highway Bridge, the floods left little geologic evidence except for a temporary bathtub-like ring of mud on rocks and leaves.

Be alert when visiting flood-prone regions. If you hear the onrush of the flow, or note a rapid rise in water level, move to higher ground instead of up or downstream. Don't be caught in or near the streambed. Observe Park Service regulations, especially those provided for your safety in flood-prone areas. Mount Rainier National Park was established to conserve not an extinct volcano, but one that is dormant and ever-changing.

FURTHER READING

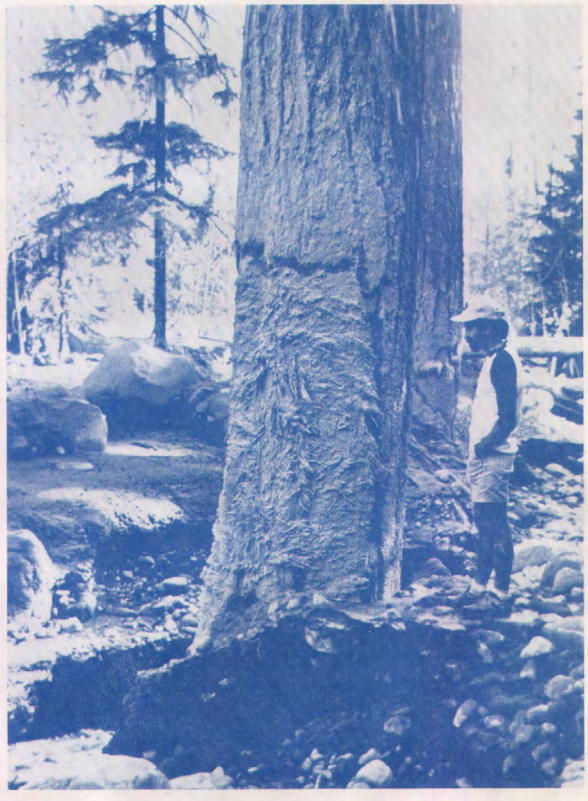
Clague, J.J., and Mathews, W.H., 1973, The magnitude of jökulhlaups: Journal of Glaciology, vol. 12, no. 66, p. 501–504.

Crandell, D.R., 1971, Postglacial lahars from Mount Rainier Volcano, Washington: U.S. Geological Survey Professional Paper 677, 75 p.

Driedger, C.L., 1986, A visitor's guide to Mount Rainier glaciers: Pacific Northwest National Parks and Forests Association, 80 p.

Paterson, W.S.B., 1981, The physics of glaciers: Pergamon Press Inc., Maxwell House, Fairview Park, Elmswood, New York, 380 p.

Richardson, Donald, 1968, Glacier outburst floods in the Pacific Northwest: U.S. Geological Survey Professional Paper 600-D, Geological Survey Research, p. 79–86.



Flood damage and mud lines on a Douglas fir in the former Tahoma Creek picnic area.

Open-File Report 88-459

Carolyn L. Driedger, 1988