Diversion of Meltwater from Kautz Glacier Initiates Small Debris Flows near Van Trump Park, Mount Rainier, Washington

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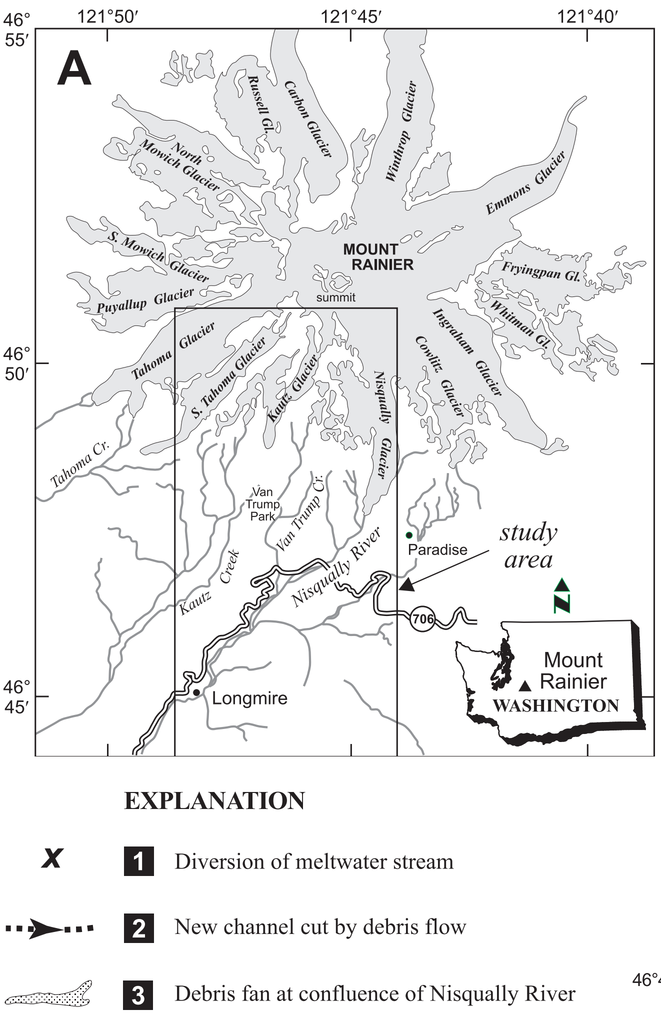
On the evening of August 14, 2001, slumping of loose glacial debris triggered a debris flow on the south slope of Mount Rainier above Van Trump Park. This debris flow swept down Van Trump Creek to its confluence with the Nisqually River (Fig. 1). Rapid melting of upper Kautz Glacier during hot summer weather was instrumental in initiating this debris flow. On August 13, a meltwater stream on the east margin of Kautz Glacier began to spill muddy water into the Van Trump basin through a 2- to 3-m (7–10 ft)-deep notch in the left-lateral moraine at the lower end of Wapowety Cleaver at an



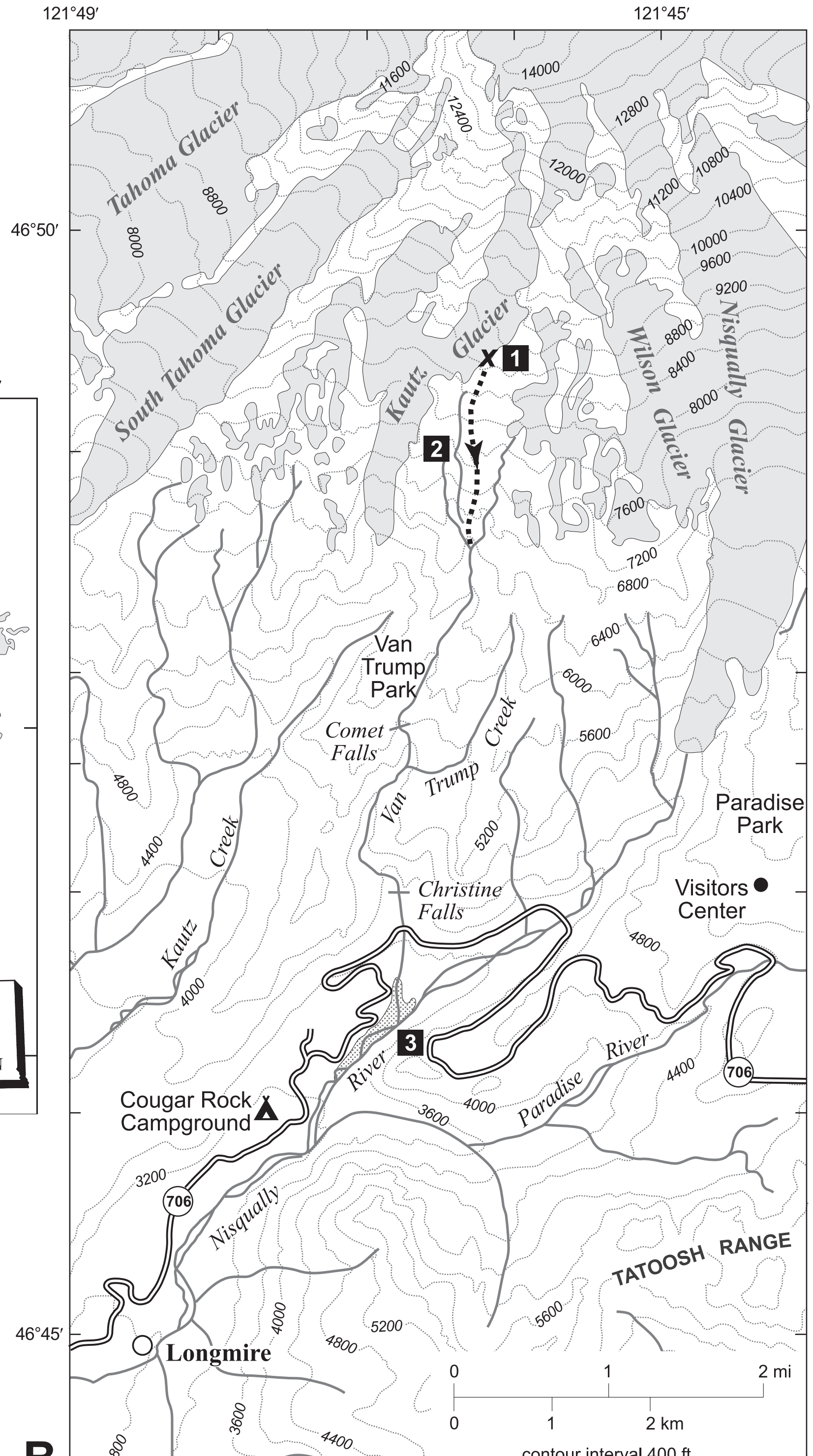


Figure 1. **A.** Map showing location of Mount Rainier and study area. **B.** Map of study area showing diversion of meltwater and path of channel incised during debris-flow events of August 14 and 15, 2001.

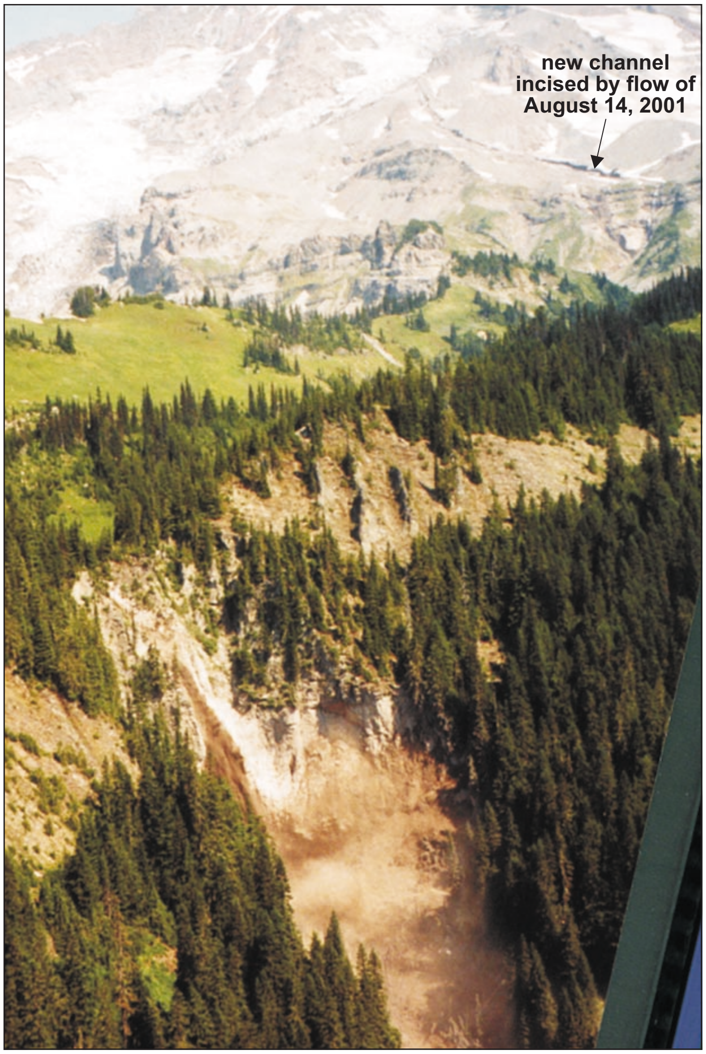


Figure 2. The south side of Mount Rainier, Kautz Glacier (center top and left), upper Van Trump drainage basin (upper center), and Comet Falls (lower left). Note debris flow descending Comet Falls. *Taken August 15, 2001, by C. Driedger.*

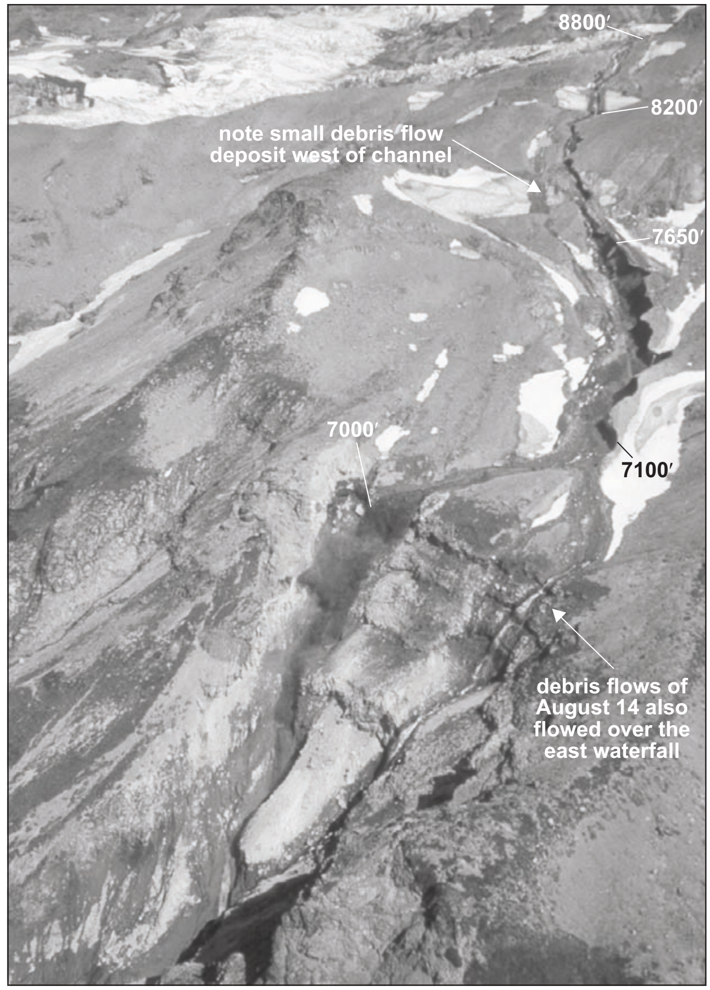


Figure 3. Meltwater diversion, newly incised channel, and debris flow descending waterfall, the top of which is at altitude 2134 m (7000 feet). The larger debris flow of August 14 descended both branches of the waterfall. *Taken August 15, 2001, by J. W. Vallance.*

altitude of about 2682 m (8800 ft)(Figs. 2 and 3). Beginning about 9:00 p.m. on August 14, the flow incised a channel through the 5 to 30 m (16–98 ft) thick ground moraine in Van Trump Park and formed the largest of a series of debris flows. Progressive slumping of the glacial deposits during the next few hours formed additional debris flows and created a steep-walled channel that was visible at first light on August 15 (Figs. 2 and 3).

Field reconnaissance showed that the initial debris source of the August 14 debris flows is a zone between altitudes 2377 m and 2500 m (7800 and 8200 ft)(Fig. 3). The flows eroded and incorporated the bulk of their sediment between altitudes 2164 m and 2662 m (7100 and 7650 ft)(Fig. 3). Along this reach, the new channel is 10 to 30 m (33–98 ft) deep and 25 to 50 m (82–164 ft) wide. The total volume of debris removed from the reach between altitudes 2164 m and 2500 m (7100 and 8200 ft) is about 250,000 m^3 (327,000 yd^3).

Below the unnamed waterfall at 2134 m (7000 ft)(Fig. 3), the debris flow cascaded over smaller falls and through bedrock channels, but it neither removed nor deposited a significant amount of sediment until it neared its confluence with the Nisqually River about 5.5 km (3.4 mi) downstream. There it formed a 1 to 4 m (3.3–13 ft) thick debris fan that extends from a few tenths of a kilometer up Van Trump Creek to over 0.7 km (0.44 mi) downstream in the Nisqually River valley (Fig. 4). The fan varies from 30 to 120 m (98–394 ft) wide and has an approximate volume of 160,000 m^3 (209,280 yd^3). The largest flow, occurring on August 14, maintained coherence as debris flow and continued beyond the Wonderland Trail footbridge near Cougar Rock Campground, 7 km (4.4 mi) downstream of its source. Between 7 and 10 km (4.4–6.2 mi) downstream, at Longmire, the flow gradually lost its coherence as a debris flow and became a muddy sediment-laden flood. The remaining approximately 100,000 m^3 (130,800 yd^3) of debris was emplaced in these reaches above Longmire. The muddy flood at Longmire caused a stage rise of 0.6 to 0.75 m (2–2.5 ft) and continued flowing within the river banks to Alder Reservoir about 47 km (29 mi) downstream.

In the future, heightened meltwater stream flow originating along the east margin of Kautz Glacier may again cause slumping of channel walls in glacial deposits that initiates small debris flows between elevations 2165 m and 2332 m (7100 and 7650 ft). This process is more likely during periods of hot summer weather, but could occur during periods of intense rainfall in fall and early winter, if the freezing level is well above the elevation of the diversion. We expect small debris flows to dis-

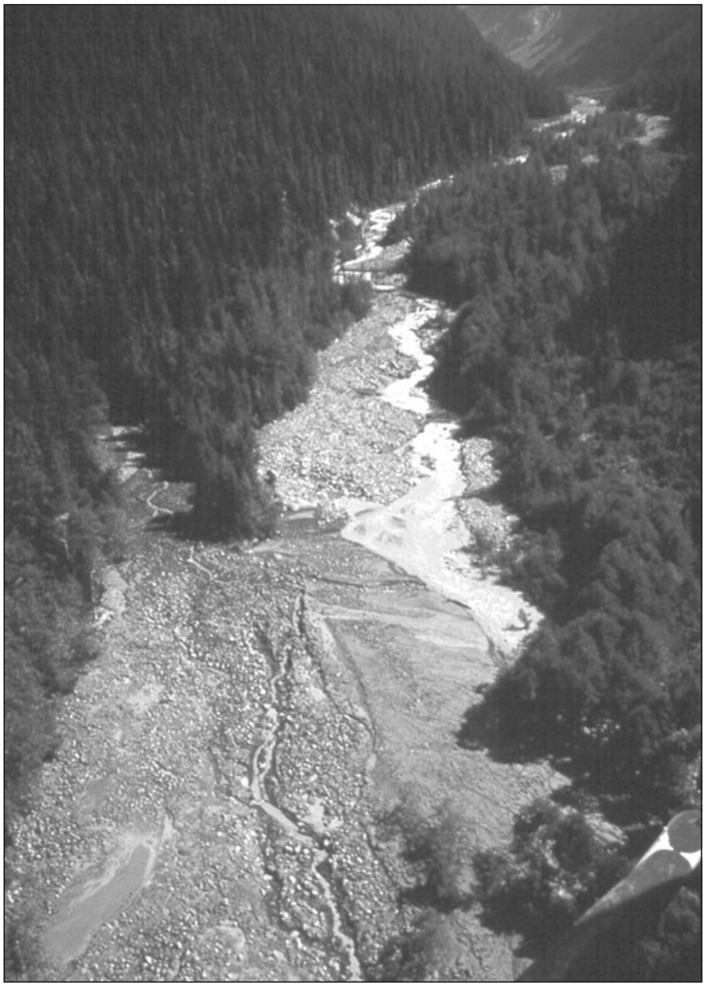


Figure 4. Debris fan formed by debris flow of August 14, 2001, at the confluence of Van Trump Creek *(left)* and the Nisqually River *(upper right to center)*. Fan is 100 to 120 m (328–394 ft) wide and 1 to 4 m (3.3–13 ft) thick in this area. *Taken August 15, 2001, by J. W. Vallance.*

sipate in the region below Comet Falls (Fig. 2). Larger flows could reach the Nisqually River.

The Van Trump debris flows of August 2001 generated considerable public attention, although they were modest in size and areal extent. They were comparable in size and character to many debris flows that occurred in the valleys of South Tahoma, Kautz, Nisqually, and Winthrop glaciers on multiple occasions during the 20th century. All originated with movement of excess meltwater through or across loose glacial rock debris. The meltwater was meteorologically produced; none was derived from volcanism (Walder and Driedger, 1994).

Hydrologic and meteorological events can trigger small debris flows like those at Van Trump Creek at or near glacier margins or termini anywhere in Mount Rainier National Park. Because they are not related to volcanism, such events occur with little, if any, warning and can be a hazard to Park visitors. Nonetheless, because of their size, these small to medium debris flows pose little threat to communities beyond the boundaries of Mount Rainier National Park.

Larger debris flows associated with landslides and eruptions, here termed *lahars* for distinction, can be orders of magnitude larger than the Van Trump debris flows of August 2001. Such lahars often begin with magma intrusion that triggers failure of locally weakened rock masses, or eruptive processes that catastrophically melt snow and ice. Volcanic earthquakes and small explosions precede eruptions that generate lahars (Scott and others, 1995). Only on the west side of Mount Rainier, where there are steep cliffs containing abundant weak altered rock susceptible to avalanching, is there a credible threat of unheralded large lahars.

References

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Walder, J. S.; Driedger, C. L., 1995, Frequent outburst floods from South Tahoma Glacier, Mount Rainier, USA—Relation to debris flows, meteorological origin and implications for subglacial hydrology: Journal of Glaciology, v. 41, no. 137, p. 1-10. ■

Murdock Trust Grant Awarded to Vancouver Teacher and DNR Geologist

The Department of Natural Resources (DNR) has received a $14,000 grant from the M. J. Murdock Charitable Trust to allow high school science teacher Rusty Weaver to carry out research with DNR geologist Pat Pringle over the next two summers.

Weaver, of Heritage High School in Vancouver, Wash., and Pringle, of DNR's Division of Geology and Earth Resources, will conduct research on the Bonneville landslide along Washington's Columbia Gorge. The research project is titled: "Use of dendrochronology for dating and an improved understanding of the Bonneville landslide, Columbia Gorge, Washington."

Known in Native American oral history as "the Bridge of the Gods", the Bonneville landslide dammed the entire Columbia River, formed a temporary lake that later drained, and drowned trees whose remnants were observed and described by explorers Lewis and Clark. The slide, possibly triggered by an earthquake, is estimated to have occurred several centuries ago.

DNR will receive the $14,000 grant from the Partners in Science Program of the Murdock Trust, established by the late Melvin J. (Jack) Murdock of Vancouver, Wash. The program provides high school science teachers with opportunities in cutting-edge science to revitalize their teaching skills and encourage the use of inquiry-based methods in teaching science.

Grants are based on the qualifications of the teacher's scientist mentor, the quality of the scientific research proposed, and the potential school benefits.

Applications are accepted from high school teachers and mentors from five Pacific Northwest states to conduct summer research. The Murdock Trust seeks to strengthen this region's educational and cultural base in creative and sustainable ways by making grants to organizations. ■