LEG M: WESTSIDE ROAD

With an extended trip to Round Pass, the Puyallup River, and Klapatche Point via hike or mountain bike

Although infrequently visited, roads and trails in the western areas of Mount Rainier National Park reveal some of the most beautiful vistas of the mountain. About 1 mi (1.6 km) east of the Nisqually Entrance to Mount Rainier National Park (elev. 2000 ft or 610 m), the short Westside Road leads north up the valley of Tahoma Creek to Round Pass (elev. ~3800 ft or ~1160 m), where it begins the descent into the valley of the South Puyallup River (Fig. M-1). For the first several miles, the road is bounded on the west by spectacular Mount Wow, composed of fragmental volcanic rocks and lava flows of the Oligocene Ohanapecosh Formation. The peak towers more than 3500 ft (1067 m) above the valley floor, and during the rainy season, graceful waterfalls cascade from its abrupt buttresses. An active fault likely passes between Mount Rainier's summit and the older rocks of Mount Wow (Crosson and Frank, 1975), and this may explain why huge landslides have tumbled down its slopes in the past. Note the enormous landslide blocks of Ohanapecosh Formation near the road.

Vehicle access to the western part of Mount Rainier National Park has been limited since about 1988 due to intermittent jökulhlaups, or glacial outburst floods, that have destroyed Westside Road on multiple occasions (Walder and Driedger, 1993, 1995). These sudden torrents of water from the South Tahoma Glacier have incorporated huge quantities of boulders, sediment, and organic debris from glacial moraines, the Tahoma Creek stream channel, and nearby terraces to swell into damaging debris flows. Numerous killed and injured trees and abundant lobes of bouldery debris are testimony to the fury of these flows. Aggradation of the debris fan and frequent channel changes in response to these events have also caused damage (Walder and Driedger, 1994). The November 2006 floods triggered a debris flow(s?) and major channel changes to the area once again.

Visitors can hike or bike from the Mount Wow debris cone area to points farther along Westside Road that are inaccessible to vehicles. A good map is important for keeping track of landforms en route. Useful trail maps are available online and at visitor and information centers within the park.

Debris flows can happen at any time, so it is important for hikers and bikers to be aware of the possibility of sudden debris flows and be able to get upslope to safety away from a potential channel if they hear the rumble of an approaching flow. Erosion and deposition will probably continue to cause dramatic changes in the streambeds in the future, so the trail route may change again.

During the winter season (typically November through April), the road is gated near the entrance road used by skiers, about 1 mi (1.6 km) east of the Nisqually entrance to Mount Rainier National Park. Cross-country skiers should be mindful of severe snow avalanche hazards. Road and trail status can be checked at the Mount Rainier National Park website or by contacting the park by phone. (See "Websites and Phone Numbers", p. 176.)

Distances along the route are given in miles, followed by kilometers in italics. If you take any of the optional side trips, you'll have to keep track of and add those miles to all the remaining mileages in the leg. Having a pencil and paper handy, and even a calculator will be helpful.

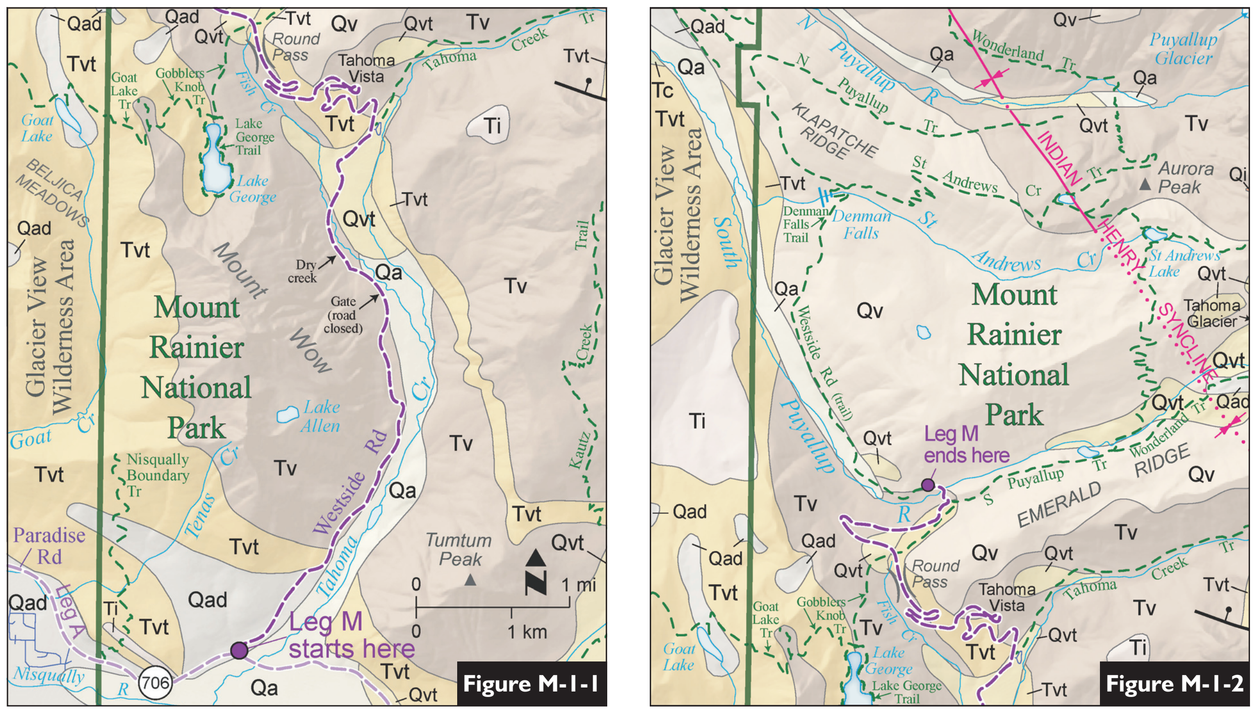

Figure M-1. Geologic map for Leg M (two consecutive panels). The geology was adapted from 1:100,000- and 1:500,000-scale digital versions of Schasse (1987b) and Schuster (2005) and has been draped over a shaded relief image generated from 10-m elevation data. The leg maps were constructed using source-map data whose scale is smaller than the leg map scale, thus minor exposures may not appear on leg maps. The map explanation is on the inside back cover.

photo by Beth Norman

Figure M-2. Dark-green to gray Ohanapecosh lavas from the Mount Wow complex of flows, a probable center of Oligocene volcanism.

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0.0 *0.0* Turn onto Westside Road from Paradise Road. Dark-green to gray outcrops west of the road for the next 2 mi (3.2 km) are Ohanapecosh lavas from the Mount Wow complex of flows, a probable center of Oligocene volcanism (Fig. M-2).

0.1 *0.2* Pavement ends.

1.7 *2.7* Pass an outcrop of Ohanapecosh lavas.

2.4 *3.8* Good view (if the weather is clear) of Tahoma Creek with standing dead trees and erosion from the 2006 floods and previous debris flows.

2.5 *4.0* Large outcrop of volcaniclastic rocks is on the left with a shear zone.

3.2 *5.1* Tahoma Creek area. The road is closed here. From this point you can see the Mount Wow debris cone complex, lahar deposits, and deposits left by and the effects of the 1986 to 1992 glacial outburst floods and the great November 2006 flood. Much of Westside Road has been closed intermittently since November 1988 because portions of it have been destroyed by debris flows and flooding. Although destructive, these events also have exposed previously unseen older deposits for geologists to interpret. Some visitors may choose to walk or bicycle farther up Westside Road. (See "Optional Route for Hikers and Bikers along Westside Road" on p. 157.)

Figure M-3. Historical photo of a debris fan from Mount Wow taken by Asahel Curtis, June 4, 1928. The car is crossing the small bridge over "Dry creek", the local name for a bouldery gully that drains the north margin of another debris fan whose deposits are exposed by the road excavation (left and right foreground). The buried trees shown in Fig. M-4 was about 150 ft (45 m) southeast of Curtis when he took this picture. Note the gently northeast-dipping volcanic rocks of the Ohanapecosh Formation (~36–28 Ma) exposed on Mount Wow on the skyline. View is to the northwest. The debris fan deposits are not shown on the geologic map (Fig. M-1). Washington State Historical Society Photo 53995.

Note the large, rocky, largely unvegetated debris fan that heads on Mount Wow (Fig. M-3). Crandell (1969b) mapped this as an "alluvial cone"; however, the large size of most of the boulders combined with the morphology of the fan and the wedge-shaped headscarp indicate that this fan could have been deposited in large part by one or more catastrophic rock slides. Some of the large blocks were carried down by snow avalanches.

Figure M-4. Trees buried in the toe of a debris fan from Mount Wow were exhumed by the debris flows of 1986. The leaning tree is about 40 ft (12 m) tall. The rubbly deposits of the fan consist chiefly of poorly sorted debris of the Ohanapecosh Formation. This location is about 3 mi (4.5 km) up Westside Road. The roadbed is visible at top of the outcrop on the extreme left. View is to the north on May 23, 1990. The road was repaired and protected by riprap after later flows eroded farther into the landslide deposit and removed the tree.

At a location along the Westside Road approximately 0.2 mi (0.3 km) south of "Dry creek", the local informal name for a rocky gully slightly south of the debris cone shown in Figure M-3, some large subfossil trees were exhumed by the debris flows of 1986 (Fig. M-4). These trees had been buried in another debris-fan deposit from Mount Wow. One of the trees, a large Douglas-fir, protruded about 16 ft (5 m) above the deposit in 1986. Using a graph by Cline and others (1980) of decomposition rates of Douglas-fir in the Oregon Coast Ranges (Fig. M-5), I first estimated that the tree died between 150 and 200 years ago. Later I was able to crossdate its tree rings with those of old living trees, which revealed that the tree may have been injured about A.D. 1821 to 1824; it is not clear if a catastrophic rockfall avalanche buried the tree and killed it at that time, or if it was killed by a rapid progradation of the toe of the Mount Wow debris fan within a few years after being injured (Fig. M-6).

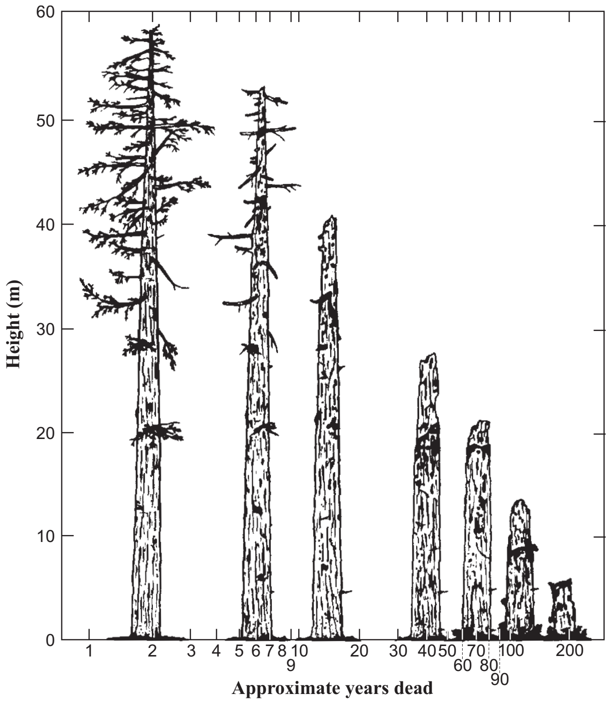

Figure M-5. Progression of decomposition of a Douglas-fir tree in the Oregon coast range over a 200-year period. Trees of this species at Mount Rainier decompose at about the same rate. Dramatic examples of the relative rates of decomposition for different species can be seen at Kautz Creek (see Leg A), where a forest was partially buried by a debris flow in 1947. There, Douglas-firs and hemlocks have undergone rapid decay, whereas western redcedars are relatively well preserved (and identifiable by their narrow, pointed tops). Modified from Cline and others (1980).

The deposit that partially buried the tree is a monolithologic breccia of Oligocene Ohanapecosh Formation rocks from Mount Wow. This breccia is visible in roadcuts and streamcuts here and in the bed of Dry creek that is incised into the Dry creek fan.

OPTIONAL ROUTE FOR HIKERS OR BIKERS ALONG WESTSIDE ROAD. Leave the Mount Wow debris cone complex and go north on Westside Road. At Fish Creek, a debris fan shows where debris flows and floods have traveled along the right of way of the road or have cut across it farther upstream to enter Fish Creek. This area is constantly changing as Tahoma Creek's channel wanders from one side of the valley to the other, occasionally escaping its channel to flow into Fish Creek. All mileages from here on refer to distance traveled on foot or by bicycle, unless the road is reopened and you can travel by car.

Walk or bike about 0.9 mi (1.4 km) up the road from the parking area near Dry creek to the old picnic ground to see deposits of the Tahoma lahar and debris flows that have flooded this area since 1986. A trail links the segments of the Westside Road washed out by floods. About 0.3 mi (0.5 km) of Westside Road north of Fish Creek was damaged by the floods of November 1990. This stretch was partially filled in by a debris flow on Nov. 6, 1991. The road was partially destroyed again by an event on Sept. 8, 1992, and subsequently has been closed and reopened, depending on the activity and depositional patterns of the debris flows and Tahoma Creek. The channel changes caused by the November 2006 floods in Tahoma Creek were probably the largest since the 1988 events here.

Older deposits of many kinds have been exposed by recent floods and debris flows. One of these deposits, that of a lahar, is a poorly sorted, clay-rich, yellowish layer exposed in the streambed at the site of the picnic ground mentioned above. This may be the same deposit that caps the terrace adjacent to Westside Road slightly north of Fish Creek. Farther upstream, the lahar deposit sits on top of Mount St. Helens ash layer Wn, which was deposited about A.D. 1480 (Yamaguchi, 1983, 1985). USGS geologists thought that the lahar was likely correlative with a layer mapped by Crandell (1971) and visible on the right bank of Tahoma Creek 1.2 mi (2 km) upstream of this site (Scott and others, 1995). Trees overwhelmed by the lahar were rotted to the ground surface, indicating at least 200 years of weathering. It's possible this lahar is correlative with the Electron Mudflow of about A.D. 1500. Another grayish, sandy lahar deposit is visible underneath the lahar locally. Fragments of an organic soil horizon containing Mount St. Helens tephra Wn found on top of the gray unit suggest that it was deposited prior to 1480 A.D.

The debris flows since 1986 almost certainly began as outburst floods (jökulhlaups) from South Tahoma Glacier, about 3.5 mi (5.6 km) upstream of here to the northeast. The fact that most have occurred during clear weather indicates that a source of water other than precipitation was responsible for their initiation. That source was water stored inside or underneath the glacier (Walder and Driedger, 1993). Outburst floods have eroded two zones of stagnant ice that provide much of the sediment for the debris flows. The upper stagnant-ice zone is glacier ice overlain by a veneer of rock debris, whereas the lower zone consists of complexly layered glacier ice and rock debris.

Figure M-6. Photomicrograph of the outer annual growth rings (to the right) in a 0.2-in. (5 mm)-diameter core sample of the partially buried Douglas-fir tree shown in Fig. M-4. Pencil dots mark decade rings. The narrow rings and abundant resin canals (not visible at this magnification), both potential signs of stress, suddenly appear about A.D. 1821 to 1824; the tree died shortly thereafter. This stress, and ultimately the death of the tree, was likely caused when the tree was partially buried, thus the tree rings allow an interpretation of the timing of burial. Notice the faint or missing latewood in the 1801 'light ring' (black arrow). Light rings are low-density rings that denote unusually cool summers (Yamaguchi and others, 1993). Light rings are easily recognized in Douglas-fir and other species growing above about 2000 ft (600 m) elevation and are useful as marker rings for cross dating. Many low-density rings have been correlated with very large volcanic eruptions (for example, Tambora in 1815) that injected enough sulfurous aerosols into the stratosphere to cause significant global cooling (Briffa and others, 1998). The 1801 light ring has not been confidently associated with any volcanic event to date.

A typical debris flow along Tahoma Creek moves a few tens of thousands of cubic yards (meters) of sediment. Between 1986 and 1994 there was as much as 10 ft (3 m) net aggradation of bouldery deposits over a reach about 2.5 mi (4 km) long (Walder and Driedger, 1994). Fine sediments carried by the watery recessional phase of debris flows have moved as far as the bridge on the main road between the park entrance and Longmire,

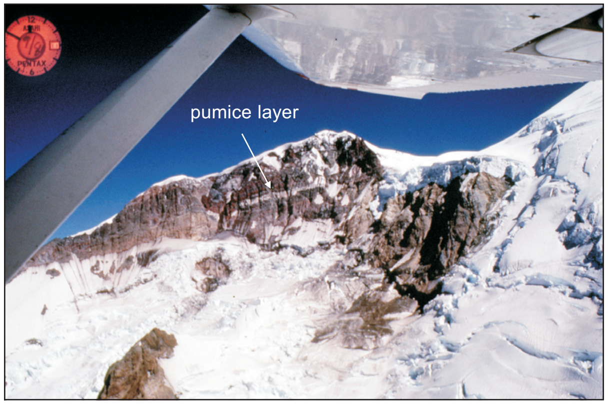

Figure M-7. Sunset Amphitheater, showing the approximately 65-ft- (20 m)-thick pumice layer (at arrow) that extends many tens of miles to the west-northwest. The pumice was dated by geologists Tom Sisson and Marvin Lanphere (1999) at about 190 ka; the same pumice was found in fluvial deposits on Ketron Island in southern Puget Sound by Walsh and others (2003). Tahoma Glacier can be seen cascading off Columbia Crest cone at the far right; at the far left is the uppermost portion of Puyallup Glacier. Contained in the Sunset Amphitheater section are layers that record multiple periods of volcanic eruption and hydrothermal alteration punctuated by glacial erosion. Photo by USGS geologist Rick Hoblitt, 1981.

and some have reached the Nisqually River about 0.6 mi (1 km) downstream of the main road. However, nearly all sediment transported by debris flows remains within the Tahoma Creek drainage basin.

The evidence for outburst floods is largely circumstantial. Crandell (1971) and Scott and others (1992) described erosion of glacier ice near the terminus of Tahoma Glacier by water emerging from the glacier near the base of an icefall. Walder and Driedger (1994, 1995) suggested that rapid input of meltwater or rainwater to the glacier bed triggers release of water stored in large cavities between ice and bedrock to initiate these floods.

5.0 *8.0* Round Pass. Here you can see the volcano's chiseled west flanks. On a clear day there are fine views of the lava flows, breccias, pyroclastic flow deposits, and tephra layers that make up the mountain, and of some of the noteworthy glaciers, such as the Mowich, Puyallup, Tahoma, and South Tahoma, that are actively carving it. All demonstrate that Mount Rainier has formed by multiple periods of volcanic eruption, hydrothermal alteration, punctuated by glacial erosion and mass wasting.

The Round Pass mudflow (2,600 yr B.P.) described by Crandell (1971) crops out on the west side of the road. About 2.1 mi (3.5 km) to the northwest, outside the park, deposits of the mudflow can be found as much as 820 ft (250 m) above the South Puyallup River. At that location, 2 mi (3.2 km) northeast of Round Pass, is at a reentrant tributary valley draining the west side of Mount Wow. There, exposed trees that were killed by the mudflow lean northeast toward the South Puyallup valley, an orientation that indicates the Round Pass mudflow may have run up over Mount Wow—a vertical distance of more than 1476 ft (450 m)—and flowed north on the west side of Mount Wow before overrunning the trees and re-entering the South Puyallup River valley.

The Marine Memorial Airplane Crash Monument at Round Pass is a good place to observe the upper west flank of Mount Rainier and Sunset Amphitheater (Fig. M-7). A yellowish deposit lying near the glacial terminus is the rubble of a large avalanche that came to rest there at about 1900 (Crandell, 1971). This memorial was dedicated to the 32 U.S. Marines who died when their plane crashed on South Tahoma Glacier on Dec. 10, 1946, and who are still buried within the glacier.

8.4 *13.5* Well-exposed block-and-ash-flow deposit in the South Puyallup River (Fig. M-8). Tom Sisson and Jim Vallance (USGS, written commun., 2003) note an approximate age for this deposit of 2,500 yr B.P. based on secular variation and the similar paleomagnetic signature of young Mount Rainier lavas exposed in the Emmons and Winthrop Glaciers. Correlative lahar-derived deposits extend as far as Puyallup, more than 42 mi (70 km) downstream (Pringle and Palmer, 1992).

Figure M-8. Block-and-ash flow deposits along the Westside Road slightly north of where the road crosses the South Puyallup River. The photo shows two or more separate pyroclastic flow units. Note the 3-ft (1 m)-diameter volcanic bombs (blocks) that have radial jointing patterns and the pocket knife for scale at the base of one flow unit (see Fig A-11, p. 60). The outcrop is about 50 ft (15 m) high. View is to the north.

The road log ends here, but you can hike farther up the road. Otherwise, you can retrace the route and access another leg. ■