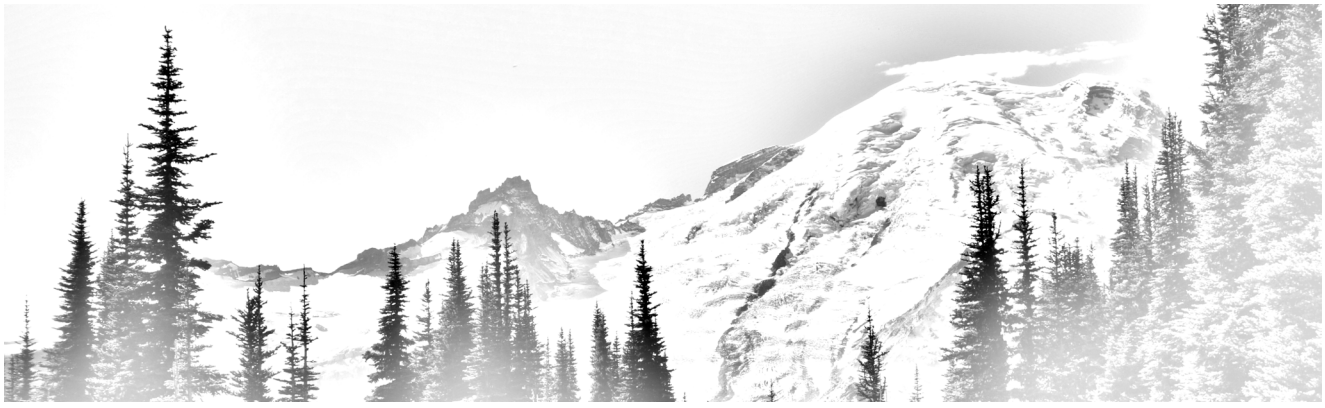
Mount Rainier National Park

National Park Service
U.S. Department of the Interior

Sunrise Geology Audio Tour



Welcome to the Sunrise Geology Audio Tour at Mount Rainier National Park. The first part of the tour is intended for listeners driving along the Sunrise Road. Once you reach Sunrise, the second part of the audio tour takes you on a short walk to view some of Mount Rainier's glaciers. While we encourage you to enjoy the impressive views while traveling up the road, please stay aware of the road and drive safely. The Sunrise Road is steep and winding. Watch out for bicyclists and other drivers on the road, as well as wildlife. To start the audio tour, stop at the White River Ranger Station or the White River Campground if you need to set up the audio tour, such as connecting your mobile device to your vehicle's sound system. Please do not stop your vehicle in the road and block traffic. Thank you, and we hope you enjoy the Sunrise Geology Audio Tour.

Introduction

The road from White River up to Sunrise is a journey through the geologic history of Mount Rainier. The road carves through the slopes of a lava ridge that was shaped by ancient glaciers, leading to impressive views of not only Mount Rainier but also the surrounding region. Volcanoes and glaciers have dramatically shaped the landscape. As you travel up the mountain to Sunrise, discover geologic evidence left behind by these two forces that have molded Mount Rainier and still do so today.

When you reach the junction of the road to the White River Campground and the Sunrise Road, set your odometer to zero before beginning the climb up to Sunrise. Mileage will be used to mark the location of some stops. As you begin your journey to Sunrise, note the exposed hillsides on the left side of the road created by the road cut. There are several pull offs along the lower part of the road, but a particularly good example of an exposed hillside is at the pull off 1.6 miles from the gate. Or, you may play the next section of the audio tour while driving. Please drive safely.

Hillside Road Cuts

Mount Rainier is an active volcano formed by the accumulation of many layers of lava, volcanic debris, ash, and pumice during thousands of years of volcanism and glaciation. Some of these events, such as the Osceola Mudflow, form visible layers of different types of material in the hillside road cuts. Here's a description of what to look for along the road from Carolyn Driedger, a hydrologist from the United States Geologic Survey:

Carolyn Driedger: "As you're traveling up the road, especially in the lower part of the valley, you're going to see some outcrops of very loose rock unsorted. It has big boulders set into a fine matrix and much of that is from the Osceola Mudflow, the big mudflow that formed 5600 years ago when we had an eruption of Mount Rainier... So we're looking at this landslide from just the base of the mountain, and you'll see as you travel that it did travel a fair ways up the valley wall... It hardened here in place and you can see it's a very unstable slope and we get a lot of small rock falls off this slope over the years."

Your next stop will be at a pull off with a low profile exhibit sign that is 2.3 miles from the gate. Across the road from the pull off is a rock formation that looks like dark grey columns embedded in the hillside. These columns are remnants of an old lava flow that helped form Sunrise Ridge. Stop at the pull off and play the next section of the tour.

Columnar Rock Formations

The lava that formed the columnar rock formations you see at this stop flowed here during an eruption approximately 496 thousand years ago, making it one of the oldest lava flows from Mount Rainier.

Carolyn Driedger: "We're very high up here and you have to ask the question, how did the lava flow get here? Why did it perch up here so high? And the reason is because... when the eruption occurred, the valley of the White River was filled with a thousand feet or so of glacier ice at least to the surface that we are at today."

These lava columns are evidence that the valley was once filled with glacial ice. As the lava cools it crystallizes into columns pointing in the direction of cooling. Normally, one would expect them to be vertical, assuming that the coldest direction would be the air above the lava flow. These columns however lay horizontally, indicating that the cooling surface was to the edge of the lava flow. Geologists think that this lava flow actually erupted while the White River valley was filled with a very thick Ice Age glacier. The lava flow skirted the edges of the glacier, cooling as it came into contact with the ice along its flank. When the glacier eventually melted away, it left behind the lava ridge Sunrise is built on.

Continue towards Sunrise Point, a sharp hairpin turn in the road with near 360-degree views, located at 7.4 miles. This is an excellent place to park and take a look around. Then, play the next section.

Sunrise Point

Sunrise Point offers unparalleled views of the surrounding Cascade Range in addition to views of Mount Rainier. Mount Adams is visible to the south and on clear days Mount Baker can be glimpsed in the distance to the north. Like Mount Rainier, Mount Adams and Mount Baker are volcanoes.

The Cascade Range consists of volcanic and metamorphic rocks established over millions of years. Prominent volcanoes like Mount Rainier and Mount Adams are much younger. They have grown on a basement of older uplifted rocks that formed the Cascade Range. Modern Mount Rainier began growing about half a million years ago but it is not the first volcano to be located here. An ancestral volcano grew at about this same site between one and two million years ago. The ancestral volcano has almost entirely eroded away during the past million years, so that only a few remnants of it exist today.

Continue to travel up the road from Sunrise Point. While driving, play the next audio section or stop at the pull offs either at 9.1 or 9.4 miles from the gate.

White River Valley View

If the weather is clear, you will be treated to some of the best views in the park while driving this last section of the road. Looming above you to a height of 14,410 feet, Mount Rainier is the most intensely glaciated mountain in the contiguous United States with 25 glaciers covering 34 square miles - enough to cover more than half of the city of Tacoma, WA in ice! Mount Rainier actually has two summit craters, of which the rim of the east crater is visible from Sunrise. Warmed by escaping steam and gases, the rock rims of the craters remain visible year-round, despite the mountain's permanent coating of glacial ice. From this vantage you can also look down and across the White River Valley on the left as you head towards Mount Rainier.

When you reach the end of the road you have arrived at Sunrise. Here the tour continues as a short walking tour. Once you have parked and before leaving your car, play the next audio part.

Sunrise

At an elevation of 6,400 feet, Sunrise perches on a shoulder of Mount Rainier. It is the highest point in the park accessible by car. Sunrise Visitor Center is built on the same half-million-year-old lava flow that forms the horizontal columns viewed earlier on the drive up. The skyline to the north, or to the right of the parking lot as you look towards the visitor center, forms Sourdough Ridge. The ridge crest consists of older rocks of the Cascade Range formed prior to eruptions of Mount Rainier.

From the Sunrise parking lot, take the short walk down to the first of the Emmons Vista Overlooks. From there the whole northeast side of the mountain is visible, from the summit to the bottom of the White River Valley. The trail starts from the left side of the parking lot as you look towards the Sunrise Visitor Center where you may also pick up a trail map. When you reach the first Emmons Vista Overlook, play the next audio section.

Emmons Vista Overlook 1

If you stood at this point 5,600 years ago just before the occurrence of several major volcanic events, the volcano would have looked very different. Instead of the smooth sweep of the Emmons Glacier from the summit down to the valley floor, the northeast face of the volcano would have been broken up with craggy buttresses and ridges, much as the other sides of the volcano appear today. However, 5,600 years ago the summit and northeast flank of Mount Rainier collapsed in a gigantic avalanche during an eruption, forming a fast-moving slurry of mud and debris called the Osceola Mudflow, which washed up as high as the present site of the Sunrise Visitor Center. You may remember seeing some of the loose Osceola sediment in the hillside road cuts as you drove up the road. The eruption that created the Osceola Mudflow left a large horseshoe-shaped crater in the northeast flank of the volcano, much like the crater left on the north flank of Mount St. Helens after the 1980 eruption. The enormous Osceola Mudflow had a total volume of about a cubic mile. The mudflow filled the valleys of the White River system to depths of 300 feet or more and flowed more than sixty miles to the Puget Sound. Again, Carolyn Driedger, with the United States Geologic Survey.

Carolyn Driedger: "Mount Rainier has an east-west fracture zone across its summit and that's where magma has risen in the past and as it has risen in there it has baked the surrounding rocks... The surrounding rocks were bathed in a weakly acidic solution of sulfuric acid and that actually transformed the chemistry of the rocks, transforming the rocks from a hard rock to a soft clay... The fact that it was hydrothermally altered made the slide much more extensive than it would have been otherwise, and it slid much further down valley. Most of the hydrothermally altered rock on the east side of Mount Rainier was carried down in that mighty Osceola mudflow. The west side of the mountain and the summit still contain a fair amount of hydrothermally altered rock and that creates a hazard for people who live on the Puyallup river valley on the west side of the volcano because the rock remains and will fall some day."

Subsequent lava eruptions filled-in the horseshoe-shaped crater left by the Osceola mudflow, forming the smooth summit cone of the volcano that you see today. Glaciers reformed on the peak, but have not yet had time to carve the volcano into the craggy forms visible on other sides of the mountain. Instead, the expanse of the Emmons Glacier smoothly wraps around the northeast side of Mount Rainier.

Continue along the trail to the second Emmons Vista overlook. At the second overlook, play the next section of the tour.

Emmons Vista Overlook 2

In front of you is the Emmons Glacier. It covers 4.3 square miles and is the largest glacier by area not only on Mount Rainier but also in the contiguous United States. The present terminus of the Emmons Glacier is not where the white snow and ice ends, but rather is where the river becomes visible emerging from the dark colored, rock-covered ice front. From here you can see the uppermost Winthrop Glacier, which flows northward from the triangular-shaped Steamboat Prow to form the headwaters of the West Fork of the White River.

Carolyn Driedger: "Much of the appearance of the glacier that we see today has been determined by an event that happened in 1963... Rock fell off Little Tahoma peak on the left side of the glacier, rolled down onto the surface, completely covered the lower glacier, and came part way down the valley... Because of that 1963 rock fall that brought so much rock onto the lower portion of the Emmons glacier, the Emmons glacier has a lot more rock on it, a lot more rock within it, and so the moraines here are a little bit higher than they might have been otherwise."

Moraines are piles of rock, sand, and silt left behind by glaciers as they carve the landscape. There are several different types of moraines visible from the Emmons overlooks. The terminal moraine forms at the end, or terminus, of the glacier where rocks and other materials picked up by the glacier during times of glacier advance are left behind when the glacier ice melts away, or retreats. Lateral moraines accumulate similarly along the sides of glaciers. A few hundred years ago, the Emmons Glacier extended much farther down the White River Valley than it does today. As it melted and retreated up valley, it left terminal and lateral moraines that you can see below. The small milky-green ponds visible at the bottom of the valley are formed from melt water from ice that broke off from the retreating glacier and was left behind in the core of older terminal moraines. The large, steep lateral moraines skirting the edges of the White River valley were actually left by Little Ice Age glaciers 200–500 years ago.

Emmons Vista Overlook 2 (cont.)

Carolyn Driedger: "I like to say to people that the Mount Rainier your grandparents see is a little bit different from what you will see and what your grandchildren will see because we have rock fall and changes in the glaciers and sometimes we have volcanic eruptions."

These modern-day moraines will eventually erode away or perhaps be buried by lavas or other volcanic deposits from Mount Rainier, just like the moraine layers left behind by ancestral glaciers. Future volcanic eruptions and lahars will reshape the mountain and its surrounding valleys. For thousands of years, the mountain has been built up and torn down by volcanic forces, and sculpted and molded by glaciers. These processes leave a mark, and the evidence is visible on a grand scale throughout Mount Rainier National Park.

This concludes the Sunrise Geology Audio Tour. Please take your time returning to the trailhead and enjoy your visit to Sunrise! Exhibits in the Sunrise Visitor Center further explore the dramatic geology of Mount Rainier and the Sunrise area.