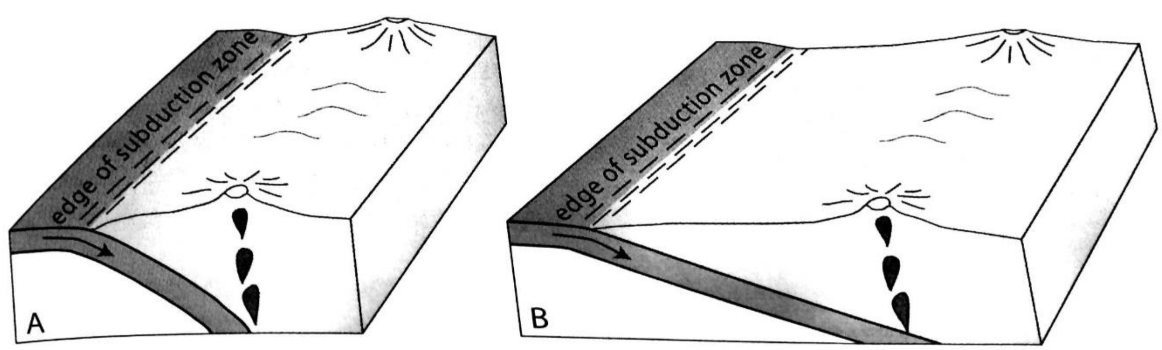
A view of the geology of Quartzville Creek
by Milo Mecham, geology enthusiast

The geology of Quartzville Creek, indeed, of most, if not all, of the Douglas Fir National Monument is volcanic in origin.

Plate tectonic theory explains the volcanic character of the area in terms of one tectonic plate being pushed under another tectonic plate (subsidence). Along the edge of the North American plate, west of the proposed national monument, the subsiding plate is the ocean floor of the Juan de Fucca plate. As the subsiding plate travels downward, it heats up, which releases water into the overlying rock. The superheated water causes the overlying rock to melt and create magma. The magma rises toward the surface, some making it to the surface, where it appears as a volcano. Since the North American plate continues to move over the Juan de Fucca plate, the cycle repeats itself.

When these plumes of magma reach the surface they form volcanos inshore of the edge of the upper tectonic plate. You can see this phenomenon in the string of volcanos that now make up the High Cascades. Mt. Jefferson and Three Fingered Jack, which make up the summit of the Douglas Fir National Monument are examples of these High Cascades volcanos.

To explain the geology of the proposed national monument, we need to start more than 30 million years ago, with the growth of the old Cascades. At that time the process of volcanism was similar to what it is now, but it was closer to the ocean, closer to the point where the oceanic plate travels under the North American plate. The illustration below attempts to show the process of the formation of the old Cascades, and then the formation of the new Cascades.



A decrease in the angle of subduction (B) shifted the volcanic activity eastward.

From Miller, Marli B. 2014. Roadside Geology of Oregon, Second Edition Mountain Press Publishing Company. pg. 115, used by permission.

In this illustration you can see the super-heated magma rising through the plate to form a volcano. Not all of the magma gets to the surface, some of it cools part of the way up. These bodies of magma cool more slowly than does the lava that makes it to the surface. The lava that makes it to the surface forms a type of rock in this area of the Cascades called andesite. The magma that does not make it to the surface forms granite and granite-like formations called plutons.

Over millions of years the mountains are built up of layers. At the bottom are rocks formed by other means, or rock from previous volcanos. Above this rock are layers of lava that flowed out from the volcanos. One of the more striking examples of this can be seen south of the proposed national monument. Between Coburg and Eugene, Interstate 5 passes by an example of Old Cascades lava covering older sedimentary rock. An observer looking east of I-5 will see a layer of rock, probably sedimentary rock, which is partially covered by a basalt flow that has partially cooled into columns.

At some point, perhaps 15 to 20 million years ago, the oceanic plate subsuming under the North American plate changed, so that the volcanos of the old Cascades stopped erupting. The volcanos of the Old Cascades became extinct and began to erode. Rain and wind and the stream that is now named Quartzville Creek, and other streams, carried the peaks downhill to lower levels. As the stream cut down through the mountains it exposed old layers of basalt, and eventually it has cut through some rocks that never made it to the surface of the mountains, exposing the plutons.

The "shrinkage" of the Old Cascades was also caused by faulting. The crust has extended (pulled apart) to form the faults. This causes the mountains to sink – subside.

It may have been at this point that the quartz of Quartzville creek was introduced. Again superheated water is thought to be the source. In this instance, the water travels upward toward the surface through the faults in the rock. The water carries with it the chemicals that becomes quartz. It also carried with it other minerals, such as the gold, silver, copper, zinc and lead that are found in the Upper Santiam basin. This phenomenon gave Quartzville Creek its name, and was the reason for the mining district formed in this part of the Cascades.

If you travel up Quartzville Creek there is a crossing where the creek has washed out a bridge, which can be seen just downstream of the new bridge. Upstream of the new bridge there is a pullout that shows much of the geological history of this part of the cascades.

Across the road from the creek there is a steep cliff. This is, I believe, an example of the granite plutons that rose through the layers of basalt towards the volcanic peak, but stopped part way up and cooled into a granite pluton. The road cut and the previous stream cut have exposed what seems to be the edge of the pluton. Across the stream one can see a different type of rock, probably the andesite of the Old Cascades. The stream has cut through what I believe is the boundary between the pluton and the andesite.

This is, I believe, a photo of the edge of a granite pluton

When the pluton rose through the basalt, which was laid down by eruptions millions of years before, it heated the old volcanic rock again. The heat and the fluids altered the basalt into rock with a different appearance. The rock takes on a denser appearance, and a greenish color. This can be seen several places along the creek, perhaps most obviously in the creek bed at the place of which I have been speaking. One can observe this different rock as a light green dike of rock on the sides and presumably under the stream.

You can see the altered basalt dike in Quartzville Creek bed.

Note the different types of rocks. I would label these andesite and altered basalt

Eventually, about 12 million years ago, the volcanos of the Cascades resumed their eruption, but this time their eruption was further east, forming the modern High Cascades. (Compare illustration A and B above.) One common explanation for this change is that the subsumed ocean plate was more shallow. The reduced depth would mean that the plate would travel further under the North American plate before it became hot enough to melt and produce the volcanic eruptions that build the Cascades.

The eroded Old Cascades are still there, west of the new, building Cascades. The Old Cascades are also under the new Cascades. There are occasional places where the old Cascades still show through the newer High Cascades.

South of Quartzville Creek, the dividing line between the Old Cascades and the High Cascades still being formed is roughly along Highway 22. That is, the upper end of Quartzville Creek starts in the High Cascades, and flows through the old Cascades. If you travel up Quartzville Creek and then south along Highway 22 you will notice a major change when the old Cascades give way to the High Cascades.   The volcanos seem to be producing different rock. Part of this may be because the rock the rising magma is traveling through is different. The main difference is that the old Cascades are deeply eroded, whereas the modern High Cascades are continually producing new lava that changes the topography.

Erosion is a continuing force for the High Cascades as well as the Old Cascades. The "pure" volcanic character of the modern Cascades is confused by erosion. Three fingered Jack probably used to be a peak like Mt. Jefferson. Erosion, most recently especially by glaciers, has carved the peak down to what it is now. Mt. Jefferson has also eroded, including by glaciers. Some of the erosion of the Cascades is old enough that it has turned into sedimentary rock.

A geological visit to the Douglas Fir National Monument provides a great opportunity to visit a geological smorgasbord that puts on display much of the geologic history of western Oregon. The area is a mix of many kinds of rock: Old volcanic elements from the Old Cascades and plutons that have been eroded to the surface are mixed with and partially covered by newer volcanic rock; lava and tuff (created by pyroclastic eruptions), and a spread of eroded rock on top and mixed with the other rock.

References

I have relied on a number of sources, but all the mistakes are mine alone.

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