Oregon Caves

National Park Service
U.S. Department of the Interior

Oregon Caves National Monument
Cave Junction, OR

Geology 301

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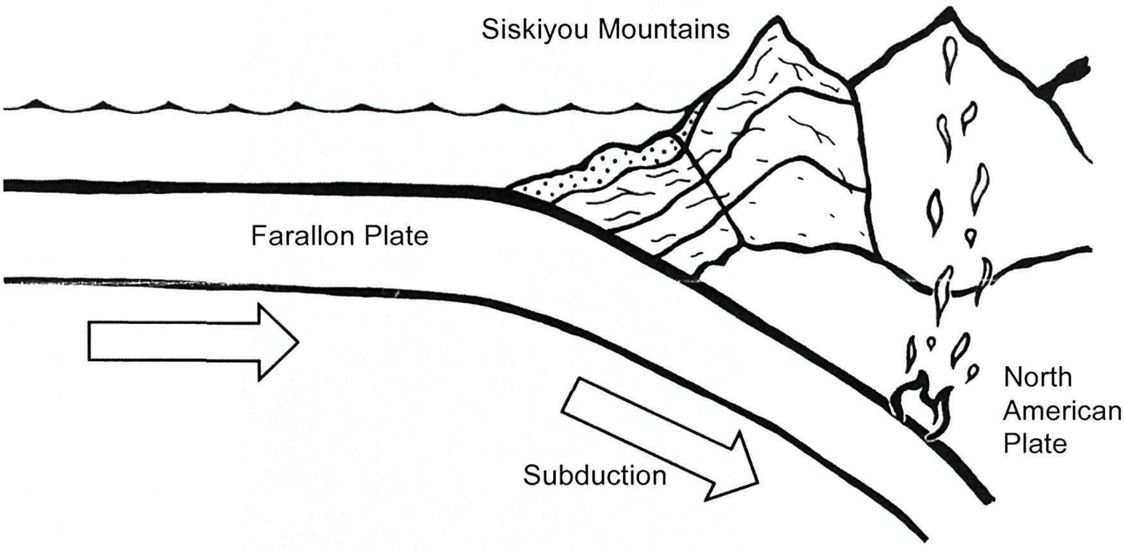
An in depth, advanced look at the geology of the cave and the region.

Regional Geology

Oregon Caves is located in the northern reaches of the Klamath Mountain System, in a subset of this range known as the Siskiyou Mountains. Though Oregon is located within the "Ring of Fire," the Siskiyou Mountains are not the result of recent volcanism, but rather of the addition (accretion) of much older volcanic seafloors and granites. Together these form the Klamath superterrane. This is an assemblage of over half a dozen terranes, (groups of rocks that share a common history), which became a part of the accretionary prism west of the North American Plate; this process can be found in Geology 201.

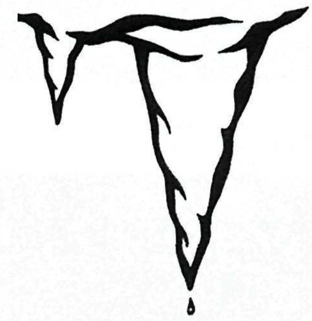
The Cascade Mountains, found to the east, are the mountains that were formed by volcanism long after the Klamath Mountain System had accreted to North America. The densest part of the Farallon Plate, an oceanic plate, slid further and deeper under the North American Plate until it hit a melting point. The newly melted rock, known as magma, was less dense than surrounding rock which enabled it to rise and erupt at the surface as lava through volcanoes.



Volcanism at Oregon Caves

Some magma never reaches the surface to become lava. Batholiths are massive magma chambers beneath the surface, (surface area > $100km^2$), that never become a volcano. Approximately 160 million years ago (think Jurassic Park!) the Greyback batholith grew right below the marble, and was exposed inthe "Ghost Room" when the Caves formed much later Here, we can see how the batholith shot through what was a small crack in the marble and widened it, creating an igneous dike composed of diorite. With it, the intrusion brought along sulfide minerals that, when mixed with water and certain bacteria, formed sulfuric acid. Sulfuric acid is quite a bit stronger than carbonic acid and thus helped to make quick work chemically eroding the "Ghost Room.". In the course of just a few hundred thousand years the sulfuric acid, along with all the cracks, was able to dissolve away a large portion of the room, making it the largest chamber in our cave!

Cave Formations



Geology 101 explains and illustrates some of the major formations that can be seen in the cave, but the process was oversimplified. While Geology 101 simplifies the building of formations to evaporation, it is important to know that the water, for the most part, is not actually evaporating away. Instead, most of the process can be attributed to different carbon dioxide (CO_2) levels in the air and water in the cave.

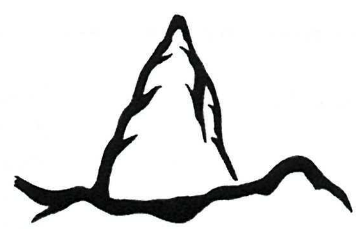
Carbonic acid (H_2CO_3) is a weak acid that is created as carbon dioxide (CO_2) in the soil dissolves into rainwater (H_2O) that has filtered into the ground. Carbonic acid reacts with the calcite ($CaCO_3$) in the marble and creates an aqueous solution called calcium bicarbonate, $Ca(HCO_3)_2$. This solution is highly saturated with CO_2.

$$CO_2\,(g) + H_2O\,(l) \rightarrow H_2CO_3\,(aqueous)$$

$$H_2CO_3\,(aq) + CaCO_3\,(s) \rightarrow Ca(HCO_3)_2\,(aqueous)$$

Calcium bicarbonate drips through the small cracks and fractures in the rock until it finds a cave where airflow has flushed out so much carbon dioxide that the air can be 50 times less saturated in CO_2. than the water is. At this point, the process is reversed as the CO_2 reaches equilibrium; if there is more CO_2 in the water than in the cave air, the gas will move into the air. CO_2 is removed from the solution, resulting in precipitation of the less soluble $CaCO_3$ that was once suspended in solution.

$$Ca(HCO_3)_2(aq) \rightarrow CO_2\,(g) + H_2O\,(l) + CaCO_3\,(s)$$



Things you may not have seen...

Calcite Crystals

Most calcite crystals in cave formations are so small it is impossible to see them with the naked eye. However, there are a few areas in the caves where it is possible to see such big crystals. These larger ones formed from a solution only slightly saturated with calcite. Visible calcite crystals form when an area has a fairly constant climate, one where calcite only deposits on a few older crystals that then get larger. Where oversaturation occurs too fast, small crystals form on most surfaces. Once there is an opening nearby, conditions change fast daily. Formations with many tiny, invisible crystals such as moonmilk or cave popcorn then begin to form.

Moonmilk

Calcite moonmilk usually only grows in cold and wet environments, and therefore can only accumulate during the winter months. During this time, air entering the cave must warm up, thus making the air dry enough to evaporate cave water. It is believed to form as the calcite-rich water moves through the marble and reaches microbial life that can use nutrients in the water. The microbes eat the organic acids and then are wrapped around by the now lesss soluble calcite. Strange shapes can be produced when the moonmilk completely covers tree roots.

Vermiculations

Vermiculations typically look like convoluted pieces of brown yarn a few inches long. They grow on smooth surfaces of cave walls and ceilings that were flooded with silt-rich water. The more intricate vermiculations may show the effects of electric charges and bacteria sticky enough to collect suspended sediments from floodwaters. Now all that remains is the particles of dirt clinging to the roof.