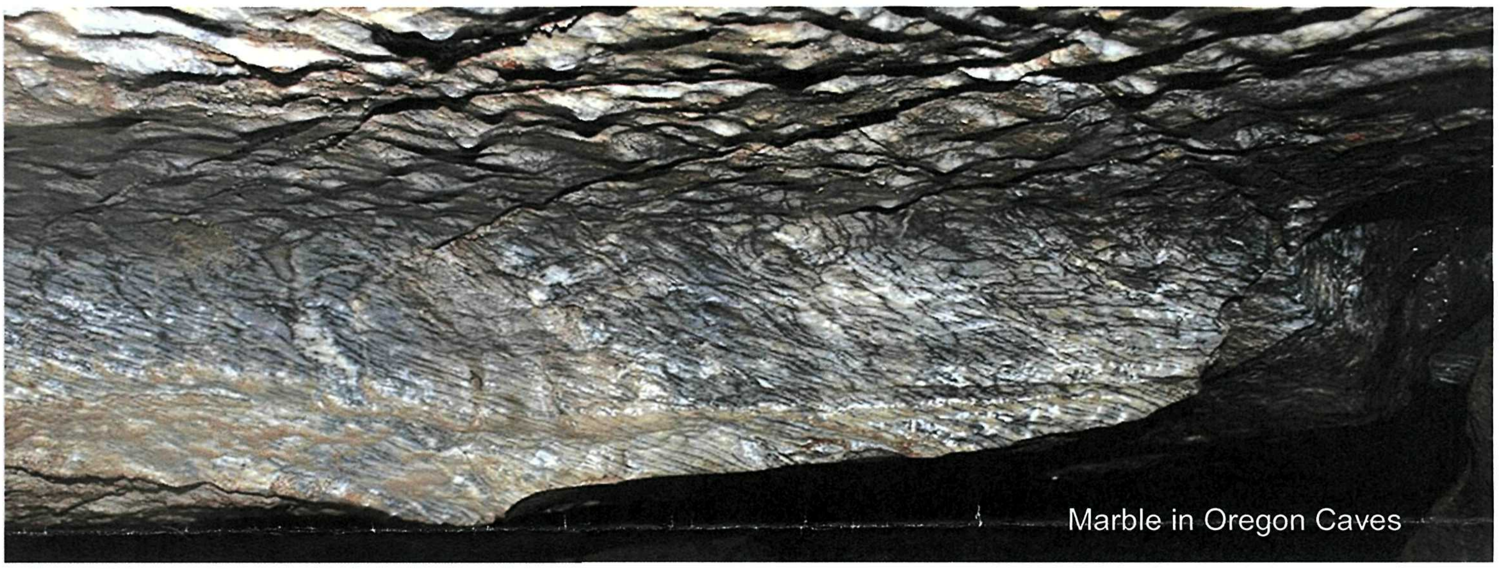
Geology 201



Marble in Oregon Caves

Geology 201

Geology 201 follows Geology 101 and gives a more in depth description of how the cave was created.

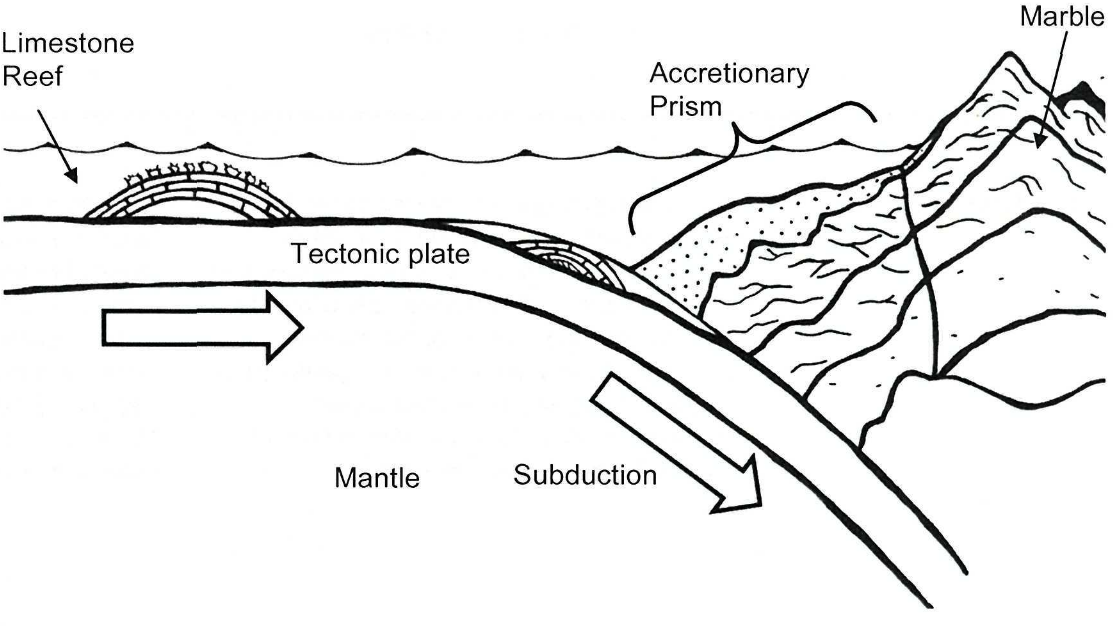
Formation of the Marble

Marble is a metamorphic rock, which means the rock has undergone temperature and pressure changes; enough to cause it to re-crystallize but not high enough to melt it. Marble found here originally began as a sedimentary rock called limestone. Approximately 250 million years ago a limestone reef was created by microbes that lived in a relatively hot, shallow ocean.

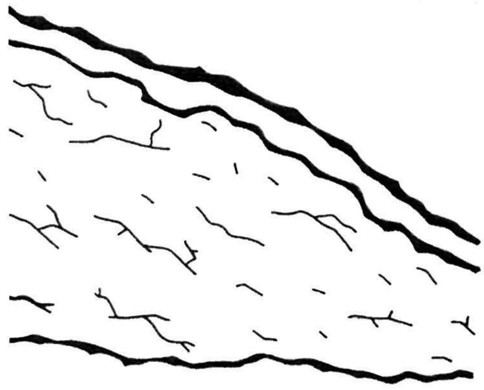
Microbes were some of the only animals living in the ocean because the water was too warm and acidic for other forms of life. Predators of the microbes were killed as the oceans warmed, which allowed the microbes to grow extremely large reefs. The microbes breathed carbon dioxide (CO_2) which removed it from the water. The removal of CO_2 caused the mineral calcite to precipitate out of the water and deposit on the reef.

Regional Geology

This seafloor sat on a tectonic plate, part of the outermost layer of Earth. Like all plates, it "floated" on a surface of elastic rocks called the mantle, and was en route for a head-on collision with a land known today as North America. Approximately 170 million years ago the seafloor crashed into and slid under the western edge of the North American Plate. The densest material was pulled *under* the continent (subduction), and lightweight sediments were scraped off the ocean floor and pressed *against* the continent, forming an accretionary prism. This is a matter of buoyancy; dense rocks sink and lightweight rocks rise. Continental plates like the North American Plate are less dense because they do not have as many heavy minerals as oceanic plates. As a result, when plates collide, the denser oceanic plates slide under the buoyant continental plates. The accretionary prism provided just enough heat and pressure to morph the limestone into marble.

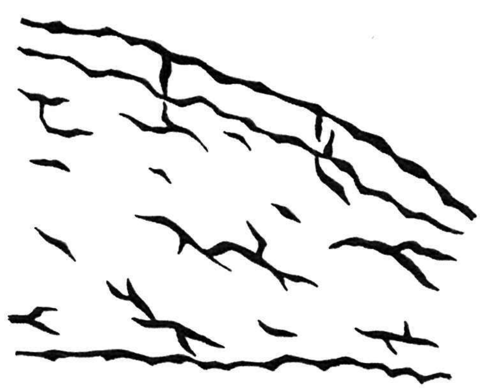


Creation of the Cave



Thin cracks from uplift

Additional islands riding on the sinking seafloors continued to crash into North America and subduct under the marble. The collisions squeezed the land shorter, just like when you push a sheet of paper from both sides and it rises up. This "floated" the marble upwards, above denser and thus lower lying seafloors. This is called uplift. As the rock rose up into mountains, erosion uncovered the buried marble. The loss of pressure from the overlying rocks created microfractures in the marble, approximately four one hundredths of an inch (half the width of a hair). These miniature cracks have been essential in the formation of the cave.

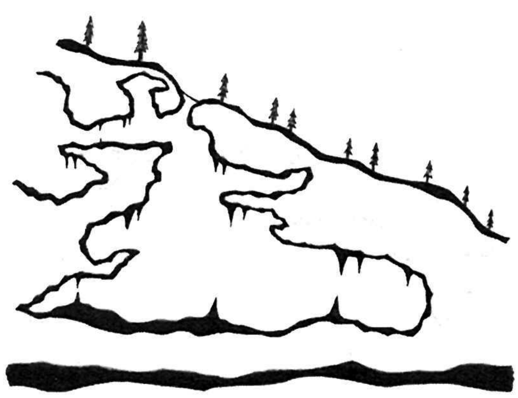


Enlarged cracks

Oregon Caves is a solution cave, meaning it was formed as an acid chemically eroded the marble away in a process called dissolution. Carbon dioxide (CO_2), which is released by most organisms and all decaying plants in the soil, mixes with rainwater (H_2O) underground, and forms a weak acid called carbonic acid (H_2CO_3):

$$CO_2 + H_2O \rightarrow H_2CO_3$$

Gravity pulls the carbonic acid through the microfractures in the rock, enlarging them, and allowing more acidic water to pass through the marble. Increased acidic water movement allows for more chemical weathering to occur, thus, faster cave formation.



Air filled passageways

Eventually the cracks become wide, continuous and interconnected. This moves water through the mountain so fast that the cave drains and becomes air filled. Think of this as adding several drains to a bathtub; it will drain faster when there are more paths the water can take!

Cave Location

It is no accident the cave has formed on the north side of Mount Elijah. Northern facing slopes do not receive as much sunlight, and therefore it is the cooler side of the mountain; this should be nothing new but is very important for the formation of our cave! Warmer temperatures on southern facing slopes promote higher evaporation rates, decreasing the amount of water available for cave formation.

In contrast, northern facing slopes have much lower evaporation rates, and therefore can provide the amount of water necessary for extensive cave formation. Water on the northern slope is relatively cool compared to the southern slopes, and therefore has the ability to hold more dissolved gases (in this case CO_2). Increased CO_2 levels promote faster chemical weathering rates, and in turn, larger cave systems.