

Florissant Fossil Beds

Petrified Forest

National Park Service
U.S. Department of the Interior

Florissant Fossil Beds
National Monument
Colorado



A forest of tall redwood trees grew in the Florissant valley 34 million years ago. Some of the trees survived as fossils that are visible on trails today. Scientists have studied Florissant's fossil wood to understand changes in climate and forest composition and the process of petrification—turning wood into rock.

Why are only stumps left?

Heavy rain or rapid snowmelt can sweep rock and ash from volcanos into thick mudflows called lahars. Lahars can rush downslope at up to 120 miles/hour (190 km/hr). One lahar from the ancient Guffey volcano flowed through the Florissant stream valley 34 million years ago. This flow buried the forest there under more than 16 feet (5 m) of debris and killed the trees by preventing oxygen from reaching their roots. The lahar encased and protected the lower trunks, which are preserved as fossil stumps. The roots and treetops decayed or broke off.



Artist reconstruction of the Eocene forest and lahar.

What kinds of trees lived in Eocene Florissant?

Most Florissant fossil stumps are redwoods similar to the coastal redwoods now living in California and Oregon. Other petrified wood comes from hardwoods, including *Hovenia* (related to Japanese raisin trees), *Koelreuteria* (golden rain tree), *Robinia* (locust), *Zelkova* (related to elms), and *Chadronoxylon* (extinct).

Are there more stumps underground?

Researchers have searched for undiscovered stumps at Florissant in several ways. Ground-penetrating radar, which measures reflections from electromagnetic pulses, has not been effective because the upper soil of the park is rich in clay. A recent study shows promise for detecting stumps with a magnetometer instead. This is because the local magnetic field is weaker above the silica-rich stumps than above the surrounding volcanic rock, which contains the magnetic mineral magnetite.

How does a tree petrify?

When mineral-rich water penetrates wood, it deposits silica on the cell walls. As the wood decays and water continues to seep in, more silica minerals (opal, quartz, and a quartz with microscopic crystals called chalcedony) form inside the cells over time through a process called permineralization. Most of the silica in the stumps at Florissant probably originated from volcanic ash. Certain types of wood, like redwood trunks, are more durable than others, which may make them more likely to petrify. Experiments show that wood can begin to petrify in tens to hundreds of years in ideal conditions, but it likely took much longer for the stumps at Florissant to turn into rock. Some plant tissue remains after wood petrifies, which helps preserve the tree anatomy in cellular detail.

A section of fossil wood from *Koelreuteria* (golden rain tree) shows vessels. Magnified 20x.



Scientists cut thin sections of petrified wood to study growth rings and other plant features under a microscope. During petrification, minerals form in the spaces of organic tissue. This process can preserve individual plant cells.

Thin section of Florissant fossil redwood (magnified 40x)

Do the stumps have growth rings?

Some of the petrified redwood stumps at Florissant show clear growth rings, while others are hollow in the center. The Florissant fossil tree rings are wider than those of living coastal redwoods, indicating a better growing season in the past. A technique called tree ring cross-dating matches the patterns of thin and thick rings among different trunks to see if the trees lived through any of the same drought or wet periods. Petrified Florissant trees have the same patterns, so it is likely that all the trees in the forest died at the same time. A single lahar probably covered the entire valley in a day.

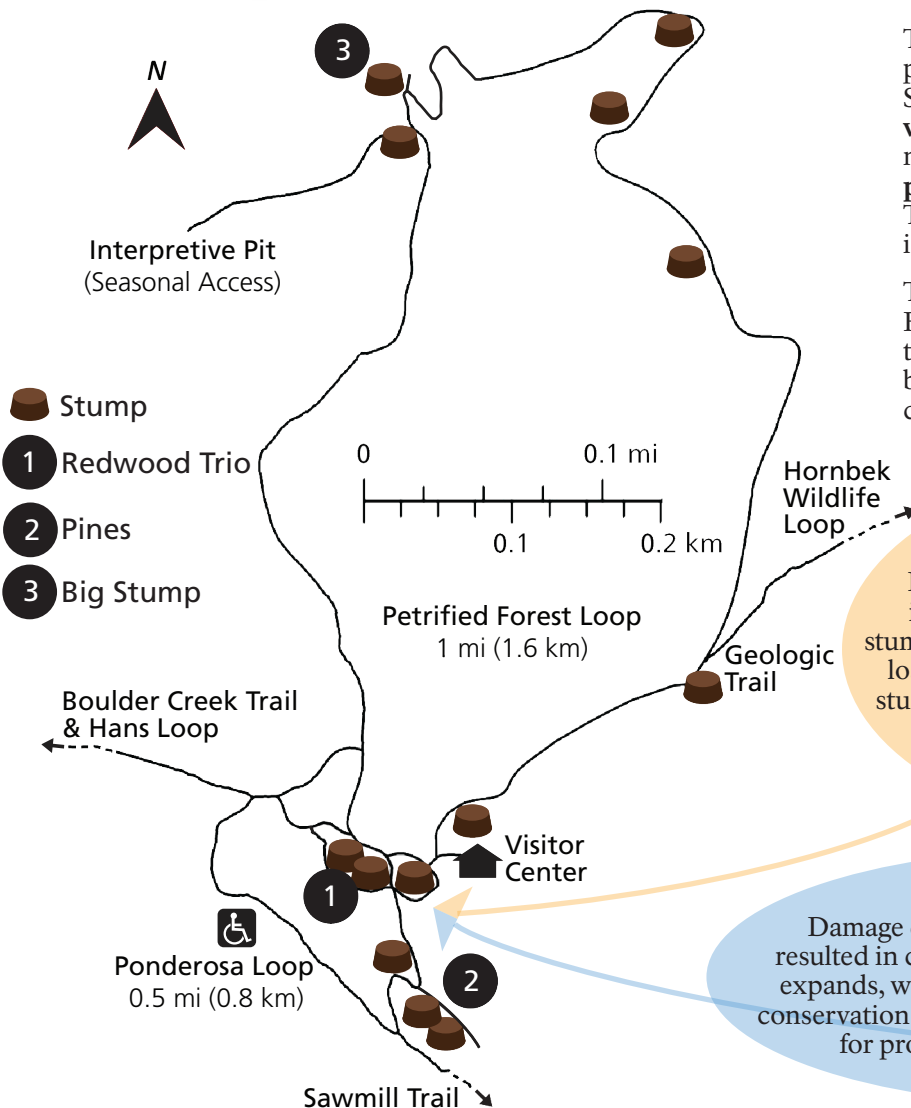
Colorful Petrified Wood

You can see many colors in the petrified stumps. Cream-colored fossil wood usually contains quartz. Dark brown or gray indicates organic material, often in opal. Iron minerals make other colors, including black and dull red.

Where can I see petrified stumps?

The Ponderosa Loop and Petrified Forest Loop trails pass more than a dozen petrified stumps (map at left). Some of the **best stumps lie right behind the visitor center (1)**. On the Ponderosa Loop trail, a modern forest surrounds the fossil one, and **living pines grow directly on top of petrified stumps (2)**! The **Big Stump (3)** on the Petrified Forest Loop trail is completely excavated.

The petrified stumps are the largest fossils at Florissant and are some of the largest diameter fossil trees in the world. Please help protect them by staying behind railings. Federal law prohibits disturbing or collecting fossils in the national monument.



Past Explosive Excavations

Early settlers knew of the stumps near Florissant, and tourists arrived with the railroad in 1887. Collectors removed dozens of exposed stumps by the turn of the century, sometimes by wagon loads. In the 1920s, two commercial sites excavated stumps on their land. One of these private operations used dynamite, which likely contributed to the cracks visible in the stumps under the shelters by the visitor center.

Future Conservation

Damage during early excavation of the stumps resulted in cracks where water seeps in, freezes, and expands, which causes ongoing deterioration. New conservation studies are underway to explore methods for protecting the stumps into the future.