Florissant Fossil Beds

National Park Service
U.S. Department of the Interior

Florissant Fossil Beds
National Monument

Fossil Plants

More than 130 plant species have been described from Florissant. These are represented by leaves, fruits, flowers, seeds, wood, and pollen, yet the only fossils most visitors see are the stumps of ancient redwood trees. Why is this? Fossilization is a complex process that can be affected by a number of factors, and multiple forms of fossilization took place during Eocene Florissant.

Depositional Environment

Most of the plant diversity at Florissant comes from the abundance of plants preserved in shale. The volcanic mudflow that preserved the redwood stumps was very high-energy, meaning that only the most durable plant parts, such as trunks, cones, and seeds, would have survived the flow intact. More delicate plant parts were preserved poorly or not at all. Well-preserved leaves, flowers, and fruits were typically deposited in quiet environments with fine grained sediments that prevented decomposition and preserved fine features.

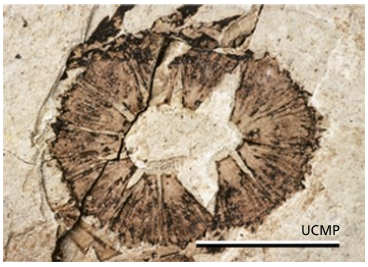
In Eocene Florissant, plants were deposited at the bottom of Lake Florissant, a low-energy, low-oxygen environment. They are preserved in paper shale, a very fine grained rock produced by the deposition of volcanic ash and diatoms, which are a kind of microscopic algae. Unlike the redwood stumps, you can't see the shale fossils while walking around the Monument because they are still trapped within layers of rock. The shale is very susceptible to weathering so any fossils that are exposed from the rock deteriorate quickly. In order to collect fossils for research, Monument paleontology staff must conduct excavations in which they dig out pieces of shale, split them to reveal the fossils, and bring them back to the lab where they are safe from the elements.

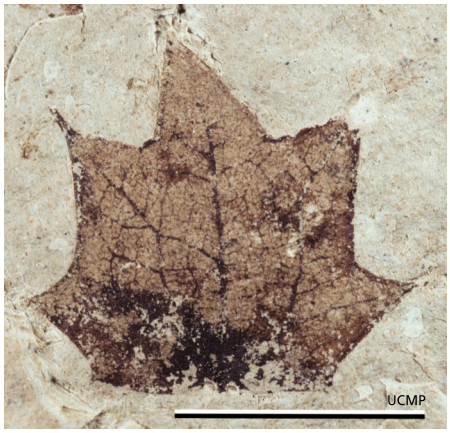
Habitat

Eocene Florissant was made up of a variety of plant habitats, stretching from the aquatic environment of Lake Florissant to the drier and harsher environments of the surrounding mountainsides. The distance between a plant and the lake greatly influenced the likelihood of it being fossilized. Since most of the plants represented by fossils are terrestrial species, they would have had to be transported into the lake and would have faced a high risk of destruction in the process.

Species like *Sequoia* (redwoods; far left) were preserved frequently since they lived in the wet valley bottoms. *Pinus* (pines; above left), *Cercocarpus* (mountain mahogany; above center), and *Quercus* (oaks; above right), which are seen less frequently as fossils, lived on more distant hillsides.

The abundance of certain species also plays a role in how often they are preserved. One of the most common fossil plants found at Florissant is *Fagopsis longifolia* (below), an understory tree that inhabited the banks of the lake and streams. The number of these fossils relative to those of other species suggests that *Fagopsis* was also one of the most common species in the Eocene environment.

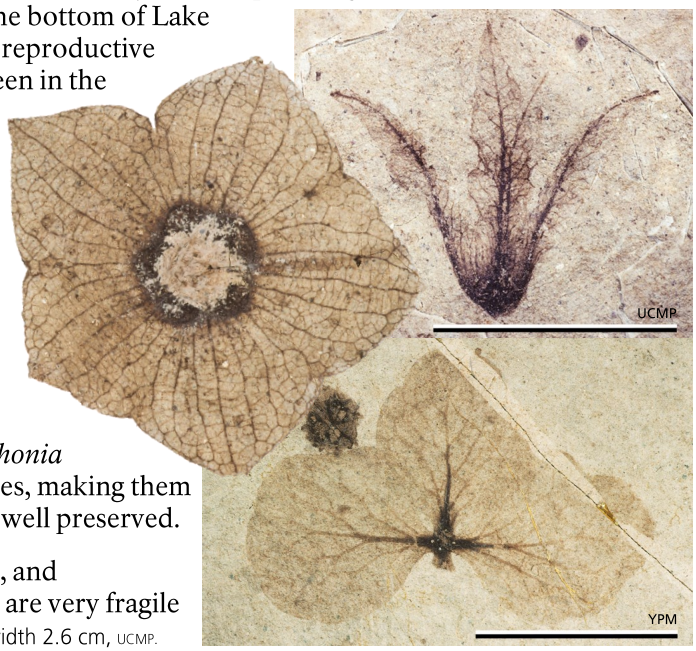




Plant Organs

Plants in the fossil record are unique in how certain organs are preserved preferentially. A plant organ is a part of a plant that has a specialized function. For example, leaves are considered organs because they are responsible for collecting sunlight for photosynthesis. Other plant organs include flowers, seeds, fruits, and stems.

Unlike animals, while a plant is alive it continually releases and regrows many of its organs. All plants, even evergreens, drop leaves. All plants release reproductive structures such as pollen, seeds, and fruit. This means that many isolated plant organs can be found in depositional environments like the bottom of Lake Florissant. Therefore, leaves and reproductive structures are more commonly seen in the fossil record than other plant parts that are not released from the plant during its life, such as the wood of a trunk or stem. The abundance of isolated organs in the fossil record poses a problem for paleobotanists. When different organs belonging to the same species are found separately they are often assigned to separate species. Only when multiple organs are preserved attached to each other can they be definitively assigned to the same species.



There is also variation in fossilization frequency of plant organs based on the durability of the organ. Certain leaves are more likely to reach a depositional environment intact than others. Evergreen leaves, like *Mahonia* (above; a relative of holly), are thicker and sturdier than deciduous leaves, making them better able to withstand damage during transport and more likely to be well preserved.

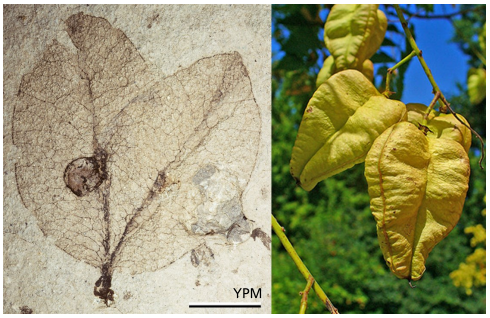
Fossil flowers like *Asterocarpinus* (right top), *Florissantia* (right middle), and *Hydrangea* (right bottom) are rare at Florissant. This is because flowers are very fragile and can easily fall apart or be destroyed before being buried. *Florissantia* width 2.6 cm, UCMP.

The microscopic spores (gyrongonites) of charophytes, a primitive aquatic plant, have a high potential to preserve because they are encased in calcite, a resilient mineral. After the gyrongonites are buried, they retain the intricate detail on their exterior even after millions of years. Image width 0.5 cm.

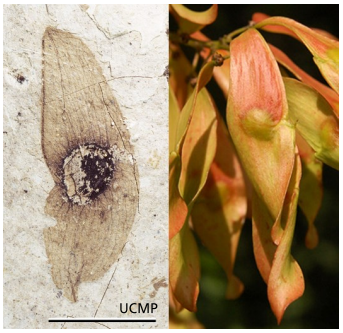
What happened to the Eocene Florissant plants?

At the end of the Eocene, there was a large drop in global temperature and the Florissant climate began to change from subtropical/warm temperate to cooler temperate. In response to the intense cooling, many plants native to the ecosystem that were not cold-adapted either became extinct or dispersed to other parts of the world.

The two most abundant plant fossils a Florissant, *Fagopsis longifolia* (left), a beech relative, and *Cedrelospermum lineatum* (left bottom), an elm relative, became extinct. *Fagopsis* length 7.3 cm FLFO, *Cedrelospermum* length 5.3 cm FLFO.



The last living species of *Sequoia*, the coastal redwood, lives on the US Pacific coast. *Koelreuteria* (right top) and *Ailanthus* (right bottom), two types of trees widespread during the Eocene, now live only in Asia and Oceania.



Many genera present in Eocene Florissant survived under the colder conditions. These include many plants which are still common across North America, including *Acer* (maple), *Rosa* (rose), *Carya* (hickory), and *Hydrangea*. At Florissant, *Pinus* (far left) and *Populus* (left) have survived since the Eocene and are abundant today as ponderosa pines (*Pinus ponderosa*) and quaking aspens (*Populus tremuloides*).

All scale bars 1 cm. Images courtesy of Yale Peabody Museum (YPM), University of California Museum of Paleontology (UCMP), and Florissant Fossil Beds National Monument (FLFO).