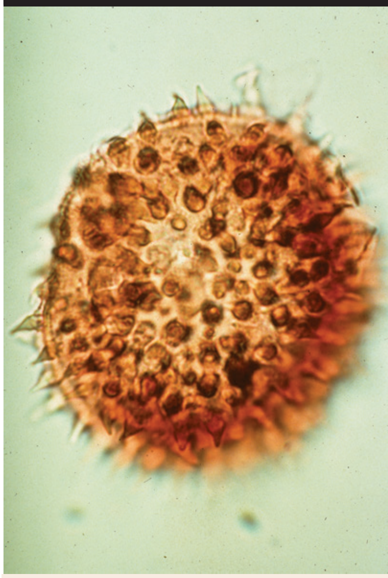
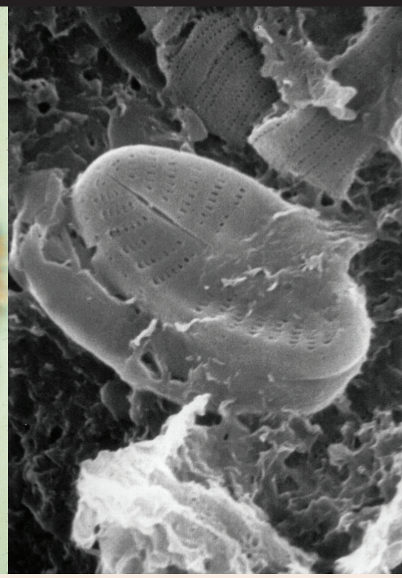
Florissant Fossil Beds

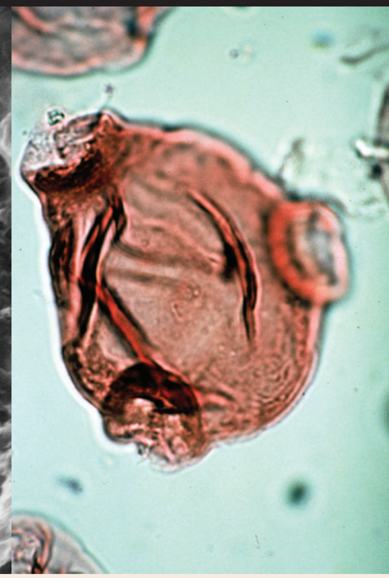
Microscopic World of Florissant

National Park Service
U.S. Department of the Interior

Florissant Fossil Beds
National Monument
Colorado



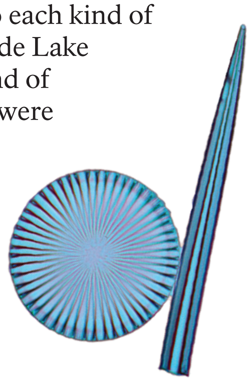


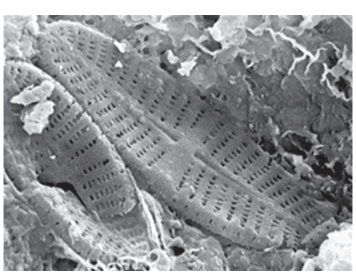


For every Florissant fossil large enough to see with the human eye, there are countless fossils only visible under a microscope. Millions of pollen grains, diatoms, and microscopic invertebrates are preserved at Florissant, and some played a key role in the process of fossilizing other organisms at the site. Microfossils are critical for understanding habitat, water quality, and climate at Florissant 34 million years ago.

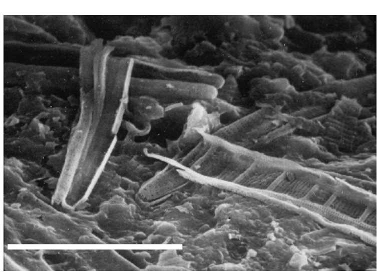
Miniature Glass Ornaments

Single-celled algae called diatoms grow hard cases (frustules) out of silica. The glassy shells come in many shapes and are adorned with pores and ridges unique to each kind of diatom. Ash from volcanic eruptions made Lake Florissant rich in silica and acted as a kind of fertilizer that nourished diatoms, which were critical for the preservation of fossils at Florissant. Diatoms bloomed at the surface as they used up the silica. After the algae became stressed for resources, they exuded sheets of slimy mucus, which settled as mats on the bottom of the lake. The mucus trapped dead organisms and may have slowed their decay, helping to preserve them as fossils. The paper shales that contain many Florissant fossils are made up of layers of ash, clay, and diatom material.





Scanning electron microscopes reveal diatoms like these, less than 6/10,000 inch (0.014 mm) long.



Diatoms and the organic material they produced form layers in Florissant shales. Scale is 4/1,000 inch (0.1 mm).

Stonewort Corkscrews

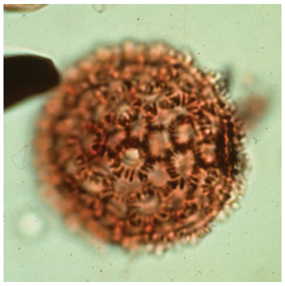
Some of the earliest plants to evolve, more than 400 million years ago, were freshwater algae called charophytes. Many charophytes, commonly called stoneworts, grow only in clear, still water. The presence of fossil charophytes in Florissant shales may provide evidence for similar water conditions in ancient Lake Florissant.

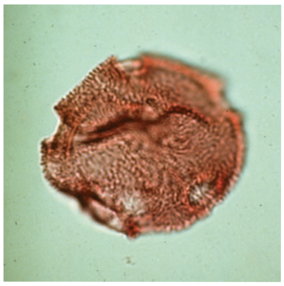
Stoneworts grow up to several feet (more than a meter) in length, but the fossils preserved at Florissant belong to a life stage only twice the thickness of a fingernail in diameter. Charophytes undergo a complex lifecycle with both a sexually reproducing and asexually reproducing stage. The sexual form develops from a spore, which grows a protective capsule and is then called a gyrogonite. The most common fossils of charophytes are gyrogonites.

Spiral capsules protect spores of *Chara*, a kind of green alga, during harsh environmental conditions. Scale bars are 4/100 inch (1 mm).

Fossil Pollen and Spores

Pollen and spores settled on the bottom of ancient Lake Florissant after wind blew them onto the surface or streams washed them into the water. Some of these tiny reproductive plant stages became fossilized in the layers of lake shale.





A grain of pollen is usually only thousandths to ten-thousandths of an inch (0.01-0.1 mm) wide. In order to examine such small fossils, paleontologists first isolate them by dissolving shale in various acids. Then they stain the extracted fossils with dye and mount them on glass slides to examine under a microscope. This is how the pictures at left were produced. These techniques were not yet developed when scientists first described fossils at Florissant in the late 1800s. Only in recent decades have paleontologists been able to study fossil pollen to learn more about the ecosystem at Florissant in the late Eocene.

More than 130 different species of plants have been identified from fossil pollen and spores at Florissant. Of these, plants from 25 genera are known only from fossil pollen and spores. Some pollen travels long distances in the wind, providing evidence of the ancient forests that grew on nearby mountains.

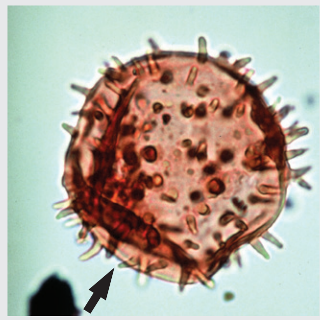
What kind is it?

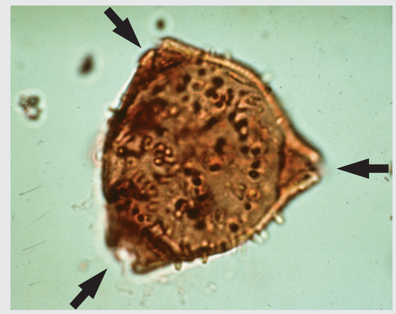
The size, shape, sculpturing, and number and location of pores and furrows are unique to each kind of pollen.

Some conifers make pollen grains with two sacs, like the fir (*Abies*) pollen grain at right. Botanists call this shape "bisaccate."

Water lillies (Nymphaceae; bottom left) and some other plants make pollen grains with one furrow ("monocolpate").

Some plants make pollen grains with three furrows and/or pores (bottom right).





What are the smallest fossil animals?

Fossils indicate that Lake Florissant may have held a rich assemblage of invertebrates. Some of the most common fossil aquatic invertebrates are ostracods, small crustaceans almost like a shrimp enclosed in a shell. They likely lived in the shallow areas of Lake Florissant, where they ate detritus that settled to the bottom. Several species of snails and clams are preserved at Florissant as well. The smallest of these, a snail called *Gyraulus* (below), grew up to about 1/4 inch (5 mm) across. Teeth from rabbits, rodents, and other mammals were preserved as fossils, many of which are only tenths of an inch (a few milimeters) long. Most of the species of Florissant mammals have been identified from teeth alone.

Fossil ostracod, 3/100 inch (0.7 mm) long.

The name *Gyraulus florissantensis* means "spiral from Florissant." Scale bar is 2 mm, about 1/16 inch.

Why study shells?

Fossil clams can hold evidence of past conditions.

Calcium-rich shells from ostracods, clams, and other aquatic animals are a kind of time capsule for scientists, providing clues about the original habitat in which an animal lived. As an animal grows its shell, it records chemical signatures of salinity, temperature, and other aspects of water quality. Chemical isotopes in fossils can be studied to reconstruct water conditions at Florissant 34 million years ago.

Understanding how past changes in water conditions affected aquatic animals is important to predict how modern climate change will impact ecosystems over the coming decades as water acidity changes. In particular, ostracods, along with snails, corals, and other aquatic animals, build shells from calcium compounds that dissolve in more acidic water. Acidity is defined by hydrogen ion concentration, which the National Oceanic and Atmospheric Association measurements show has increased 30% (a pH decrease of 0.11) in oceans since the Industrial Revolution. The greater acidity is caused by an increased concentration of carbon dioxide molecules in the atmosphere, which react with water molecules to form carbonic acid.