

Foree's Turbulent Worlds

National Park Service
U.S. Department of the Interior

John Day Fossil Beds
National Monument



The colorful rock layers and textures of Foree indicate explosive geologic events that forever changed this landscape. This region is marked by ashfalls, floods of molten rock, and violently destructive clouds of superheated volcanic material. As you hike the Flood of Fire and Story in Stone trails, peer into tempestuous worlds of ecological succession and devastation: life and death.

Flood of Fire

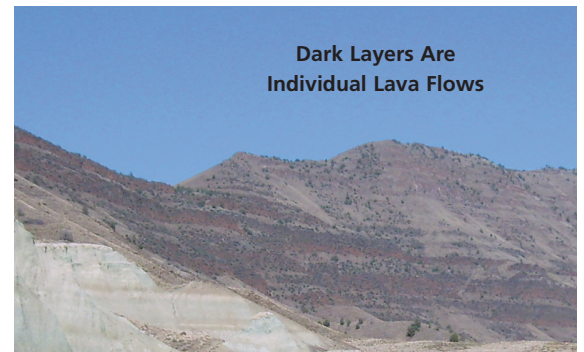
The trails at Foree offer some of the best views of the Picture Gorge Basalts, the dark layered rimrocks of ancient lava.

Gushing from long deep cracks in the earth, floods of molten rock flowed across an open canopy forest. Huge lakes of lava covered thousands of square miles. Over time, more fissures formed, and more molten rock poured out on top of the old lava. This was part of a cycle of immense lava floods which engulfed much of Oregon, Washington, and Idaho 16.5 to 14.5 million years ago.

After basalt flows cooled, life on the new lands slowly reestablished over thousands of years. The first arrivals to the barren terrain were likely insects and spiders, followed by windblown soils, then seedlings. Trees and grasses eventually took hold on the newly

formed soils, and other animals followed, only to be flooded yet again in about 15,000 years.

This cycle repeated over and over. Sixty-one different lava flows have been counted here in the canyon walls. Some individual flows are as much as 52 ft (16 m) thick. Altogether, flows in this area are over 1,300 ft (400 m) deep.



Land-Building Debris

Below the basalts, geologists have discovered evidence of two major catastrophic eruptions. The Picture Gorge Ignimbrite came from explosions of the Crooked River Caldera about 28.7 million years ago.



Originating over 80 miles to the west, superheated clouds of ash and gas swept across this area. As the powerful blast cloud settled, the hot material fused together to form the hard, welded volcanic rock called ignimbrite. The red and gold Picture Gorge Ignimbrite caps the cliffs of green siltstone and claystone at Foree. The magnitude of the catastrophic event is evidenced by the fact this layer is over 150 ft (45 m) thick in some places.

Additional clues to the power and destructive force of this flow have been found in the shattered remnants of a burned and petrified forest at the base of the ignimbrite on private land near the park. Very few fossils are found in this rock layer because almost everything was incinerated by the intense heat of the blast.

Ash to Soil to Stone

As volcanoes to the west and east erupted every few decades, massive clouds of rhyolitic ash fell like snow, piling up several inches to many feet thick. As time passed, the particles weathered into clay and silt to form fertile volcanic soils. These ancient soils (paleosols) were later buried by additional layers of new ash. Over time, the immense volume of buried paleosols compacted and hardened into claystone and siltstone. Although it may look like these blue-green rocks are oxidized copper, the color is from celadonite, a mineral formed as hot water chemically weathered the alkaline volcanic soil.

The blue-green sedimentary rock entombed evidence of past life such as animal burrows and trackways. Paleontologists have found a remarkable amount of unusual fossils within each of the colorful layers. The ancient ecosystem, rich in animal diversity, included mouse-deer, three-toed horses, tortoises, and tiny limbless lizards that hunted in the leaf litter of



Fossil Jaw Bone of Mouse-Deer with Teeth

the forest floor. Analysis of paleosols and fossil plant communities indicates precipitation in Foree was about 40 inches per year (102 cm), compared to an average of 14 inches (36 cm) today.

Foree is just a few chapters in the story of the John Day Basin. Spanning almost 50 million years, the John Day Basin has one of the longest and most continuous fossil records exposed in the world!

The Right Tuff

Many of the exposed badlands along the trails at Foree contain lightly colored rocky ledges called tuffs. Tuffs are consolidated volcanic ash from eruptions. Each of these ledges signifies a single volcanic event: generally the thicker the layer, the larger the event.



Scientists can date the age of the tuff layers with great accuracy, since they often contain radioactive isotopes. Small amounts of unstable elements change at a measurable rate over time as they decay into stable elements. By comparing the ratio of unstable elements to stable elements contained within the tuff, scientists can determine how long the rock has been decaying and thereby determine its age.

Foree's tuffs range in age from about 30 to 27.5 million years old. Knowing the age of compacted volcanic fragments allows the inference of the fossil ages. The John Day Basin is one of the few areas on the planet with numerous datable volcanic rock layers interspersed throughout fossil bearing sedimentary layers.

Story in Stone

The John Day Basin is a land formed from floods of fiery molten rock and suffocating ashfalls. Fifty million years of volcanic eruptions buried the landscape, along with its plants and animals, under several thousand feet of ash, rock, and sediment deposits.

Today, scientists study the different rock layers and the corresponding contact zones to piece together the geologic story captured in stone. Their search for clues, preserved in the varied colors and textures of weathered rock layers, yields an extraordinary record of evolutionary and climate change from

the Cenozoic: the Age of Mammals.

