For more information visit:

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Geology of Keyhole State Park

A typical outcrop of the Cretaceous Fall River Formation in Coulter Bay. Modern-day erosion causes the large sandstone blocks to tumble into the reservoir. Photograph courtesy of Cory Reeves.

INTRODUCTION

Keyhole State Park, home to Keyhole Reservoir, is in the Black Hills region of northeastern Wyoming. The rocks in and around the park record more than 150 million years of Earth history and preserve evidence of a large inland seaway that once covered much of the state.

GEOLOGIC HISTORY

More than 100 million years ago, during a geologic timespan known as the Cretaceous Period, the North American plate deformed as the Farallon plate subducted under the continent. This created a low-lying area that stretched from Canada to Mexico, and from what is now Wyoming east through the Great Plains. Sea level also began rising around this same time, and ocean water flooded onto the continent over millions of years, forming an inland sea.

Geologists named this ancient sea the Western Interior Seaway, and at its largest, it connected the Arctic Ocean to the Gulf of Mexico. As sea level rose and fell through time, the Keyhole State Park area alternated between being beneath and above water. The variety of rocks now exposed along the shore of Keyhole Reservoir are remnants of this sea level fluctuation. About 70 million years ago, near the end of the Cretaceous Period, the seaway began retreating toward the edges of the continent, and the modern-day Rocky Mountains began to form.

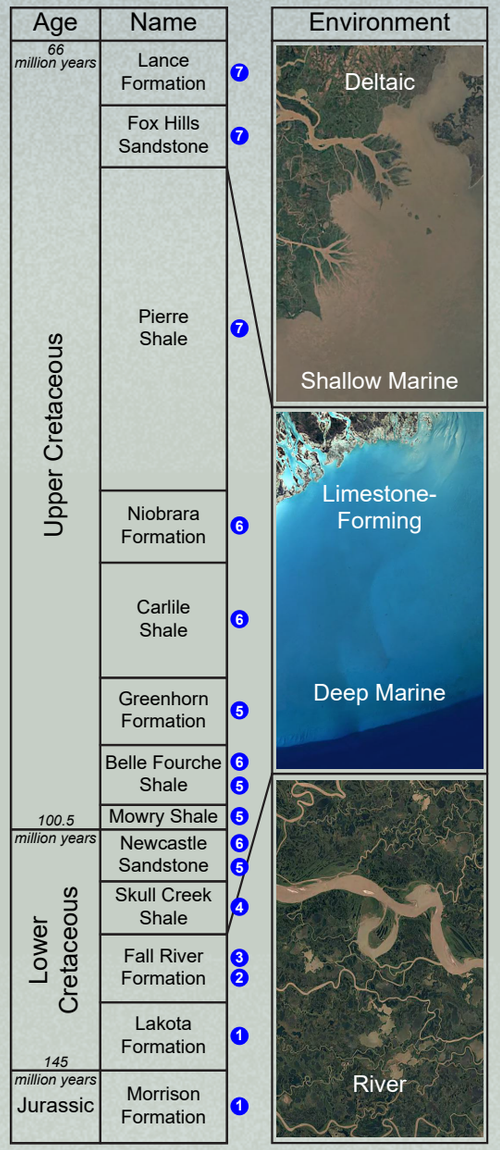
The Rocky Mountains, including the Black Hills, developed during a mountain-building event known as the Laramide orogeny, which faulted, folded, and tilted the originally flat-lying rocks in the park. This event exposed older strata near the eastern end of the reservoir and younger strata near the reservoir inlet. Two major folds—the arch-shaped Pine Ridge Anticline and the step-like Black Hills Monocline—are visible between the dam and inlet.

THE ROCKS OF KEYHOLE STATE PARK

When rock layers fold into the shape of an arch, the oldest layers are in the middle of the fold. The oldest rocks found in Keyhole State Park—the Morrison and Lakota formations—are in the core of the Pine Ridge Anticline (1 on the geologic map and geologic column). These formations existed before the Western Interior Seaway and were formed by ancient rivers that coursed across the landscape 150 million years ago.

The large tan, blocky sandstone cliffs above the Lakota Formation near Coulter, Eggie Creek, Cottonwood, and Mule Creek bays (2,3) are part of the Fall River Formation. Shallow ocean waters deposited this sediment as the Western Interior Seaway moved into the region. As the seaway deepened, it left behind the dark-black Skull Creek Shale and light-gray Newcastle Sandstone that are now exposed in Mule Creek Bay (4).

Around Wind and Deep Creek bays (5, 6), the remnants of deep marine waters are preserved in the Mowry, Belle Fourche, and Carlile shales. As the Western Interior Seaway warmed, hard-shelled organisms like oysters and clams left behind the limestones of the Greenhorn and Niobrara formations found west of the bays. Limestone is a rock composed of calcium carbonate, the same material found in the shells of these organisms.



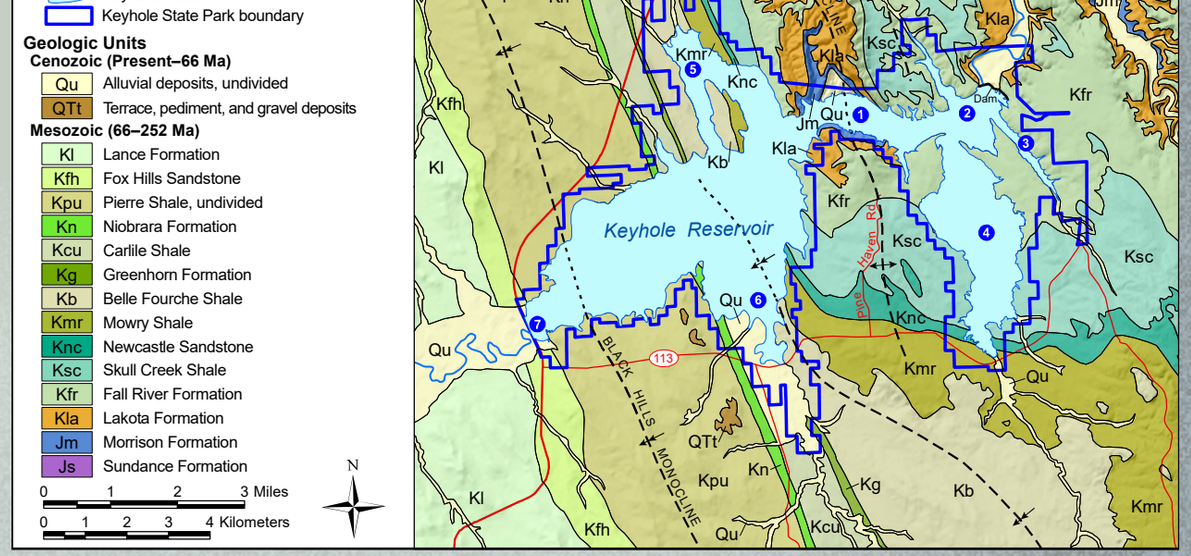
The geologic formations exposed in Keyhole State Park range in age from Jurassic (Morrison Formation) to Upper Cretaceous (Lance Formation). Blue circles with numbers correspond to locations described in the text and on the geologic map. Rivers deposited the oldest formations, later flooded by ocean waters of the Western Interior Seaway. The seaway retreated at the end of the Cretaceous, allowing shallow-water deltas and rivers to return to the area.

The Pierre Shale, exposed west of Wind Creek Bay near U.S. Highway 14 (7), records the deepest waters of the Western Interior Seaway. Much of the oil and gas exploration west of the park is in the Pierre Shale. The youngest rocks in the area—the Fox Hills Sandstone and Lance Formation—are exposed west of U.S. Highway 14. These formations record the retreat of the Western Interior Seaway across the continent and the early uplift of the Black Hills and modern-day Rocky Mountains.

HYDROGEOLOGY

Keyhole Reservoir sits behind an earthfill dam constructed in 1952 on the Belle Fourche River. The reservoir is the largest body of water in northeastern Wyoming, covering approximately 13,700 acres, or 85 percent of the park's area. Most of its water is from regional surface runoff.

Keyhole Reservoir and the local groundwater form an integrated hydrogeological system. This means water moves between aquifers and the reservoir through pore spaces between sand and mineral grains. Similar water levels in the reservoir and nearby groundwater wells are evidence of this integrated system. The Lakota and Fall River formations and the Newcastle Sandstone serve as important aquifers throughout northeastern Wyoming. Many wells completed in these formations provide water for irrigation and watering livestock.



Bedrock geologic map of Keyhole State Park. Age ranges of rock are in millions of years (Ma). Blue circles with numbers correspond to locations described in the text and in the geologic column.