Geology of Sinks Canyon State Park

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INTRODUCTION

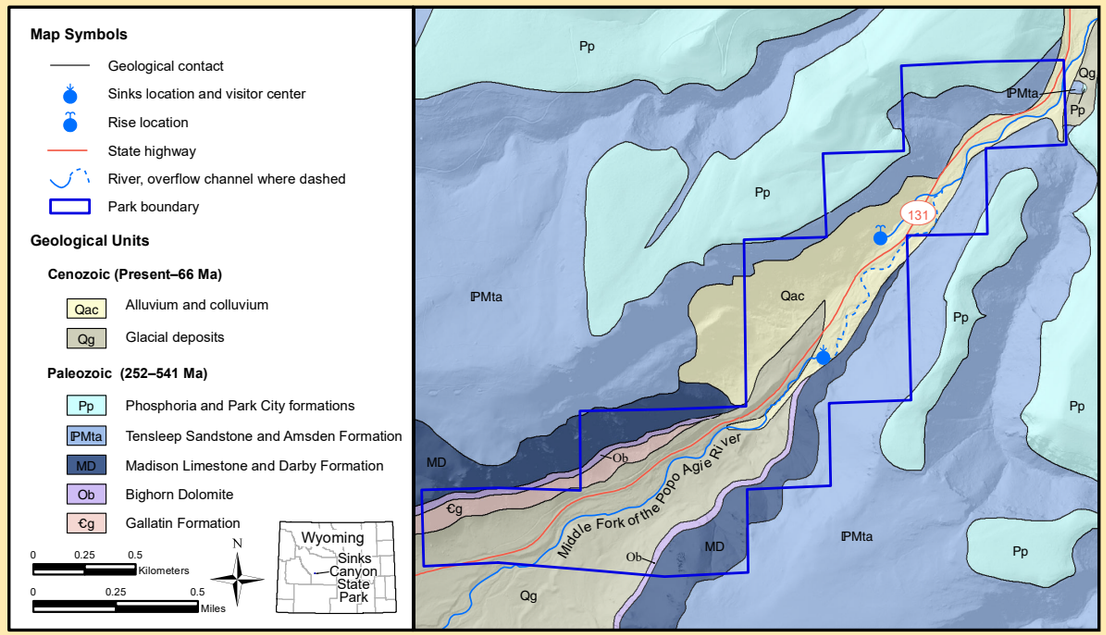
Sinks Canyon State Park is nestled on the eastern slope of the Wind River Range near the city of Lander. The park hosts a variety of interesting geologic features, from rock formations 500 to 280 million years old that formed from ancient seas and coastal sand dunes, to young glacial deposits. The highlight, however, is “the Sinks,” where the Middle Fork of the Popo Agie River disappears into a cavern only to reappear about a half mile down the canyon at “the Rise.”

GEOLOGIC HISTORY

Ancient Seas

Ancient seas covered this area for millions of years and formed many of the rock units exposed in the canyon. The oldest marine bedrock is the about 500-million-year-old Gallatin Formation—a mostly gray to tan limestone with conglomerates of limestone pebbles, plus a soft-gray to greenish shale. The Gallatin is visible in the western part of the park low on the valley walls, where it is mostly hidden beneath glacial deposits.

Above the Gallatin Formation is the 440-million-year-old Bighorn Dolomite, another marine unit. It is about 160 feet thick, can be white, gray, or pink, and weathers to chalky white. The dolomite forms the lower cliffs in the western portion of the park, and has fossils of corals and other sea creatures.



Simplified geologic map of Sinks Canyon State Park and its surroundings. Geologic unit ages are in millions of years (Ma).

Higher up the canyon walls is the hard-to-see, 20-foot-thick Devonian Darby Formation (about 390 million years old). The slope-forming Darby consists of tan crystalline dolomite with lenses of white sandstones.

One of the most prominent rock units in the park is the Madison Limestone (345 million years old), which forms the 400-foot cliffs that tower above the heart of Sinks Canyon. The lower part of the Madison is a bluish-gray to gray limestone with cherty layers. The upper part of the Madison is a gray, tan, and yellowish-tan dolomite and limestone, which contains many caves and fractures. Several beds of the Madison contain fossils, such as brachiopods, that reflect deposition in an ocean environment.

Above the Madison Limestone is the Amsden Formation (370 million years old), which forms a reddish slope about 150 feet thick. In the western part of the park, it is above the Madison cliffs and is visible farther down the valley, where it makes up the red slope seen below the Tensleep Sandstone cliffs.

The Tensleep Sandstone forms whitish cliffs across the road from the visitor center. This 300-million-year-old sandstone formed in a near coastal environment, where huge ancient dunes were preserved, now visible as sloping lines in the rock called cross-beds.

Mountain Building

The rocks exposed in Sinks Canyon were uplifted and deformed during the Laramide orogeny (orogeny means “mountain” and “origin”), which occurred around 75 million years ago. This mountain-building event uplifted the Wind River Range above the surrounding basins such that rocks in the interior of the range are now up to 45,000 feet higher than equivalent rocks buried deep in the Green River Basin to the west. The layers of sedimentary rock visible in the park have mostly been eroded from the high peaks of the Wind River Range, which has a core of metamorphic and igneous rocks up to 2.7 billion years old. Along the eastern flank of the range, in locations like Sinks Canyon, the east-dipping sedimentary rocks are still preserved and provide evidence for the folding and tilting that accompanied Laramide mountain building.

In the western part of the park, the Madison/Darby Limestone (M/D) tops the cliff (top photo). Traveling on the highway toward Lander, the Madison Limestone descends the canyon to the Sinks. From the visitor center, the Tensleep Sandstone (T) is at the top of the cliff (middle photo). At the Sawmill Campground, the Tensleep comprises the cliffs across the highway (bottom photo).

Glaciers

In the last two million years, glaciers formed in the high peaks of the Wind River Range. The glaciers flowed slowly from the mountains into lower-elevation canyons, scouring the land surface and collecting large amounts of sediment. The sediment inside and on top of the ice flowed down the valley as the glacier moved, and large, hummocky mounds of glacial debris called terminal moraines were deposited at the lowest end of the glacier. These moraines are composed of unsorted, rubbly deposits of boulders, sand, silt, and clay known as glacial till. The Canyon Loop Trail, across the river from the Popo Agie Campground, traverses glacial till. A terminal moraine from the second-to-last, or “Bull Lake,” glaciation is near the Sawmill Campground. At the Sinks lies the terminal moraine of the “Pinedale” glaciation, the most recent widespread glacial episode in the Rocky Mountains. In and around Sinks Canyon, moraines of the Bull Lake glaciation have been dated to 163,000–93,000 years old, and moraines the Pinedale glaciation have been dated to 22,000–19,000 years old.

HYDROGEOLOGY

The most dramatic feature of Sinks Canyon State Park is the place where the Middle Fork of the Popo Agie River vanishes underground. It enters a cavern in the Madison Limestone at the Sinks and reappears at the Rise. The river’s course from the Sinks to the Rise remains a bit of a mystery. How does it travel through the rock? Limestone units, like the Madison, often dissolve to form caves. Is there a single cave that connects the Sinks and the Rise? To study the river’s underground pathway in the park, scientists added an ecologically safe dye to the river above the Sinks. The dye resurfaced at the Rise, confirming the connection, but the dye took 2–8 hours to move underground from the Sinks to the Rise—a straight-line distance of less than a half mile. Thus, the water in the cavern takes far longer to flow underground than it would take to flow on the surface. This difference in time suggests a twisting underground path through caves and fractures. In addition, the volume of water coming out of the Rise is greater than the water entering the Sinks, indicating that other sources of water join this underground system.

The Middle Fork of the Popo Agie River emerges at the Rise and flows northeast into the Wind River Basin.

Outside the Sinks, the Middle Fork of the Popo Agie River is a spectacular agent of erosion and deposition. In some areas, rapid waters have carried away glacial clays, silts, and sands to leave behind only cobbles and boulders, as seen by the enormous rocks in and along the riverbed. The more powerfully the river is flowing, the larger the boulders it can carry. By the time it reaches the lower river valley of the park, the river has dropped the large boulders and cobbles and is transporting mainly sands and silts. During the spring snowmelt, the Middle Fork of the Popo Agie River can run very high. Sometimes the river is so full, the Sinks cannot accept all of the water and excess water flows into a nearby surface overflow channel.