The Grand Canyon & Colorado River

Describe the events that formed the Grand Canyon.

As recently as the Cretaceous period one hundred million years ago, much of western North America was still part of the Pacific Ocean. Tectonic forces from the collision of the Farallon Plate with the North American Plate pushed up the Rocky Mountains between 50–75 million years ago in a mountain-building episode known as the Laramide Orogeny. The Colorado first formed as a west-flowing stream draining the southwestern portion of the range, and the uplift also diverted the Green River from its original course to the Mississippi River west towards the Colorado. Approximately 20–30 million years ago, volcanic activity related to the orogeny led to the Mid-Tertiary ignimbrite flare-up which created smaller formations such as the Chiricahua Mountains in Arizona, and deposited massive amounts of volcanic ash and debris over the watershed. The Colorado Plateau first began to rise during the Eocene, but did not attain its present height until about five million years ago, about when the Colorado River established its present course into the Gulf of California.

The exact nature in which the river's present course and the Grand Canyon were formed is uncertain. Before the Gulf of California was formed approximately 5–12 million years ago by faulting processes along the boundary of the North American and Pacific Plates, the Colorado flowed west to an outlet on the Pacific Ocean – possibly Monterey Bay on the Central California coast, forming the Monterey submarine canyon. The uplift of the Sierra Nevada mountains began about 4.5 million years ago, diverting the Colorado southwards towards the Gulf. As the Colorado Plateau rose between 2.5–5 million years ago, the river maintained its ancestral course (as an antecedent stream) and began to cut the Grand Canyon. Antecedence played a major part in shaping other peculiar geographic features in the watershed, including the Dolores River's bisection of Paradox Valley in Colorado and the Green River carving its way through the Uinta Mountains in Utah.

Sediments carried from the plateau by the Colorado River created a vast delta made of more than 10,000 cu mi (42,000 km3) of material that walled off the northernmost part of the gulf in approximately one million years. Cut off from the ocean, the portion of the gulf north of the delta eventually evaporated and formed the Salton Sink, which reached about 260 feet (79 m) below sea level.[79][80] Between then and now the river changed course into the Salton Sink at least three times, transforming it into Lake Cahuilla, which at maximum flooded up the valley to present-day Indio, California. The lake took about 50 years to evaporate after the Colorado resumed flowing to the Gulf. The present-day Salton Sea can be considered the most recent incarnation of Lake Cahuilla, though on a much smaller scale.

Between 1.8 million and 10,000 years ago, massive flows of basalt from the Uinkaret volcanic field in northern Arizona dammed the Colorado River within the Grand Canyon. At least thirteen lava dams were formed, the largest of which was more than 2,300 feet (700 m) high, backing the river up for nearly 500 miles (800 km) to present-day Moab, Utah. The lack of associated sediment deposits along this stretch of the Colorado River, which would have accumulated in the impounded lakes over time, suggests that most of these dams did not survive for more than a few decades before collapsing or being washed away. Failure of the lava dams caused by erosion, leaks and cavitation caused catastrophic flooding which may have been some of the largest ever to occur in North America, rivaling the ice age Missoula Floods of the northwestern
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United States. Mapping of flood deposits indicate that crests as high as 700 feet (210 m) passed through the Grand Canyon, reaching peak discharges as great as 17 million cubic feet per second (500,000 m³/s).

Describe the route of the Colorado River. What does Colorado mean?

Colorado is a Spanish word meaning red-colored. The Colorado River is the principal river of the southwestern United States and northwest Mexico. The 1,450-mile river drains an expansive, arid watershed that encompasses parts of seven U.S. and two Mexican states. Rising in the central Rocky Mountains in the U.S., the river flows generally southwest across the Colorado Plateau before reaching Lake Mead on the Arizona–Nevada line, where it turns south towards the international border. After entering Mexico, the Colorado forms a large delta, emptying into the Gulf of California between Baja California and Sonora.

The Colorado rises at La Poudre Pass east of the Never Summer Mountains in the Colorado Rockies, about 60 miles northwest of Denver. The river runs south before turning west below Grand Lake, the largest natural lake in the state. After passing Kremmling it cuts a series of narrow canyons, including Gore, Glenwood, and De Beque. The Colorado emerges from the mountains at the Grand Valley, where it is joined by the Gunnison River before arcing northwest into desert Utah. Carving its way southwest across the Colorado Plateau, the Colorado forms Cataract Canyon and other gorges and receives its principal tributary, the Green River, before flowing into Lake Powell, a reservoir formed by the Glen Canyon Dam in Arizona nearly 200 miles (320 km) downstream.

The Colorado passes Lee's Ferry in Arizona, the official dividing point of the Upper and Lower Colorado River Basins, before swinging south then west through the Grand Canyon. Below Lake Mead – the largest man-made lake in the U.S., formed by Hoover Dam at the junction of Arizona, Nevada, and Utah – the river turns sharply south. As it enters the Lower Colorado River Valley the Colorado delineates much of the Arizona–Nevada border, the entirety of the Arizona–California border, and is impounded by a series of dams, including Imperial Dam, where most of its flow is diverted into the All-American Canal to irrigate the Imperial Valley in California.

Below the confluence with the Gila River the Colorado forms a short stretch of the Mexico–United States border before passing entirely into Mexico. It empties into the Gulf of California via a large estuary, the Colorado River Delta, roughly 75 miles (121 km) south of Yuma, Arizona.

With its headwaters at 10,184 feet (3,104 m), the Colorado River loses nearly two miles in elevation by the time it reaches the Gulf. Most of the Colorado above Lake Mead is a swift-moving whitewater river, with the exception of the region around Grand Junction, Colorado, where it exhibits braided characteristics, and the marshy Kawuneeche Valley near the headwaters. The lower river between Hoover Dam and the international border is generally a slow-moving, meandering stream. Much of the upper Colorado ranges from 200 to 500 feet (61 to 150 m) wide, compared with 500 to 1,000 feet (150 to 300 m) for the lower river, with an average depth of 10 to 30 feet (3.0 to 9.1 m). Some parts of the river are as shallow as 2 to 8 feet (0.61 to 2.4 m) in the lower course in dewatered sections near Yuma, and one notable section in the Grand Canyon reaches up to 110 feet (34 m) in depth.
Joseph C. Ives, who surveyed the lower river in 1861, wrote that "the shifting of the channel, the banks, the islands, the bars is so continual and rapid that a detailed description, derived from the experiences of one trip, would be found incorrect, not only during the subsequent year, but perhaps in the course of a week, or even a day." The delta and estuary of the Colorado River were once also subjected to a major tidal bore that has almost disappeared with reductions in river flow and some dredging of the estuary channel. The first historical record of the tidal bore was that made by the Croatian missionary in Spanish service Father Ferdinand Konščak on 18 July 1746. During spring tide conditions, the tidal bore formed in the estuary about Montague Island in Baja California and propagated upstream. It was locally called El Burro or burro.