YELL 264

A GEOLOGY OUTLINE OF YELLOWSTONE NATIONAL PARK

Many events have shaped the Yellowstone we see today, and the land is still changing. The following is an outline of some of the significant geological events which have occurred in the area known as Yellowstone National Park. This will help you to understand what forces have shaped the park's landscape and why there is such an abundance of geothermal activity here.

2.7 BILLION YEARS AGO: The oldest rocks known in Yellowstone were formed. These Precambrian gneisses and schists are exposed in parts of the Gallatin Mountain Range.

570 MILLION YEARS AGO: A 2.1 billion year gap exists between the Precambrian rocks and this time. Probably some uplifting occurred during this period, and a great deal of erosion took place. At this time, the area that is Yellowstone was basically a featureless plain. What rocks are known from this time period may be found on Buffalo Plateau in the north central part of the park.

570 TO 75 MILLION YEARS AGO: For about 500 million years (from Cambrian to the Cretaceous periods), Yellowstone was periodically flooded by shallow seas that covered much of what is the western United States. Many sedimentary rocks found in Yellowstone were formed as deposits in these seas (sandstone, shale, limestone, dolomite, and various "formations" which combine types of rocks). Based on the fossil record, it appears that seas advanced and retreated at least one dozen times in the Yellowstone area. Rocks from this time may be found on Mount Everts, the Gallatin Mountains, and around the Snake River.

75 MILLION YEARS AGO: Tha Laramide Orogeny began about this time, lasting about 20 million years. Major crustal movements took place in Yellowstone and throughout the Rocky Mountain area as mountain building occurred. Anticlines, synclines, and various faults date from this period. The crustal movements probably helped to lead to the volcanic events which came later. Uplifting movements during the orogeny changed stream courses and increased erosion.

55 to 50 MILLION YEARS AGO: Several large volcanoes erupted in and near Yellowstone. Volcanic rocks from eruptions of the Absaroka and Washburn ranges now cover part of the Gallatin Mountains as well as other areas of Yellowstone. Both intrusive and extrusive rocks date from this time, including lava, ash, pumice, rhyolite, andesite, basalt, and breccia. Some eruptions were "quiet" lava flows; others were violent. Heavy rainfall at this time also caused some known mudflows and landslides. The timing of these varied eruptions resulted in the petrified tree specimens found in the park on Specimen Ridge and the Gallatin Mountains. Probably several hundred years passed between eruptions.

50 TO 40 MILLION YEARS AGO: Erupting Absaroka volcanoes buried most of Yellowstone under thousands of feet of lava, breccia, and ash. This extensive deposition turned Yellowstone into a plateau with just a few volcanic peaks towering above it and sluggish streams cutting through it. Yellowstone was probably not as high above sea level then as it is today. Based on the fossil record, Yellowstone's climate was warm, almost subtropical.

40 TO 10 MILLION YEARS AGO: There are no examples in the park from the period between the Absaroka volcanoes and this time. Some rocks dating from this gap can be found south of the park. In Yellowstone, rocks from this time period were probably eroded away.

10 MILLION YEARS AGO: Another period of uplift occurred. The Teton and Gallatin mountain ranges were uplifted thousands of feet, increasing drainage and erosion throughout this area. As the uplift went on, Yellowstone was characterized by sharply defined canyons, mountains, and tablelands.

3 TO 2 MILLION YEARS AGO: Magma had been building up for some time in two chambers under Yellowstone. About two million years ago a first eruption from these chambers occurred. Much of the huge caldera caused by this eruption was obliterated by a later eruption that occurred 600,000 years ago. The removal of so much magma caused the two chambers to collapse around a ring fracture zone, leaving the second caldera several thousand feet deep and many miles in diameter. This caldera was roughly bounded by the Washburn Range, Absaroka Range, Flat Mountain, the Red Mountains, and the Madison Junction bluffs. A third caldera eruption took place between 200,000 and 125,000 years ago in what is now the West Thumb of Yellowstone Lake. This caldera within a caldera measures four miles wide and six miles long. Dust and ash from the caldera eruptions filled Yellowstone's lowlands. Only peaks as high as Bunsen Peak stood above the ash (which settled into a "welded tuff").

Molten lava continued to flow from the two magma chambers, with much of the lava filling in the caldera but some running over the rim. Lava flows of rhyolite now compose some park plateaus, such as the Madison Plateau; a few lava flows were basaltic, such as the columns found along the Yellowstone River near Tower Fall. Obsidian Cliff was also formed at this time, but it derived from a lava flow outside the caldera area. The last of the lava flows took place about 60,000 years ago.

300,000 TO 8,000 YEARS AGO: Three periods of glaciation took place in Yellowstone. The "Pre-Bull Lake" glaciation lasted from about 300,000 to 180,000 years ago; the "Bull Lake" glaciation lasted from 125,000 to 45,000 years ago. As the previous entry indicates, these glaciers were in Yellowstone at the same time lava was flowing in parts of the park.

The "Pinedale" glaciation lasted from 25,000 to about 8,000 years ago. This glacial period is better known than the previous two. In fact, it obscured much of the change that the previous two had caused. Icefields from the Absaroka and Gallatin ranges as well as from mountains north of the park contributed to the Pinedale glaciers covering Yellowstone. Glacier ice built up to as much as 3,000 feet thick (over the Lake Basin) within the park. Only the west edge of the park and the highest ridges escaped being glaciated. As ice and rock, the glaciers gouged and smoothed the topography. As they melted, glaciers left behind moraines and boulder erratics, especially in the lower Lamar Valley. Streams and lakes developed from glacial meltwater, causing erosion and redistribution of sediments. Although some snowfields exist year-round in the park, there are presently no glaciers in Yellowstone. A few glaciers can still be found in the Teton and Wind River ranges.

THE PRESENT TIME: Features which probably attract some visitors to Yellowstone-the Grand Canyon of the Yellowstone River, geothermal features, waterfalls, rivers, and lakes-resulted from geological processes still happening today. Yellowstone has more geysers, mud pots, hot springs, and fumaroles than any other place in the world. Long-term erosion is exemplified on a grand scale by the Grand Canyon of the Yellowstone and the park's numerous waterfalls. Because many faults are located in Yellowstone, earthquakes regularly occur here. Most earthquakes are not readily noticeable. However, in 1959 a powerful earthquake (7.8 on the Richter Scale) was centered just outside the park to the west; it triggered landslides and caused radical behavior in geysers within the park.

Suggested reading:

The Roadside Geology of Yellowstone Country by William Fritz
Interpreting the Landscape of Grand Teton and Yellowstone National Parks by John Good and Kenneth Pierce
The Geologic Story of Yellowstone National Park by W.R. Keefer