

# 1. THE COLORADO PLATEAU

## GENERAL FEATURES

The geology of the United States has been divided into a number of geographical provinces based on structure and perceived geologic history. Much of the area to be considered in this guide is in what is known as the Colorado Plateau Geological Province. This plateau radiates out from the Four Corners region, the only place in the United States where you can stand on four different states at the same time. It covers major portions of Utah, Arizona, Colorado and New Mexico. The Plateau is not named after the State of Colorado, but after the Colorado River, which courses from the northeast to the southwest of this region.

The varied topography of the Colorado Plateau exposes many easily recognizable, widely distributed and distinctive rock formations. The Plateau is surrounded by major regions of volcanic activity including the high plateaus of central Utah, the San Francisco Mountains of central Arizona, the Datil region of western New Mexico, and the San Juan Mountains of southwestern Colorado. The Colorado Plateau itself is dominated by smaller plateaus, mesas, and buttes that expose a rich array of sedimentary rocks. Volcanic peaks and mountains formed by the intrusion of molten rock between the sedimentary layers can be seen here and there; some form mushroom-shaped bodies called lacoliths. The La Salle, Abajo, Ute, and Carrizo Mountains around the Four Corners area are all such mountains. In the more central part of Utah are the Henry Mountains, where G. K. Gilbert first described and named the lacolith intrusion feature. Other intrusions of molten rock include several well-known residual volcanic necks such as Shiprock, and Cabazon Peak in New Mexico.

The Grand Canyon is one of the most instructive and intriguing features of the Colorado Plateau. The Canyon cuts right through a broad uplifted area with the Kaibab Plateau to the north and the Coconino Plateau to the south. It exposes the Paleozoic layers of the region as well as Precambrian sedimentary, igneous and metamorphic rocks (consult the Glossary, Rock Classification, and the Geologic Column at the end of this guide for explanations of these terms).

## THE STANDARD, SLOW, LONG-AGES INTERPRETATION OF THE GEOLOGIC HISTORY OF THE COLORADO PLATEAU

The account begins with the low Precambrian (see Geologic Column in the Reference section at the end of this guide for location in column) rocks which can be seen in the depths of the Grand Canyon. Here rocks of various types, assumed to be in the billion year range, are free of all but the simplest kinds of fossils, and the rare, often poorly preserved examples have sometimes been reinterpreted as not being fossils at all. Rocks that have been metamorphosed by heat and/or pressure can also be seen in the form of dark schists (see: Introduction to Introductory Petrology: The Five Minute Rock Course in the reference section in back for explanation of what a schist is). Thick Precambrian layers of sedimentary deposits are seen especially in the eastern end of the Grand Canyon

and there are Precambrian intrusions of molten rock magma into both the metamorphic and sedimentary rocks of the region. All of this suggests a harsh environment devoid of most of the life forms we are familiar with.

The Precambrian period was followed by a time (Cambrian to Mississippian, 550 to 300 million years ago) during which the Colorado Plateau was mainly an ocean, providing a rich marine environment. The deposits we now see are widespread layers of limestone and shale with marine fossils which are locally abundant. Following this period several parts of the Colorado Plateau were moderately uplifted. This facilitated their erosion into the lower sedimentary basins between. This was followed by a period when many of the colorful, bright red or green, iron rich deposits of the region were laid down. This period, which lasted from Permian up to the Jurassic (consult your geologic stratigraphic column in the Reference section), is thought to have lasted around 180 million years.

Subsequently uplifts in the east and west served as sources of sediments for the plateau area, which had broad north-south marine troughs in the middle. This combination of factors, which lasted through the Cretaceous (about 70 million years ago) produced wide-spread interfingering marine and land types of deposits. Much of the coal of the region is found in these layers.

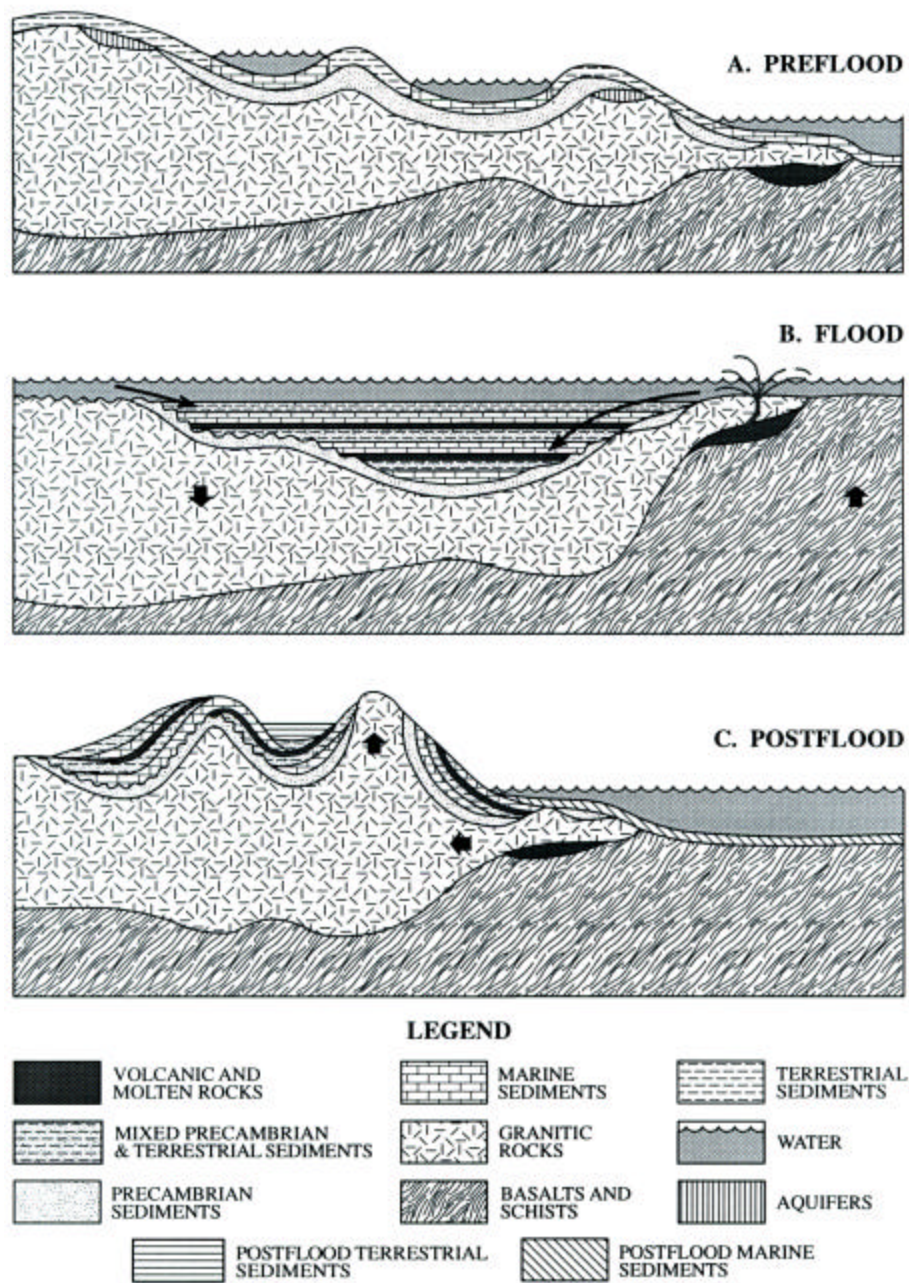
A major uplift of the Colorado Plateau, of as much as 3 to 5 kilometers, took place in the late Cretaceous to early Tertiary. This uplift, called the Laramide Orogeny, dramatically modified the landscape. The Grand Canyon region was probably also uplifted at that time and other plateaus and basins were delineated by these events. Many of the notable elongated monoclines of the region, such as Capitol Reef, were formed then. The more recent events include volcanic activity, especially around the edges of the Plateau. The abundant faulting which characterizes the Basin and Range Province which is found to the south and west of the Colorado Plateau had little effect on the Colorado Plateau itself. The faulting did produce major features such as the Rio Grande Rift to the southeast, which cradles the Rio Grande River on its way to the Gulf of Mexico.

Evidence for slow geologic changes, evolutionary time requirements, and radiometric dating are used to support this long ages model.

## **A CREATION-FLOOD PERSPECTIVE**

The following is an example of the history of the Colorado Plateau within the context of the Biblical historical record. It is subject to revision as new information is assimilated.

The Precambrian rocks seen in the deepest rocks of the Grand Canyon represent the geological history of the Earth before the flood and possibly before the six days of creation described in Genesis. This is the Earth “without form and void” of Genesis 1:2, which is dark and covered with water (see



**FIGURE 1.** An example of a flood model. The diagrams represent cross sections of part of a continent and an ocean before, during, and after the Genesis Flood.

also Job 38:9 and II Peter 3:5). Intrusions of molten rock magma, metamorphism of rocks, and the formation of sedimentary layers, would take place before the light appears on the first day of creation week. The microscopic fossils found in these rocks represent microbial life that has infiltrated after the creation of life during creation week. Infiltration could occur before, during, or after the Genesis flood.

The Cambrian through Mississippian layers, with many marine fossils, represent in its lowest parts an epiherc sea over part of a continent. As the continents sank down and the ocean floor rose up to bring about the Genesis flood (Fig. 1) marine deposits and organisms were transported from preflood seas to the continents to form the extensive lower Paleozoic marine layers of the region.

Erosion of the lower land areas of the preflood continents would bring about deposition of Upper Paleozoic land-derived (terrestrial) sediments and organisms. The sedimentary layers of the Plateau alternate many times between marine and land-derived sources as one ascends the geologic column of the area. This would have been brought about by alternation of land and ocean sources for the sediments (Fig. 1B). Erosion of the land-derived source areas would reach well down into uplifted Precambrian sediments. Towards the end of the flood, there would be an abundance of fine sediments suspended in the flood waters. These would serve as a source for the abundant shales found in the region near the top of the geologic column.

As is the case for the long geologic ages model, there would be local uplifts here and there, and there would be the major Laramide Uplift of the Plateau during the late Cretaceous and early Tertiary part of the geologic column. As the continents rose towards the end of the flood, the receding waters which covered the Earth would erode major portions of the flood sediments, leaving great denuded areas and smaller eroded canyons, such as those seen around Bryce, Zion, and the Grand Canyon. The major flood events would have taken about one year, but the lingering effects of this major catastrophe would have lasted for many centuries or for millennia thereafter.

The above is presented only as a suggestion. Several alternative flood models have been proposed. Never-the-less, regardless of the flood model being considered, a significant number of geologic features are difficult to explain if one adopts the usual explanations of billions of years for the formation of the crust of the Earth. Some of these features will be discussed in the following pages.