Geography of Big Bend National Park, Texas

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Abstract

The geologic features of Big Bend National Park formed over 500 million years of repeating cycles of mountain building, rifting, faulting and folding, basin creation, and volcanism. The oldest formation in the park are from the Paleozoic era while the youngest are of sedimentary alluvial deposits of the Pleistocene epoch. The Marathon orogeny and the Laramide fold helped to lift the Chisos Mountains to their great elevations.

Introduction

The National Park Service calls Big Bend National Park, "one of the outstanding geological laboratories and classrooms of the world," and it isn't hard to see why. With a geologic history spanning over 500 million years, Big Bend National Park has a lot to offer. In 1933, the Texas legislature inaugurated fifteen sections of land in Brewster County along the Rio Grande. The National Park Service recommended the establishment of the area as a national park in January of 1934. The park then opened to the public in 1944 and by 1972 had grown to 1250 square miles (figure 1) (Jameson 2010). The Rio Grande serves as a 107-mile-long border between Texas and Mexico (Big Bend National Park).

Figure 1. Map showing important landmarks and boundaries of Big Bend National Park (USGS 2017).

Geological History

Big Bend National Park's geologic history begins in the Paleozoic era where a deep-ocean trough extended from present-day Arkansas and Oklahoma down through the Big Bend region. This ocean trough allowed for sandstone and shale layers to cover the region (Big Bend National Park). During this same time, a continental collision between Laurentia and Gondwana occurred. The Ouachita Mountains are a byproduct of the mountains building orogeny known as the Marathon orogeny as a direct result of the continental collision (Page et al, 2008). Only the roots of these mountains are visible due to erosion, and they can be observed near Persimmon Gap within the park (National Park Service, 2015). Remnants of these mountains are characterized by northwest-directed thrust faults and outcrop belts containing Paleozoic rocks (Page et al, 2008). The rock formations found in this area are of the Middle Ordovician to Pennsylvanian age. Maravillas Formation, Caballos Novaculite, both are deep-water basinal rocks, and the deep-water shale and sandstone Tesnus Formation (Page et al, 2008).

As rifting occurred in the Cretaceous Period, the Gulf of Mexico opened and the area of Big Bend National Park saw warm shallow marine waters. With these waters came sediments of limestone and shale creating the Glenrose Formation (Neal and Neal, 1996). Inside of these sediments there are remains of sea dwelling organism such as clams and snails (Big Bend National Park). As sea levels rose and fell, additional sediments were deposited on top of the Glenrose Formation. The Del Carmen Limestone, Sue Peaks Limestone, Santa Elena Limestone, Del Rio Clay, Buda Limestone, and Boquillas Formation all suggest the regression and transgression of the marine waters (Neal and Neal ,1996). Within the Sierra del Carmen-Santiago Mountains, Nine Point Mesa, Mariscal Mountain and Mesa de Anguila you can see these formations, noted in figure 1.1 (Page et al., 2008).

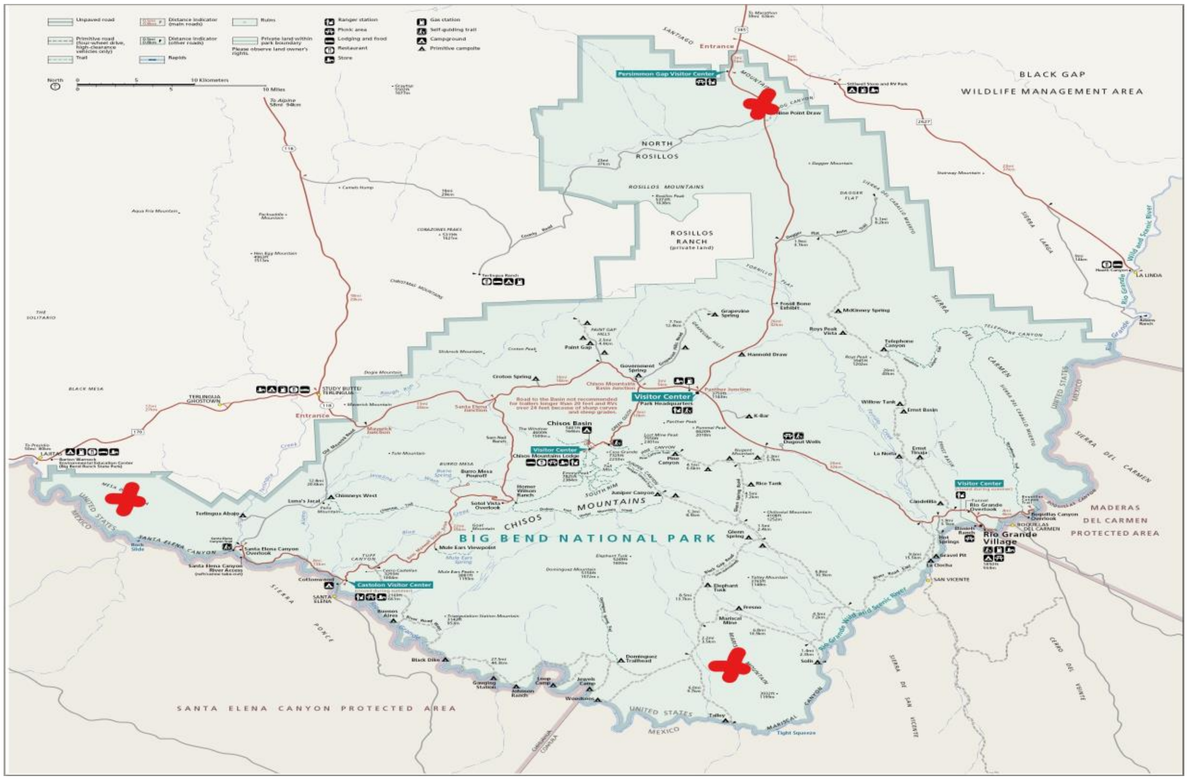

Figure 1.1. Big Bend National Park Identifying; Nine Point Mesa, Marscal Mountain, and Mesa de Anguila (National Park Service).

In the Late Cretaceous Period, there is a significant shift from marine to continental deposition and the Cretaceous Sea retreated into the Gulf of Mexico. This is obvious in the Aguja and Javalina Formations (Page et al. 2008). In these formations, we see the fossils of oysters, giant clams, ammonites, fish and even crocodiles (Big Bend National Park). This would be the last time this area would see a marine environment.

As the Earth began to warm up in the Paleocene epoch, the Big Bend National Park area shifted into a dry arid environment. This also began a very active tectonic period in the Parks history. As the Pacific plate was subducting under the North American plate, the Laramide fold and belt thrust affects were felt in the area. In the southwest of the park, Mesa de Anguila is an uplifted monocline and the Sierra del Carmen-Santiago Mountains to the east are both uplifted and associated with thrust-faulting (Page et al., 2008). Tornillo Basin sits between the two uplifted monoclines. The basin fill around these mountains are known as the Black Peaks and Hannold Hill Formations and are composed of mostly sandstone and clay sediments. The Canoe Formation overlays these formations.

Volcanic activity begins in the Mid to Late Eocene and is a result of the shallow subduction of the Farallon plate on the western margin of the North American continent. The Chisos Group of rocks is the oldest volcanic rock in the park. There are mafic lava flows, silicic ash-fall, and ash-flow tuffs in the southwest area of the park. These rocks are south and west of the Pine Canyon caldera complex (Page et al., 2008). The rocks from this complex are known as the South Rim Formation and are mostly preserved on the high Chisos Mountains. This caldera complex elevated the Chisos Mountains to their current elevation during the Oligocene epoch (figure 2).

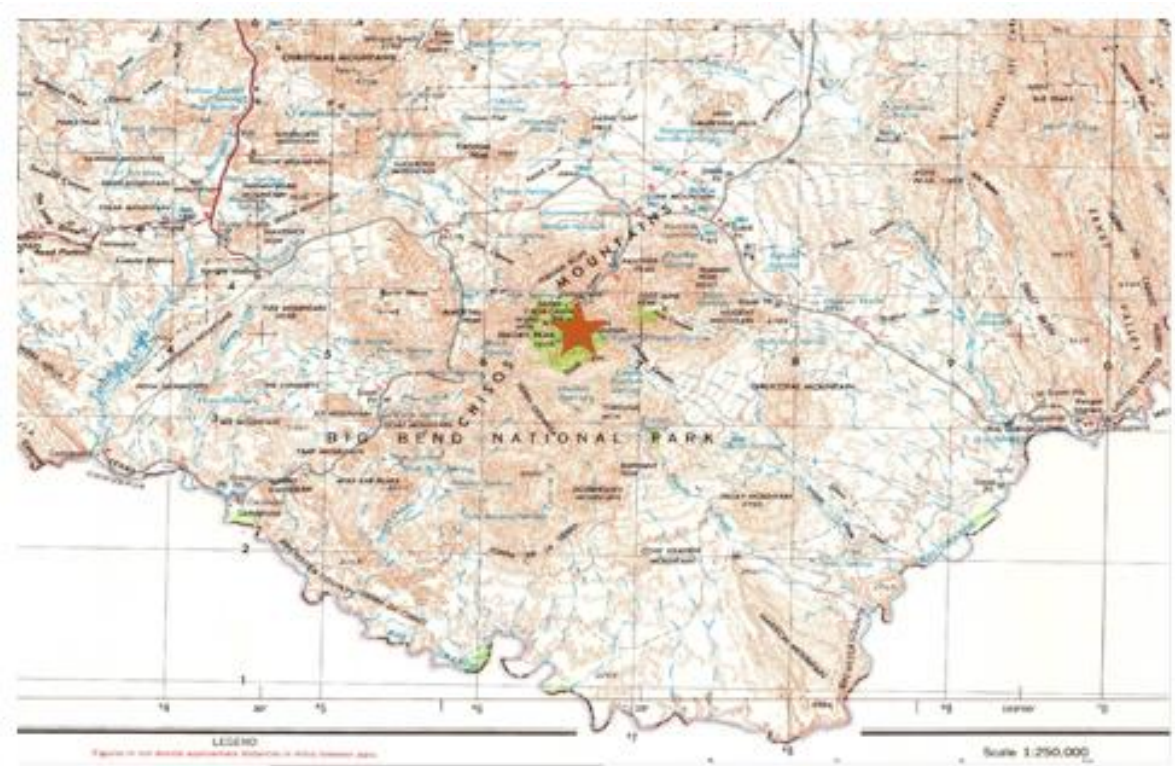

Figure 2. Topographic map of Big Bend National Park highlighting Chisos Mountain caldera complex (USGS 1959).

As faulting and volcanic activity died out in the Pleistocene, extensive erosion, down-cutting and aggradation took over. Sediments from the Big Bend National Park basin flow into the Rio Grande river as well as out to the Gulf of Mexico (Page et al., 2008). You can see in figure 3 that the park consists of mostly sedimentary rocks with volcanic rocks and intrusive bodies showing a rich volcanic history.

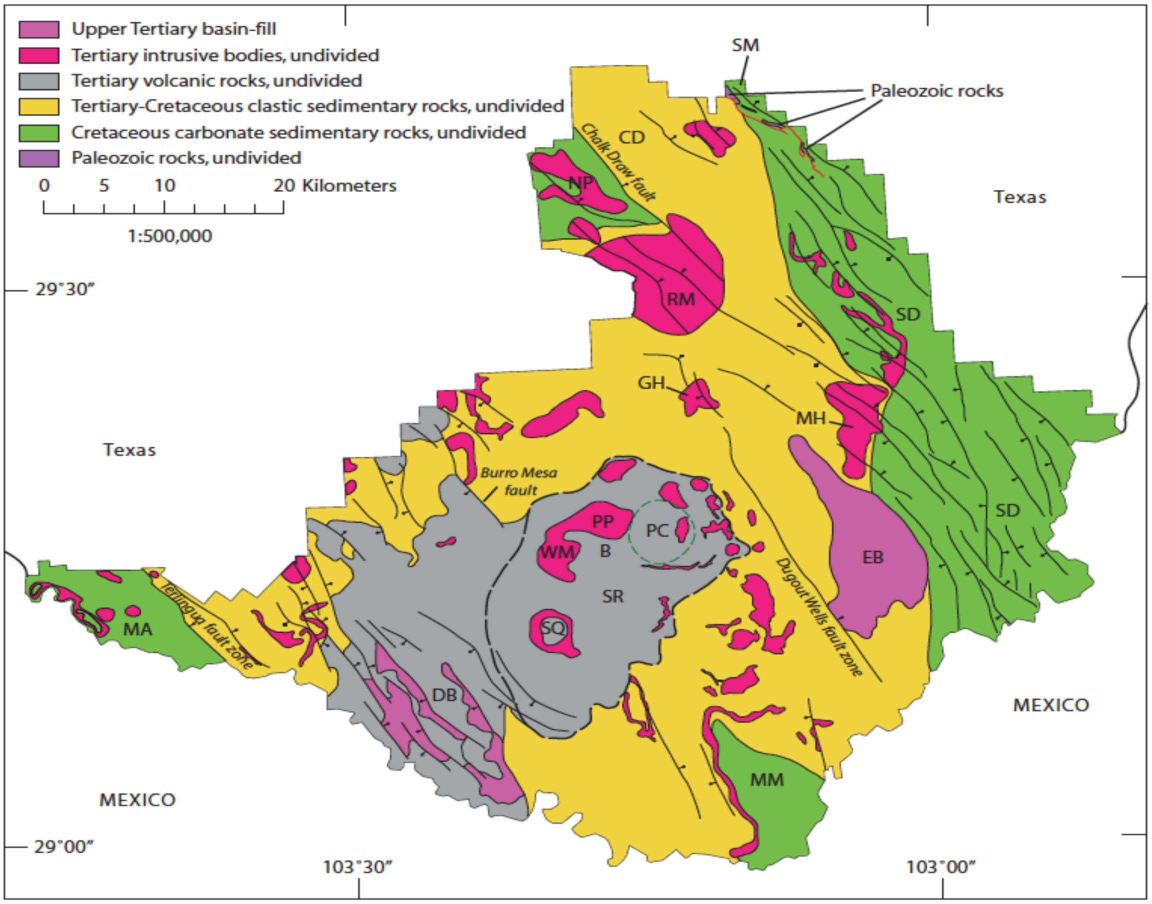

Figure 3. Geologic map of Big Bend National Park (Page et al. 2008).

The Florida Connection

The same collision that brought Laurasia and Gondwana together to form Big Bend National Park, also brought Florida close to its current location. The Florida basement was originally part of Gondwana, not Laurasia as most of present day North America was part of. The same rifting that occurred in the Cretaceous period that pulled apart Pangea, causing the area that is now Big Bend National park to become a shallow marine environment, brought evaporate minerals from the rich sea waters to the Gulf of Mexico. These evaporate minerals along with sediments being carried south from the Appalachian Mountains created the topography we see in Florida.

Conclusion

Big Bend National Park has a rich geologic history that spans three geologic eras. Marine waters, both deep and shallow, facilitated the creation of fourteen rock formations that are found throughout the park. Major episodes of volcanism, deposition, and erosion in the park to help create the geologic paradise it is today.

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