

BRIEF GUIDE TO GEOLOGY OF NEW MEXICO

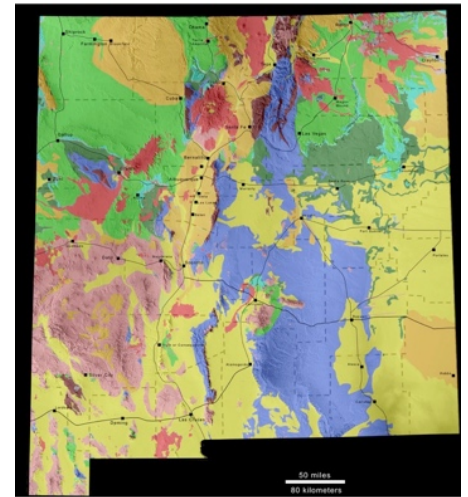
- The rocks of New Mexico represent a time period and the environment in which they were formed. They are “time capsules” that tell us about the long geologic history of our state.
- The landscapes of New Mexico, mountains, mesas, buttes and rivers, also represents a time period and the geologic processes by which they were formed. The landscape in New Mexico is young and dynamic and tells us about the more recent geologic history of our state.
- “Reading the record” of both the rocks and the landscape provides a complete picture.

New Mexico’s Rocks and Geologic History

Precambrian (4.6 billion to 542 million years ago – the early evolution of Earth and life)

- The oldest rocks found in New Mexico are granite and metamorphic rocks from the **Proterozoic**, about 1.8 to 1.0 billion years ago.
- These rocks (*shown in brown on the map*) are visible today as the cores of mountain ranges such as the Sangre de Cristo, Sandia, and Zuni Mountains.
- In these rocks we have snapshots of a very distant past, when New Mexico experienced a range of geological processes similar to today, but much of happened has been lost due to erosion or metamorphism.

Geologic Map of NM



Paleozoic Era (542 to 251 million years ago – time of early life).

- During the Early Paleozoic, shallow seas covered southern New Mexico (south of Socorro), and the northern part of the state was mostly being eroded. During the Late Paleozoic, the seas covered New Mexico, filling basins between north-south trending mountain ranges that have since eroded completely away.
- The rocks deposited during the Paleozoic in New Mexico (*shown in blue on the map*) are mostly marine limestone, with some sandstone *Museum Paleozoic Mural*

deposited by sandy beaches. These rocks are found primarily in southern and eastern New Mexico, with just a few late Paleozoic rocks in the central part of the state. Today’s Guadalupe Mountains, near Carlsbad, are the skeleton of a gigantic ancient reef formed during this era.

Mesozoic Era (251 to 66 million years ago – time of dinosaurs)

- During the Triassic Period, New Mexico was a lowland river system.
- During the Jurassic Period, three successive environments included a great sand sea similar to today’s Sahara, a large salty inland sea, and warm tropical floodplains.
- Sea levels rose and fell and at times nearly covered New Mexico during the Cretaceous Period. Marine shale, limestone, and sandstone were deposited. Much of the Cretaceous shoreline swamp and forest vegetation has been transformed into the abundant coal and gas deposits found in northwestern New Mexico.

• The rocks of the Mesozoic Era are visible today as colorful layered sandstone, siltstone, shale, and limestone shaped by erosion into the mesas and buttes of northern New Mexico (*green and blue-green on the map*).



Museum Seacoast Exhibit



Museum Volcano Exhibit

Cenozoic Era (65.5 million years ago to the present – time of mammals)

- Between 35 and 25 million years ago, New Mexico was a place of large volcanoes as a broad wave of volcanism extended across western North America, probably due to a small tectonic plate that moved beneath the North American continent. Large volcanoes formed today's Mogollon Mountains, Datil Mountains, Black Range, Sierra Blanca and Shiprock (*shown in pink on the map*).

- About 20 million years ago, as the Pacific and North American tectonic plates began to move side by side, the entire Southwest began to pull apart into long north-south basins. These basins and parallel mountain ranges are known today as the "Basin and Range" and include part of southwestern and south-central New Mexico.

- At the same time, the Rio Grande rift began to form and create the landscape of the central north-south corridor of the state. The rocks of the rift include layers of young volcanic eruptions (*shown as red in the map above*) and sedimentary rocks (*shown as yellow or tan in the map*) deposited by the river and erosion from the mountains.

New Mexico's Landscape and Geologic History

- The topography and landscape of New Mexico is directly related to the geology of the state; it is a combination of the rocks that are the record of the Precambrian through the Cenozoic Eras and the geologic processes that have affected the rocks.

- Erosion is a common geologic process that creates the shape of the land (topography) in many places; but in New Mexico, the shape of the land is much more a result of dynamic processes such as volcanism, uplift of mountains, sedimentation, and faulting.

New Mexico's Physiographic or Geologic Provinces

- The concept of a physiographic province in geology is similar to life zones or vegetation zones in biology. A physiographic (geographic/geologic) province is a region in which all of the landscape is similar in rock type, geologic structure, and geologic history.

- New Mexico is located at the intersection of six major physiographic provinces. Each of these provinces is distinguished by a distinct group of rocks and a specific geologic history; the distinctive geology of each province produces a distinctive topography.

These characteristics can be used to understand the geology of each region of the state.



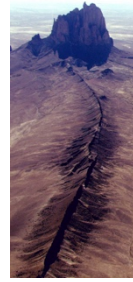
New Mexico's Geology by Region



Ghost Ranch

Colorado Plateau Province • Northwestern corner of New Mexico and the Four-Corners

- Flat-lying rock layers, red, white, and tan sandstone, shale and limestone, have been eroded into mesas and buttes.
- These Mesozoic-Era rocks were formed during the age of dinosaurs when New Mexico experienced many different environments including rivers, deserts, swamps, and ocean.

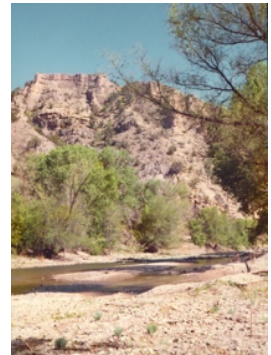


Ship Rock

- A few old volcanoes, like Ship Rock, erupted 30 to 40 million years ago through the flat layers of sedimentary rock.
- Along the southern margin of the Colorado Plateau, along a transition zone of faults, is abundant Cenozoic (Neogene and Quaternary) volcanism, including Mount Taylor.
- **Where to go to see classic Colorado Plateau:** Ghost Ranch, Bisti Badlands, Gallup's Red Rocks, El Morro National Monument, Ship Rock.

Datil-Mogollon Highlands • Southwest and West-Central New Mexico.

- This area includes today's Mogollon, Datil, Black, Socorro, and Magdalena Mountains. These mountains are the eroded and faulted remnants of multiple gigantic caldera eruptions and ash-flows from 20 to 40 million years old (Tertiary or Paleogene Period) "supervolcanoes."
- **Where to go to see classic Mogollon Highlands:** Gila Wilderness, the Cat Walk near Reserve, City of Rocks State Park, Gila Cliff Dwellings.



Gila River



Florida Mountains

Basin and Range • Extreme Southwestern New Mexico

- Parallel mountain ranges and valleys formed by the pulling apart of the North American continent that began about 30 million years ago. The Mountain ranges consist of all ages and types of rock that have been lifted up along faults.
- **Where to go to see classic Basin and Range:** Mimbres Valley, Florida Mountains.

Great Plains • Eastern. New Mexico

- The plains are formed by flat-lying older rocks capped by younger sediment.
- In the southeast, the flat Paleozoic Era marine limestone layers include the remains of an ancient marine reef, giant caverns, sink holes, and abundant oil and gas deposits.

Blackwater Draw near Clovis

- In the northeast, the flat Mesozoic sandstone layers contain dinosaur footprints and are capped by young (Quaternary) volcanoes.
- **Where to go to see classic Great Plains:** Guadalupe Mountains, Carlsbad Caverns, Blackwater Draw. Sinkholes near Roswell and Santa Rosa, Capulin Volcano National Monument, Clayton Lake State Park.





Taos Range

Southern Rocky Mountains • North Central New Mexico

- From Raton and Taos south to Santa Fe, the Sangre de Cristo Mountains represent the southern Rocky Mountain Province.
- These mountains were formed by the folding and faulting of the North American continent about 80 to 55 million years ago (around the same time as the end of the Age of Dinosaurs).
- The rocks within the mountains are billions of years old, but the mountains are about 66 million years old and shaped by ice age glaciers.

• **Where to go to see classic Southern Rocky Mountains:** Sangre de Cristo Mountains including the Taos Range, Cimarron, Wheeler Peak, and Pecos Wilderness.

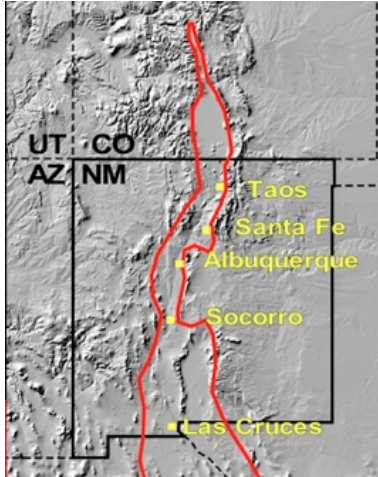
Rio Grande Rift • Central New Mexico

- The center of New Mexico is dominated by topography and geology associated with the young and still-active Rio Grande rift.
- The rift is a series of basins, with margins defined by young rift-related mountains, like the Sandia Mountains, and interiors filled with young volcanic and sedimentary rocks.
- The rift has produced much of the landscape of central New Mexico, including the central mountain ranges and the Rio Grande.

• **Where to go to see classic Rio Grande rift:** Taos Plateau, Santa Fe badlands, Fra Cristobal, San Andres, Sacramento, and Sandia Mountains, and the Tularosa Basin (White Sands National Park).



Sandia Mountains



Rio Grande Rift: The Defining Feature of New Mexico's Geology

- A rift is an area where the Earth's crust thins and pulls apart.
- The Rio Grande rift is one of only five young continental rifts in the world. It is not a plate boundary, it is located within a plate and is very similar to another rift, the East African rift valley. Other geologically young continental rifts are Lake Baikal (Russia), the Rhine **graben** (Germany), and a rift beneath the ice of Antarctica.
- The rift extends in a series of basins from the San Luis Basin of southern Colorado to northern Mexico, down the center of NM.
- The Rio Grande rift began forming about 20 to 25 million years ago at the same time as the Basin and Range began to form; both were due to a change in movement along the boundary between the North American and Pacific plates, far to our west.
- The location of the rift, in the middle of our state appears to be the result of the interaction between the Basin and Range Province and the stable and unchanging Colorado Plateau Province; it may also have been affected by a small plate that moved beneath New Mexico 20 to 50 million years ago.
- Many of New Mexico's central mountain ranges are related to the formation of the rift, and define the margins of rift basins.
- Unlike many other rivers, the Rio Grande did not initially erode its valley, but instead followed the low areas (basins) created by the rift. The Rio Grande probably became a truly major river only about 3 to 4 million years ago. Without the rift, we might not have the Rio Grande.

For questions about this Brief Guide, contact: *Jayne Aubele, Geologist and Educator, New Mexico Museum of Natural History and Science, email: jayne.aubele@state.nm.us*