

# Name: Volcanic Formation (Ecuador)

## Location/Name

- Located near the Chimborazo Volcano in Ecuador
- In the Andes Mountains range

## Age/Evidence

- Estimated age of the oldest rock in this area ranges from Late Precambrian through the Mesozoic Era
- Age determined by examining the rock layers for igneous features, such as batholiths and intrusions
- Newest layers were added during the eruption in 550 CE

## Types of Rocks

- Igneous rocks (cinders, ash, other lava rocks) layered together to form sedimentary rock
- Main types are andesite (lighter colors), basalt (darker colors), and rhyolite (reddish colors), which are all igneous rocks

## Forces & Formation

- Rock formation was created by repeated eruptions of the with the layers representing different eruptions.
- Erosion from rain and wind can also be seen along the road way.

## Facts:

- Highest peak near the equator (claims to be the tallest on Earth if measured from the middle of the Earth to the peak since it is on the "equatorial bulge")
- Last eruption was in 550 CE
- Name from "chimbarazu" meaning "the snow on the other side."
- Top of volcano is covered with glaciers



## Laws of Stratigraphy

Horizontality - "flat layers"

Superposition - lower layers are older than upper ones



# Name: Trenton-Black River Road Cut

## Location/Name

- Picture take along the roadway in Kentucky
- Other areas also found in West Virginia, New York, and other Appalachian states

## Age/Evidence

- Upper and Middle Ordovician limestone strata
- Evidenced by fossilized plant and animal remains that form oil and natural gas

## Types of Rocks

- Sedimentary rocks, such as limestone, shale, and dolomite

## Forces & Formation

- The original sediments were laid down horizontally at the bottom of a shallow ancient sea.
- Compression from colliding crustal plates compacted the sediments into rock.
- Exposed rock layers show erosion from rain and wind
- A large gap that has collapsed in the middle of the image shows evidence of gravity acting on the particles.
- Area is subject to freezing temperatures, which allows water to further crack and break down the rock.
- Faults in the area

## Facts:

- The type of rock in this formation is a good source of fossil fuels, such as oil and gas
- Several faults are located in this area
- Trenton-Black River is an oil and natural gas formation found underneath New York State to West Virginia.

## Laws of Stratigraphy

Horizontality - "flat layers"

Superposition - lower layers are older than upper ones

Cross-Cutting Relationships - Faults and erosion are younger than the surrounding rock

For scale – see the house at the top of the cliff.



# Name: Siccar Point

## Location/Name

- Located in Scotland, approximately 35 miles east of Edinburgh

## Age/Evidence

- Devonian (350-400 mya) & Carboniferous (318-326 mya) limestone (red rocks)
- Silurian (420-440 mya) - greywackes
- Evidenced by rock layers representing ancient oceans and the creation of mountain chains



## Types of Rocks

- Sedimentary rocks, such as "Old Red" limestone and older greywacke

## Forces & Formation

- Sediments deposited flat to form layers of greywacke, which were then bent or folded from pieces of earth's crust colliding
- Original rock was affected by erosion before red sandstone was deposited on top of the original rock.
- Rock formation was affected by more uplifting (tectonic forces) and tilting as well as erosion wearing exposed rock above the surface

## Facts:

- In 1788 James Hutton used this rock to develop his unconformity theory by "reading" the rock record to tell us about Earth's history
- Since part of the formation is at an angle to other parts, this shows angular unconformity.
- See picture below for scale - adult human compared to the size of the formation

## Laws of Stratigraphy

Horizontality - "flat layers"

Superposition - lower layers are older than upper ones

Cross-Cutting Relationships - Faults and erosion are younger than the surrounding rock



# Name: North Rim

## Location/Name

- Grand Canyon National Park, Arizona

## Age/Evidence

- Oldest layers (lower ones) date to the Proterozoic Eon as evidenced by relative age (older than the rocks above them)
- Exposed rock ranges from 270 mya to 525 mya, which were formed during the Paleozoic Era as evidenced by dating the marine fossils (coral, mollusks, brachiopods) found in the middle layers



## Types of Rocks

- Sedimentary rocks - Sandstone, shale, and limestone - Prone to erosion from wind and water
- Igneous rock (granite) and metamorphic rock (schist) - Does not erode as easily as sandstone; Granite formed from lava flows that were then changed by heat and pressure into schist

## Forces & Formation

- Volcanoes created some layers of igneous rocks (lower layers)
- Stream erosion from the Colorado River carved the Grand Canyon into four plateaus and began 5-6 million years ago
- Continued weather and erosion from wind and water have changed the appearance of visible layers of the canyon.

## Facts:

- No dinosaur fossils at the Grand Canyon because the rock layers with the fossils have mostly eroded away.
- The Grand Canyon is made up of almost 40 different layers or strata.

## Laws of Stratigraphy

Horizontal - "flat layers"

Superposition - lower layers are older than upper ones

Cross-Cutting Relationships - Faults and erosion are younger than the surrounding rock

Lateral Continuity - See "matching" layers on opposite sides of the canyon



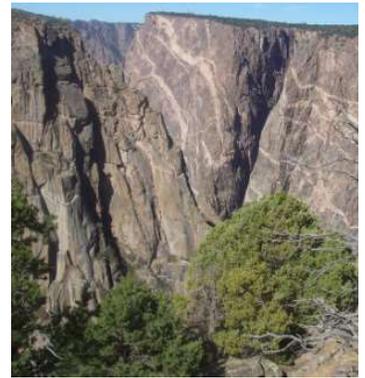
# Name: Black Canyon

## Location/Name

- Gunnison National Park, Western Colorado

## Age/Evidence

- Estimated to be nearly 2 billion years old (2000 mya) and formed from volcanoes during the Precambrian time.
- The intrusive rock (veins) are younger than the surrounding rock
- Sedimentary rock dated back to the Jurassic Period.



## Types of Rocks

- Oldest rock is metamorphic rock in the form of gneiss and schist
- Igneous rock (granites, gabbros) are also found as veins/intrusions
- Younger rock is sandstone, shale, and coal beds from sediment deposits

## Forces & Formation

- Volcanoes created some layers with igneous rocks
- Extreme pressure from tectonic forces changed igneous rock to metamorphic
- Stream erosion carved the canyon out from the existing rock
- Continued weather and erosion from wind and water have changed the appearance of visible layers of the canyon.

## Facts:

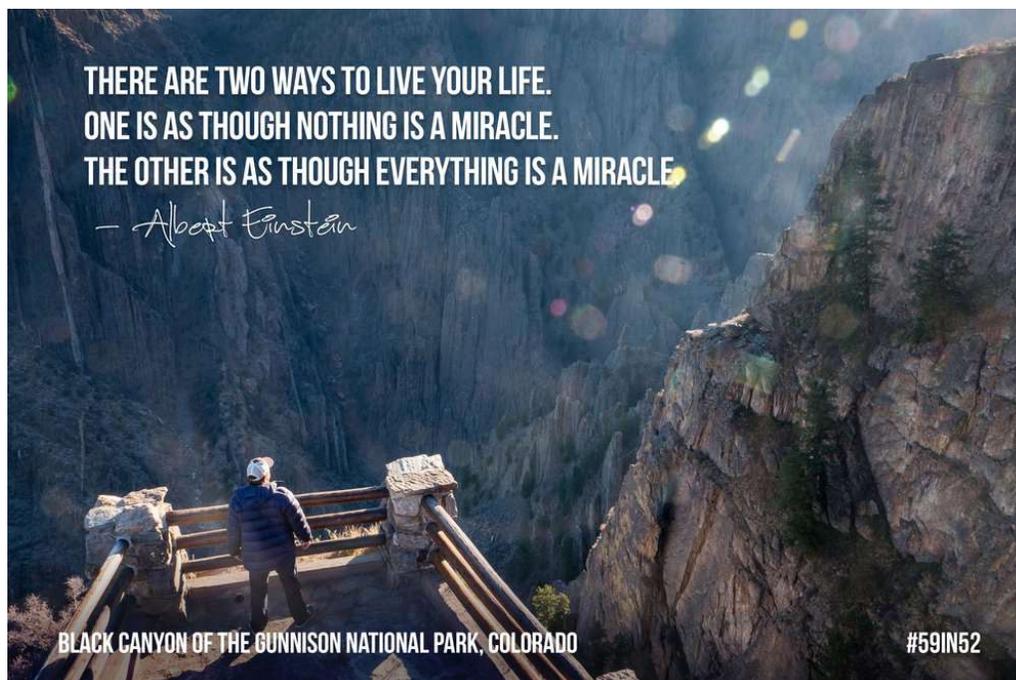
- The Black Canyon is deeper than it is wide in many places.
- The Gunnison River has a steeper drop than the Colorado River does in the Grand Canyon.
- Pink colored pegmatite dikes with crystals up to 6 feet formed across the canyon walls.

## Laws of Stratigraphy

Superposition - lower layers are older than upper ones

Cross-Cutting Relationships - Intrusions (igneous rock) are younger than the surrounding rock

Horizontality - "flat layers"



# Name: Vermillion Cliffs

## Location/Name

- Located near Page, Arizona
- Spans from northern Arizona into southern Utah

## Age/Evidence

- Oldest rock is at the base in the form of Permian rocks aged at 275 million years ago (determined by relative age of rock layers)
- Youngest rock is formed from Cretaceous sandstone and shale based on index fossils and fossils dating to that time period

## Types of Rocks

- Exposed rock is composed of "Navajo Sandstone" and is known for its reddish-color, but may also have yellow from pyrite and green from iron silicates.
- Also called an "erg" or "sand sea" as it is made up of silt and sand dunes cemented together by reddish iron oxide, bluish manganese, and other minerals.

## Forces & Formation

- Cementation and compaction created different layers of sedimentary rocks made from sand, clay, silt, and other deposited material
- Continued weathering from wind and water have created the wave formation in the visible layers of the cliffs.

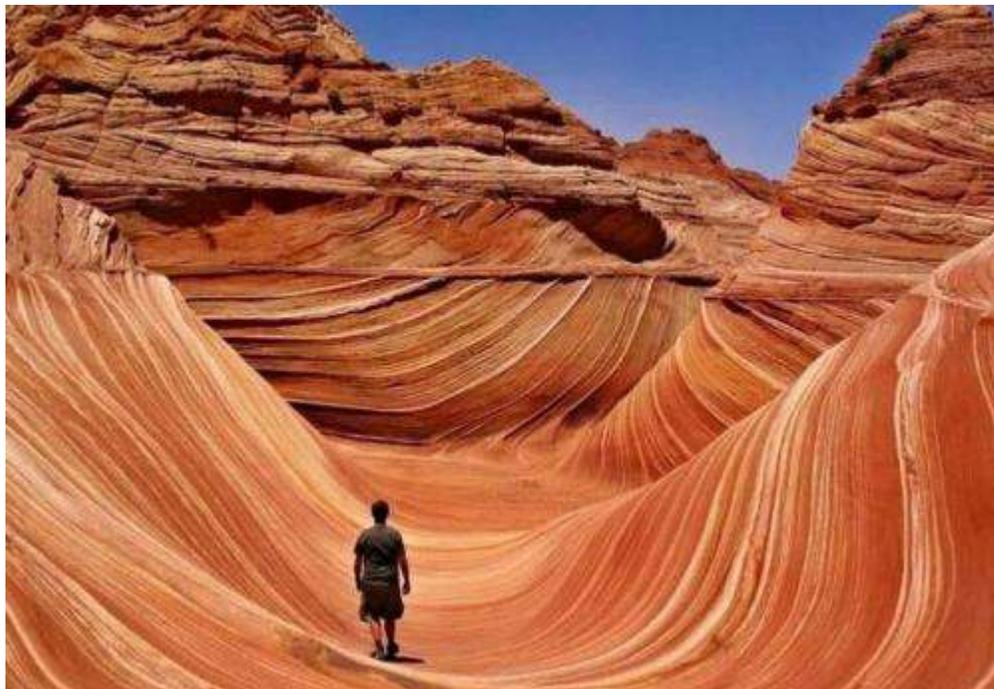
## Facts:

- Vermillion Cliffs makes up the second "step" in the 5-step Grand Staircase of the Colorado Plateau.
- Designated as a wilderness area in 1984 and later named a national monument in 2000.
- People must get a pass to visit the area and must walk to the spot, which is limited to 20 visitors per day
- Elevations in the monument range up to 3,100 feet above sea level

## Laws of Stratigraphy

Superposition - lower layers are older than upper ones

Horizontality - "flat layers"



# Name: French Canyon Starved Rock

## Location/Name

- Starved Rock State Park, Utica, IL (Northern Illinois)

## Age/Evidence

- Estimated to 425 mya based on sediments deposited in a large shallow inland sea that covered the area during that time
- Most recent major changes due to Kankakee Torrent 15000 years ago



## Types of Rocks

- Rock formations are mostly St. Peter sandstone (high silica content)

## Forces & Formation

- The sandstone in the area was lifted due to an anticline (frown-shaped fold in rock)
- Weathering and erosion from a series of floods due to glacial melt-water along
- Waterfalls and stream continue to shape the canyons and bluffs

## Facts:

- The name for the park is from a Native American legend in which members of the Illinois tribe died from starvation after taking refuge on the great rock.
- Became an Illinois state park in 1966 and hosts over 2 million visitors each year.
- The park has a total of 18 canyons and miles of hiking trails to waterfalls and views of the Illinois River

## Laws of Stratigraphy

Superposition - lower layers are older than upper ones

Horizontality - "flat layers"



# Name: Garden of the Gods

## Location/Name

- Shawnee National Forest, Southern Illinois

## Age/Evidence

- Estimated to be at least 320 million years old based on the depth and characteristics of the rock layers
- The oldest exposed rocks developed during the Paleozoic Era starting with the Devonian period and continuing to form through the Carboniferous period.



## Types of Rocks

- Most visible rock is grey sandstone, which has been changed from water and wind.
- Some layers contain sandstone, shale, siltstone, limestone, and coal deposits
- Bedrock dating back to Precambrian times includes igneous rocks (granite and rhyolite) and metamorphic rocks.

## Forces & Formation

- Water and wind have sculpted the sedimentary rocks we can see
- Deeper layers were affected by tectonic forces causing tilting or uplifts

## Facts:

- The park is in the southeast corner of the Illinois Basin, which is a depression in the area.
- The Shawneetown Fault Zone enters Illinois near the park and cross the Luck Creek Fault Zone...
- Glaciers did not reach this far south in Illinois, but the meltwater from the glaciers deposited clay, silt, sand, and gravel.

## Laws of Stratigraphy

Superposition - lower layers are older than upper ones

Cross-Cutting Relationships - faults are younger than the surrounding rock

Horizontality - "flat layers"



# Name: Santorini Island

## Location/Name

- South Aegean Volcanic Arc, which extends 500 km from mainland Greece to Turkey



## Age/Evidence

- First volcanic activity estimated more than 2 million years ago. (Some sources say 3-4, other say 6.5 million)
- Continued eruptions have created layers that can be tracked back to 12 different eruption periods based on the type of igneous rock found in each one
- Magma caused the main chamber to swell by 8-14 cm and was visible on the island's surface in 2011-2012.

## Types of Rocks

- Eruptions produced igneous rocks in the form of basalt, andesite, dacite, and rhyodacite

## Forces & Formation

- Tectonic forces caused the African plate to be subducted (pushed) under the Eurasian plate.
- The island was formed by several volcanic eruptions, which has built up the "walls" of the island.
- The island surrounds a flooded caldera, which gets deeper with each eruption.

## Facts:

- Some believe the tsunamis from the eruption caused the demise of the Minoan culture on the island of Crete, which is a source of the legend of Atlantis.
- Three sides of the island consist of 300 meter (980 feet) tall cliffs.
- It is a member of the Cyclades group of islands, with an area of approximately 28 sq mi and a population of 15,550.
- A large amount of its economy is based on tourism with many visiting cruise ships visiting the island in the summer months.

## Laws of Stratigraphy

Superposition - lower layers are older than upper ones

Cross-Cutting Relationships - Intrusions (igneous rock) are younger than the surrounding rock



## Image Sources:



<http://www.geologyin.com/2015/10/types-of-unconformities.html>



<http://www.uky.edu/KGS/emsweb/trenton/trnt.html>



[http://www.geologicnow.com/25\\_Baker+Gordon.php](http://www.geologicnow.com/25_Baker+Gordon.php)



<https://www.wired.com/2008/01/geologic-misconceptions-layer-cake-stratigraphy/>



<https://www.nps.gov/articles/geologic-principles-cross-cutting-relationships.htm>



<https://www.ck12.org/earth-science/principles-of-relative-dating/lesson/Principles-of-Relative-Dating-MS-ES/>



[https://www.isgs.illinois.edu/sites/isgs/files/maps/statewide/imap10\\_front.pdf](https://www.isgs.illinois.edu/sites/isgs/files/maps/statewide/imap10_front.pdf)



<https://www.hikingproject.com/trail/7023559/bluff-trail-west>



<https://www.greeka.com/cyclades/santorini/santorini-volcano/geology.htm>