Layers in Time: Geology of Grand Canyon

How did Grand Canyon form? By studying **geology** we learn about the Earth's history and how places change over time. What plants or animals lived in your town 150 million years ago? The ancient remains of plants and animals preserved in the rock, called **fossils**, tell stories about the past. Take a look at the chart of common fossils at Grand Canyon on the back page.

Vocabulary:

Fossils: the hardened remains or imprints of plants or animals preserved in rock

Geology: the study of the origin, history and structure of the earth

Think About It

THE OLDEST PANCAKE IN A STACK IS ALWAYS AT THE BOTTOM. THE ROCKS AT GRAND CANYON ARE A LOT LIKE PANCAKES. WHERE DO YOU FIND THE OLDEST ROCKS AT GRAND CANYON?

Cool Canyon Facts

River length: 277 miles

Canyon width: 10 miles

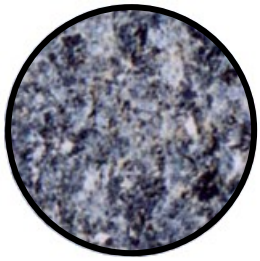
Canyon depth: 1 mile

Rocks come in all colors, shapes, and sizes. They can be very different, but to make sense of what is around us, **geologists** put rocks in groups according to how they form. The three families of rock are: **igneous, sedimentary** and **metamorphic**. Natural forces create and destroy rock, changing them over time in the rock cycle.

Igneous rocks are formed when rock is super-heated and becomes **molten** (liquid). There are two kinds of molten rock: magma (found beneath the Earth's surface) and lava (found on the Earth's surface). The **molten rock cools and hardens** on or beneath the Earth's surface forming a variety of igneous rock. Two examples are granite and basalt.

Sedimentary rocks are made of smaller pieces (like **sand or mud**), called sediments, that pile into layers. As pressure on the sediment increases over time, minerals act like glue, cementing them into solid rock. The three main types of sedimentary rocks at Grand Canyon are **sandstone, shale (or mudstone), and limestone**.

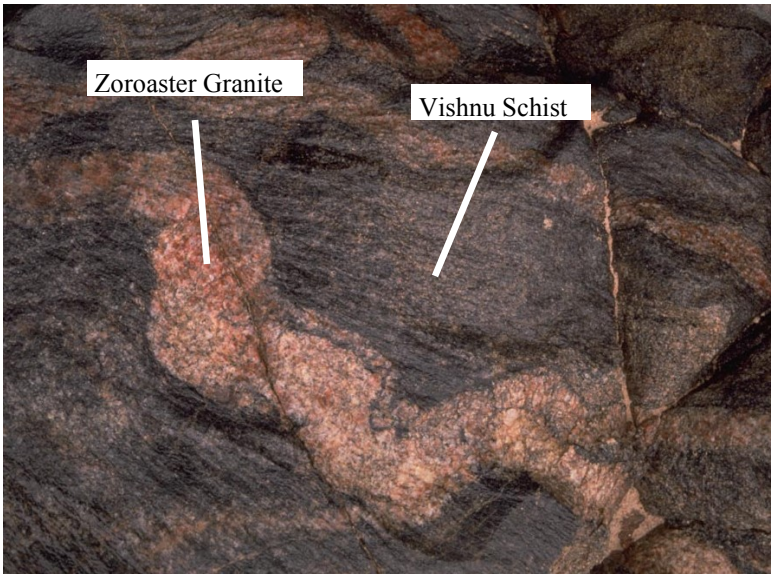
Metamorphic rocks are rocks that have been **changed under great heat and pressure**. The original rock can be sedimentary, igneous, or even metamorphic. The original rock is changed into something new, just as a caterpillar "metamorphoses" into a butterfly.



Rock layers tell stories of the past

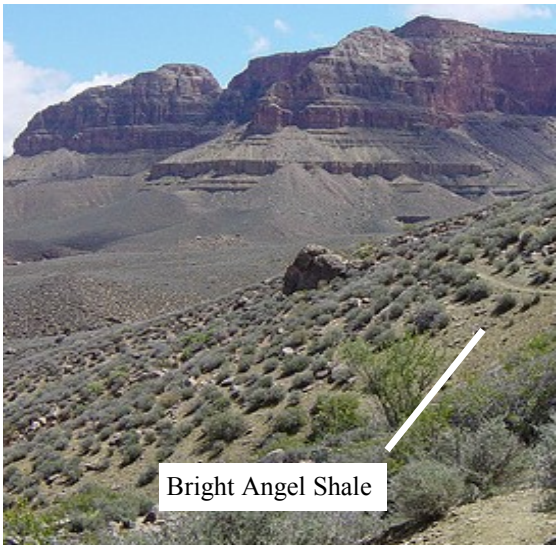
Each rock layer in Grand Canyon has a story to tell. Preserved within each layer are the clues that help us unravel these stories. Fossils give us a snapshot of past plant and animal life; sand, mud, and other sediments in the rock tell of ancient rivers, beaches, swamps and sand dunes; sparkly crystals can tell of ancient mountain building events and volcanic eruptions.

Precambrian Basement Rocks



The basement rock formed 1.8 billion years ago when the North American continent collided with an ancient chain of volcanic islands, much like today's Hawaiian Islands. Intense **heat and pressure** from the collision formed rock called Vishnu Schist. From deep under the earth's surface, molten rock flowed up as magma between the cracks of the Vishnu Schist. As the **flowing magma cooled and hardened**, it formed veins of pinkish rock called Zoroaster Granite. Because of the extreme heat and pressure that folded and changed the rock, any fossils in the original rock were destroyed.

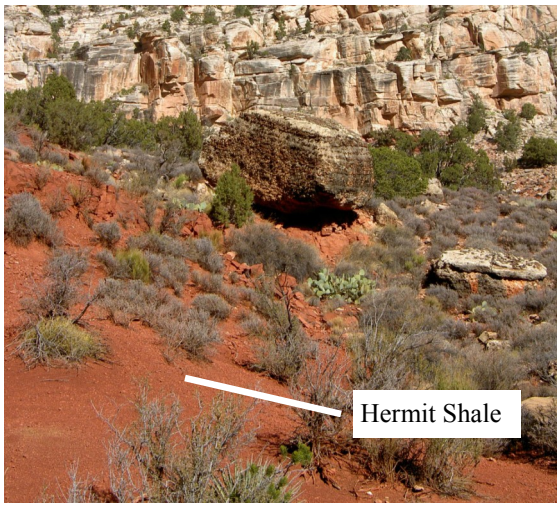
Circle which rock family(ies) these rocks belong to : Sedimentary Igneous Metamorphic



Bright Angel Shale

If you came to Grand Canyon area 515 million years ago when the Bright Angel Shale was forming, everything was covered by a very **muddy, warm, shallow sea**. Trilobites, brachiopods, crinoids and worm-like creatures that burrowed in the sea-floor thrived in the nutrient-rich water. This greenish-colored **shale** forms the broad, flat area known as the Tonto Platform in Grand Canyon.

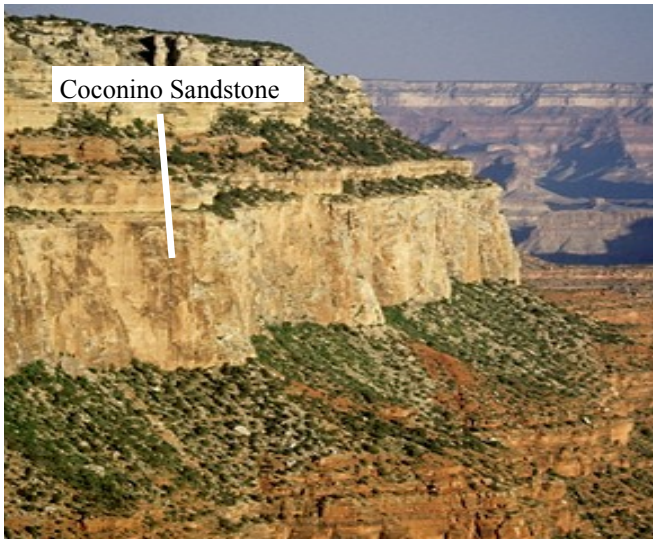
Rock Family: Sedimentary Igneous Metamorphic



Hermit Shale

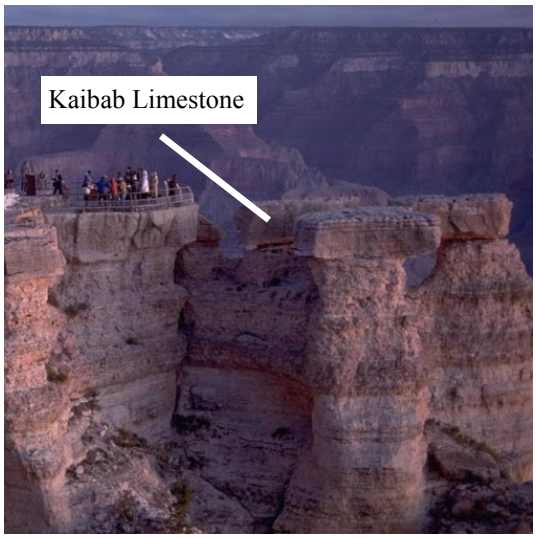
Are you ready to go wading through the mud? About 280 million years ago the Grand Canyon area was covered by a broad coastal plain that had many slowly **meandering streams**. The environment was excellent habitat for an abundance of ferns and conifers, along with reptiles and insects, including dragonflies with 12-inch wingspans. This layer consists of **siltstones, mudstones, and fine grained sandstones** rich in iron that create a gentle, red slope in most parts of Grand Canyon National Park.

Rock Family: *Sedimentary* *Igneous* *Metamorphic*



Coconino Sandstone

Have you ever wanted to visit the Sahara desert? About 275 million years ago the Grand Canyon area was covered with large dune-fields. The ocean lay to the west. Reptiles, spiders, scorpions, and other insects dwelled on the **sand dunes** of this extensive desert, leaving their tracks fossilized in the sandstone. This **sandstone** layer creates a broad, light-colored cliff a few hundred feet below the rim of Grand Canyon. Cross-bedding (lines that run at steep angles to one-another) can be seen in the rock, giving evidence to the wind-blown sand dunes that once covered the area. *Rock Family:* *Sedimentary* *Igneous* *Metamorphic*



Kaibab Limestone

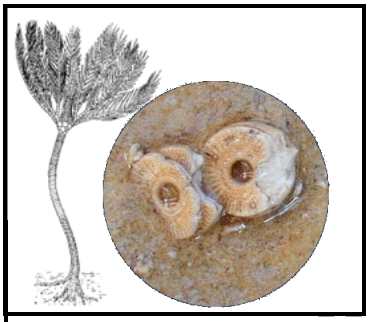
About 270 million years ago North America was the western part of the super-continent Pangaea. The Grand Canyon region was once again covered by a **shallow, warm, and well-lit clear sea with a sandy/muddy floor.** Brachiopods, sponges, and other sea creatures dominated these waters. Other species included crinoids, corals, bryozoans, cephalopods, sharks and fish. This **limestone** is the youngest, and therefore the topmost, rock layer found at Grand Canyon National Park.

Rock Family: *Sedimentary* *Igneous* *Metamorphic*

Fossils of Grand Canyon

Here are some of the more common fossils found in the sedimentary rock layers of Grand Canyon.

Brachiopods– A variety of shells lived in clear ocean waters.



Crinoids– Tiny disks made the stem and arms of this animal, that was rooted to the sea floor.

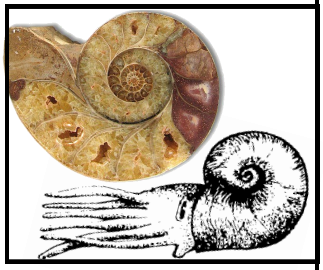
Bryozoans– These are apartment complexes for microscopic (that's really small!) animals.

Ferns– These fossils are the imprints of where leaves fell into the mud thousands of years ago.

Burrows of animals– Worms and trilobites dug tunnels in the soft muddy sediment under the sea floor.

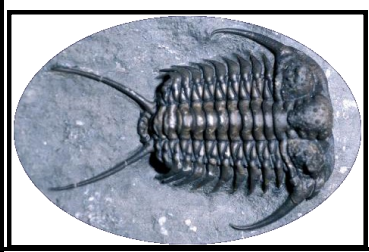
Sponges– Sea sponges are one of the most common fossils in the youngest layer at Grand Canyon.

Cephalopods– These creatures roamed the sea and are related to the squid in today's oceans.



Tracks– Reptiles and other animals left their mark in the mud and sand where they lived.

Coral– This predator was rooted to the sea floor. Descendents of this animal still live



Trilobites– These segmented animals vary in size from that of a dime to a dinner plate.