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GRAND CANYON GEOLOGY

An Overview

Big Picture

The landscape of earth exhibits tremendous beauty. Vast amounts of time and money are spent each year by eager travelers to experience the wonders of the topography of the world. It is nearly impossible to encounter the various stunning features of the world and not wonder how it happened.

God's Word provides a record of our past revealing the events that have shaped our modern-day world. The Flood of Noah's day is one of these events that requires careful consideration to make sense of the landscape we see today.

Flood Dynamics

Genesis 6–9 is the biblical account of the Flood. Genesis 6 informs us why this event took place. God was defending His holiness and judging sin. Genesis 9 tells us what happened after the Flood. Here we see the covenant God made with Noah that He would never again Flood the earth globally.

Genesis 7 and 8 are the chapters presenting what happened during the flood. Unfortunately, these seem to be the two chapters that most people spend the least amount of time to read and comprehend. But a quick walk through a few verses will give us the beginning of an understanding as to what happened.

It is important to acknowledge that we were not there to witness this event. Therefore, we should not be so arrogant as to think we have it all figured out. However, there are strong pieces left behind we can put together to get a plausible understanding of the intense dynamics of this global catastrophe. Truly, the bottom line is this:

The Flood described in Genesis 6–9 was a destructively dynamic water and geologic event resulting in the complete reshaping of the world. This was not just about a lot of water flooding everything. God describes massive continental movements, earthquakes, volcanoes, and massive water currents. These dynamics would result in massive erosion and movement of the resultant sediments further scouring the earth, wiping out plants and animals, and finally being deposited in global-scale layers of sediment filled with the fossilized remains of plants and animals.

Key Verses and Observations:

- **Genesis 7:11** — How the Flood began

"In the six hundredth year of Noah's life, in the second month, on the seventeenth day of the month, on that day all the fountains of the great deep burst forth, and the windows of the heavens were opened." (ESV)

- ✓ God uses the life of Noah to identify the beginning of the Flood.
- ✓ 2 things are mentioned as happening on day 1 of the Flood
  - Fountains of the deep were first opened (burst forth)
  - Windows of the heavens were opened
- ✓ The windows of the heavens indicate the rain.

- ✓ The fountains of the deep are a bit more dramatic.
  - The earth's crust at the time of the pre-Flood supercontinent (Rodinia) broke apart allowing the fountains of the deep to "burst forth" and the continental fragments began to move rapidly apart to form the individual continents we see today.
  - The breaking of the earth's crust produced massive earthquakes.
  - Many of these earthquakes were happening along the ocean floor creating gigantic tsunamis.
  - The energy of the tsunamis would move along the ocean floor, tearing the life off the bottom of the ocean, transporting it in mud up onto the continents where it would become buried rapidly forming fossils.
  - Once the tsunamis began to move over the continents, they would destroy the pre-Flood landscape.
    - Broken up rock and pre-Flood sediments would comprise huge loads of moving sediment.
    - Pre-Flood vegetation and animals would be destroyed.
    - The basement rock would be scoured creating a nearly flat-lying boundary between the basement rock and the layers of Flood-deposited sediments.

❖ **Genesis 7:24** — How long did it rain?

"And the waters prevailed on the earth 150 days." (ESV)

- ✓ The fountains of the deep and the windows of the heavens were open for 150 days.
- ✓ Genesis 7:17 does not say the flood stopped after 40 days. This text indicates the intense rainfall period constituted the main phase of the Flood, as the Hebrew word *mabbul* (for "flood") is applied to this forty-day period during which the Ark had to have floated due to the global inundation.
- ✓ After this, the rain and the fountains of the deep continued for yet another 110 days for a total of 150 days.
- ✓ For 150 days the pre-Flood world was pulverized by numerous tsunamis caused by earthquakes taking place all over the world.

- ✓ These tsunamis would be moving in multiple directions and, at times, fighting against one another.
- ✓ Also, the regular tides became global and thus the tidal differences between the highs and lows became amplified, and were thus superimposed on the many devastating tsunamis.

❖ **Genesis 7:19** — How deep did the water get?

"And the waters prevailed so mightily on the earth that all the high mountains under the whole heaven were covered." (ESV)

- ✓ The waters continued to prevail upon the earth until all the highest mountains under all the heavens were covered.
- ✓ If the highest land was covered, then *all* the land was covered. Therefore, there was no land left to stop the advancement of the tides and tsunamis. Those dynamics would have been powerful enough, along with the necessary time to transport those tsunamis (and their subsequent sediment load) around the entire earth, depositing fossil-bearing sediment layers all the way across the submerged continents.

❖ **Psalm 104:8** — Plate tectonics

"The mountains rose, the valleys sank down to the place you appointed for them." (ESV)

- ✓ At the end of the Flood, God raised the mountains and sank the valleys to return the water where He wanted it to be. Most of today's mountains and all the ocean basins were formed recently, so the Flood waters would have drained into those new and deeper ocean basins.

- ✓ God was discussing geology. More specifically, He appears to be describing plate tectonics.
  - The pieces of the broken pre-Flood supercontinent were now slamming into one another with great speed and force. The result was the formation of the modern-day mountains.
  - As the land emerged, the water would race off the land back into the ocean. This process would create erosional features visible today, such as sheet erosion and channelization to carve out valleys and canyons.

The Flood event described in Genesis 6–9 lasted approximately one year. Catastrophic plate tectonics and seismic earth movements created earthquakes, tsunamis, and volcanoes resulting in the complete restructuring of the earth as we know it. What we see in the landscape of our earth today is not the original creation. Rather, what we see is a re-shaped earth caused by the global Flood of Noah's time. This is even seen in the geographical location of the landscape described in the pre-Flood world.

For example, we have the Tigris and Euphrates rivers in the modern world. However, they cannot be the same as those described as a part of the Garden of Eden. In the beginning, one river was described as originating in the same place, flowing out of Eden and then dividing four ways into four rivers, two of which were named Tigris and Euphrates (Genesis 2:10). The modern rivers are totally different and instead have separate sources and travel apart from one another. They were likely named by Noah and his family in memory of the pre-Flood rivers—just like the Thames near London, Ontario was named for the Thames near London, England.

If this represents an accurate description of the dynamics of the Flood, then there would certainly be geological evidence left behind to substantiate it. The next section will provide a summary of the observable data we see in the Grand Canyon and around our globe consistent with what we would expect to find.

Geology 101

There are 2 major schools of thought when considering the geology of the Grand Canyon. Either the layers of sediment were deposited slowly grain-by-grain and regionally over long periods of time, or they were deposited rapidly in a short period of time.

We believe the observable data supports rapid and global deposition consistent with the global Flood described in Genesis 6–9. We believe the geology of Grand Canyon (as well as the landscape of the earth) affirms the Genesis Flood as a historical event. This summary provides an overview of some of the data we discuss on our rim tours and river trips.

The Grand Canyon provides an exciting and beautiful place to investigate the geology under our feet. It is important for us to first understand what we are looking at before we consider how it got there and its significance. The three important questions for us to consider are:

- What are we looking at?
- How did it get there?
- Why does it matter?

*These questions are easily summarized as **What**, **How**,* and ***Why**…*

➢ What

When investigating the geology of Grand Canyon, we understand what we are seeing is not unique to Grand Canyon. In fact, it is representative of the earth as a whole. In other words, every continent of the earth has a similar structure. Just as in constructing a building, our continents have foundation rock. From a creationist perspective, we understand it to be creation week rock. Genesis 1:9 says, *"And God said, 'Let the waters under the heavens be gathered together into one place, and let the dry land appear.' And it was so."*

Our earth is comprised of three main rock types. These three types are known as *igneous, metamorphic, and sedimentary*.

Igneous

Igneous rocks were once molten materials that cooled and hardened into rocks. The igneous rocks found in the foundation were lower crustal and upper mantle materials that melted and were then pushed up into and around the metamorphic rocks. As such, it is considered *intruded* igneous rock and is how most granite is formed.

Where molten rock reached the earth's surface, it erupted through volcanoes and fissures as lava. An example of this is the Cardenas Basalt, visible in the eastern Grand Canyon just below the Flood layers.

Metamorphic

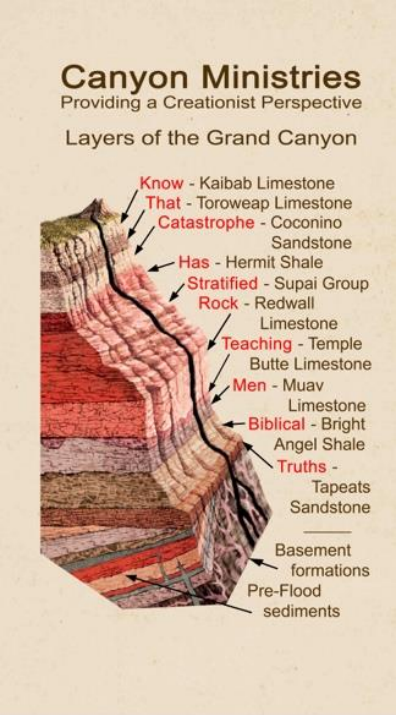
Subsequent to their formation, metamorphic rocks were once different types of rocks (igneous and sedimentary) until heat and pressure metamorphosed their original compositions into what we see today. The metamorphic rocks found in Grand Canyon are predominantly called schists. (The schists we see today may not be what these rocks were like when created by God, as they have subsequently suffered from the effects of the Flood.)

The foundation (basement) rock is a combination of metamorphic and igneous rocks that comprise the earth. These rocks average about 40 kilometers in thickness, and are “floating” on the mantle.

The basement formations have been globally planed off to a nearly featureless surface. Sitting directly upon this gently undulating surface are flat-lying, horizontal layers of sediment filled with marine fossils. The layers found above the Canyon’s layers are filled with a mixture of marine and land animal fossils.

Sedimentary

The third type of rock that makes up the structure of the earth is sedimentary rock. Sedimentary rocks are formed when material like mud and sand are transported from one location to another, laid down, and hardened into stone. The layers of sediment in Grand Canyon (and around our globe) sit like a stack of pancakes atop the foundation rocks.



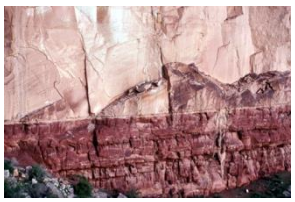
The famous colors and layers of Grand Canyon are comprised of roughly 4,500 feet of sedimentary strata. These layers consist of a combination of limestone, sandstone, and shale. The inserted diagram illustrates the foundation formations and the layers of sediment stacked upon them. A phrase that can be used to memorize the layers of sediment found in Grand Canyon is ***K**now **T**hat **C**atastrophe **H**as **S**tratified **R**ock, **T**eaching **M**en **B**iblical **T**ruths.*

➢ How

The observable data within these rock formations collectively makes a compelling case for understanding these layers of sediment to have been formed rapidly and globally. This overview will only summarize some of the data, as future overviews will be dedicated to each one with greater detail.

Rapid Deposition

- ✓ **Flat Contact Boundaries Between Layers of Sediment**
  - A feature evident to the observer of Grand Canyon is how flat the layers are sitting atop the basement rock and on top of one another like a stack of pancakes. The boundary between each layer is a nearly featureless horizontal plane. This is consistent with rapid deposition, as we see no evidence of any passage of time between layers (such as erosional features and buried ecosystems).



- ✓ **Fossils**
  - The layers of sediment covering our earth are filled with fossils. In fact, nearly 95% of the entire fossil record consists of ocean floor-dwelling marine life. And these pre-Flood ocean floor-dwelling creatures are now buried up on the continents in sediment layers covering the continents. Our earth is a massive graveyard with billions of fossils pointing to a catastrophic event in our past.
  - Today, fossilization is rare. Therefore, the geologic processes we observe today cannot explain the presence of billions of fossils buried in sedimentary rocks. Fossilization requires special circumstances. If something dies and lies on the ground, it will not become a fossil. Either it will decompose or be eaten by scavengers. Even if something gets buried slowly, it will likely not become a fossil. Critters burrowing throughout the layers of sediments will devour the buried carcass (also mixing up the flat boundaries between layers discussed above).
  - The best way to make a fossil involves burying the creature or plant rapidly enough to keep it from decomposing or getting eaten. The presence of fossils suggests rapid deposition.
  - We see a demarcation line in the rock record where there was a sudden mass destruction of life. Below this line, there are no megascopic fossils. Immediately at and above this line, there is an explosion of fossils where we see every major phylum of organism represented in the rock record. This fossil explosion is commonly referred to as the “Cambrian Explosion.”

- ✓ **Bent and Folded Rock Layers**
  - Throughout Grand Canyon, we see layers of sediments smoothly folded without being broken. Had they been laid down slowly and hardened over millions of years, the uplift many millions of years later which bent the layers would have caused these layers to shatter and crumble. Rather, we see layers of sediment folded like a moist bar of clay before hardening.

Global Deposition

- ✓ **Tapeats Sandstone**
  - The Tapeats Sandstone sits directly on top of the basement rocks and contains marine fossils. This layer of sediment extends across the United States, up into Canada, and across to Greenland. Additionally, this same layer of sediment is found covering North Africa and Southern Israel.

- ✓ **Redwall Limestone**
  - The Redwall Limestone averages 500–800 feet thick throughout Grand Canyon. In addition to the Southwest, the same limestone is found across the United States, in Ireland and England (regionally known as the Carboniferous Limestone Supergroup), and as a part of the Himalayas.
  - The Redwall Limestone is a layer of sediment spread across at least three continents and is filled with marine fossils.

- ✓ **Great Unconformity**
  - The boundary between the Tapeats Sandstone and the basement rock is known as the “Great Unconformity.” The supposed gap of time (proposed to be as much as 1.2 billion years) between these rocks is why it is considered an unconformity. This particular boundary is called the “great” unconformity for two main reasons:
    - The amount of proposed time and material missing at this boundary is far greater than most other unconformities.
    - The extent of the boundary is global. In other words, the entire earth has been scoured by a global erosional event. Sitting directly upon that worldwide erosive boundary is a horizontal layer of sediment filled with marine fossils. These are exactly the type of erosional features we would expect to find if what we read in Genesis is true.

➢ Why

The landscape of the earth is a result of the global Flood event described in Genesis 6–9. God defended His holiness and judged sin by washing the earth clean in a worldwide deluge. God certainly could have left the post-Flood world a complete wasteland. However, He chose to weave immense beauty into His wrath and judgment. When viewed through a biblical perspective, our global landscape stands as a monument to God's redemptive heart and His love for restoration.

The rocks of Grand Canyon proclaim a message of redemption and restoration. The jaw-dropping beauty on display reminds us that God is a God who redeems and restores. Studying and understanding the rock record provides us with a significant means of seeing and understanding the heart of God.

The rocks affirm that God's Word is authoritative and trustworthy from the very first verse. Romans 1:20 tells us, *"For his invisible attributes, namely, his eternal power and divine nature, have been clearly perceived, ever since the creation of the world, in the things that have been made. So they are without excuse"* (ESV). We see this on full display in the wonders of Grand Canyon.

For Further Reading

A Pocket Guide to the Global Flood (Answers in Genesis, 2009)

A Pocket Guide to A Young Earth (Answers in Genesis, 2010)