Origin of the Coconino Sandstone in the Grand Canyon

Lorence G. Collins lorencecollins@gmail.com

October 10, 2018

Introduction

In earlier **Skeptical Inquirer** articles I described how cross-bedding with maximum angles of dip greater than 30º in the Navajo Sandstone gives evidence that this sandstone was created by wind deposition that produced giant dunes in a desert environment. See: http://www.csun.edu/~vcgeo005/Nr38Reasons.pdf and http://www.csun.edu/~vcgeo005/Nr42Response.pdf. I also referred readers to the evidence reported in the book "**The Grand Canyon – Monument to an Ancient Earth: Can Noah's Flood Explain the Grand Canyon?"** edited by Carol Hill, Gregg Davidson, Tim Helble, Wayne Ranney, and others, 2016, Grand Rapids, MI, Kregel Publications. In the earlier articles I gave only a limited discussion of the Coconino Sandstone (Figure 1), indicating only that it also had similar maximum dip angles greater than 30º and had raindrop prints that supported its desert origin, but I did not expand on how the Coconino Sandstone was deposited because of many complex relationships that could not be easily condensed into two short articles. This article examines some of these complex relationships.

Figure 1. North rim of Grand Canyon showing Coconino Sandstone (white layer below the Kaibab Limestone, also white, along the rim of the canyon).

Beliefs of young-Earth creationists

Young-earth creationists (YEC) believe that the Coconino Sandstone that crops out in the Grand Canyon was deposited under water during the supposed global Noah's flood in one year. YEC argue against wind deposition for its origin because it interferes with their idea of a global flood. YEC from **Answers in Genesis** declare that "No apparent, perceived, or claimed evidence in any field, chronology, can be valid if it contradicts the scriptural record." Those people who accept this view are not willing to change their minds in spite of scientific evidence. Nevertheless, this article gives scientific information so that intelligent people can make up their own minds. To understand how the Coconino Sandstone was deposited in the Grand Canyon area the following information is provided.

Data that give understanding for the origin of the Coconino Sandstone

Sandstones are composed of quartz grains. On a Moh's hardness scale, quartz has a hardness of 7 in comparison to talc (1), calcite (3) feldspar (6), and diamond (10). Quartz is produced in silica-rich (65-72% SiO_2) melts by crystallization in granitic rocks. Granite contains on average 25 percent quartz, 70 percent feldspars (potassium feldspar and plagioclase feldspar [containing sodium and calcium]), and 5 percent iron- and magnesium-rich silicate minerals (biotite mica and hornblende), but the average granitic rock (granodiorite in the Sierra Nevada Mountains, for example), contains only 10 percent quartz.

Quartz has no planar cleavage. It breaks with a conchoidal (curved) fracture with sharp edges; hence, it is useful in its hardness (7) and sharpness as a polishing tool in sandpaper. Feldspar has a rectangular cleavage and although it has a hardness of 6 and not easily eroded, this cleavage enables it to be broken down into smaller fragments that easily alter by hydration to form clay minerals (hardness of 1) in mud and soils. Nevertheless, because granitic rocks are mostly composed of very hard minerals (quartz 7 and feldspar 6), the erosion of mountains composed of such rock generally takes millions of years to erode them down to sea level as has been observed, for example, in the Canadian Shield and the bottom of the Grand Canyon on which the supposed Noah's flood deposits rest. That erosion does not happen in 6,000 years that young-Earth creationists claim is the age of the Earth.

Granitic rocks in the Sierra Nevada erode only a few thousandths of an inch per year.

When granitic rocks weather, most of the feldspars in these rocks are converted into clay, but interstitial quartz is left over and becomes loosened residual grains. The clay gets carried by streams and is transported to the oceans or lakes, so that more than 70 percent of sedimentary rocks that are formed are shales (former clay-bearing muds) and 10 percent become sandstone layers. Calcium in former plagioclase is deposited in calcite in limestone which makes up the remaining 20 percent of most sedimentary rocks. (The calcium also comes from the weathering of plagioclase feldspar in basalt.) We generally do not see the larger abundance of the shales at the earth's surface, because shale is easily eroded to form valleys, and the harder (more resistant) sandstones and limestones stand out as ridges above the valleys. Drilling, however, confirms these abundances. The loosened hard quartz grains in the weathered granitic rocks eventually get washed away by rain and carried off in streams.

Now, having presented the above information, I can come back to discussing the origin of the Coconino Sandstone.

How sands in the Coconino Sandstone are formed

Because on average granitic rocks are composed of 10 percent quartz, for every 100-foot thickness of a sandstone layer, 1,000 feet of granite must be weathered and eroded to produce this sandstone layer. There are no granitic rocks in the Grand Canyon area from which the quartz grains in the Coconino Sandstone can be their sources. The Creator (God) did not produce these quartz grains magically by miracle so that they were locally nearby. The quartz grains had to come from the granitic rocks in the former high mountains in the east coast area, stretching from southeastern U.S. to Maine and Canada and from the Canadian Shield area in mid-North America. During the transport of the clay and quartz grains from these areas across 3,000 miles, the streams winnowed out the clay from the quartz so that the quartz in the transported sediment became nearly pure quartz in sand sediment. Note that the rush of Noah's flood waters in one year could not have sorted (winnowed) the quartz grains from the clay minerals. In such a rush of water in Noah's flood, the quartz and clay grains would be in a

chaotic mix and completely unsorted from each other. In normal transport by streams, clay minerals are transported farther than sand grains, and the lagging-behind sand grains are deposited in water in stream channels, but in times of little rainfall, wind can pick up the transported sand grains and transport them to form large deposits of dune sands. This is what has happened in the Sahara Desert in Africa and what happened during the Permian Period when the Coconino Sandstone was formed.

What young-Earth creationists ignore is the great length of time that is required to produce quartz grains in the sandstones by the weathering of granitic rocks. They also ignore the great length of time that is required to produce the calcium in the calcite (calcium carbonate) crystals in limestone that comes from the weathering of granitic rocks and basalt to produce the Redwall and Kaibab Limestone layers in the Grand Canyon. That amount of weathering in both examples cannot happen in 6,000 years that young-Earth creationists claim is the age of the earth. As was said above, there was not an already magically produced source of these quartz grains and calcite crystals that Noah's flood could wash into the Grand Canyon area. Millions of years of time are required, not only for the weathering of the igneous rocks, but also for the emplacement and crystallization of the igneous rocks in the first place. Moreover, that emplacement and crystallization cannot have happened on a single day (Day 3 of the Genesis Week) because some granitic rocks and basalt that have been weathered and eroded are also found throughout the Earth and have ages that are the same ages of the sedimentary rocks found in the Grand Canyon.

Additional complexity involved with the Coconino Sandstone

To further discuss the complexity that applies to the origin of the Coconino Sandstone, Tim Helble, who is one of the authors for the **Grand Canyon** book, has composed a 41-image-document that discusses a view of a creationist, John Whitmore, who makes a presentation titled "**Ten Myths About the Coconino Sandstone**." See the following link. https://www.dropbox.com/s/jcp9s2e38nkxtyr/The%20Coconino%20Sandstone%20%E2%80%93%20A%20Response%20to%20John%20Whitmore%E2%80%99s%20Ten%20Myths%20Talk%20%2811-30-17%20version%29.pptx?dl=0

In this link Helble presents a detailed and thorough discussion of Whitmore's arguments that show that the conventional view is much more logical. In Helble's presentation, Whitmore gives what he says are myths that conventional geologists espouse and which are not supported by the biblical model of a global flood. Many of Whitmore's assertions are incorrect statements although some are true. In some examples, Whitmore and his colleagues seem to suggest that they were the first to discover the phenomena being discussed and that is not true. Whitmore and other YEC skip over the most obvious problem of depositing the Coconino Sandstone which is in just a few days in the Noah's flood model. That problem is the quantities of sediment that must be transported per unit of time during that one year. For example, what the YEC ignore is that the transport mechanism for the volume of sand in the Coconino Sandstone that is deposited in its areal extent is unrealistic. If it takes 150 days to deposit the sedimentary rocks that crop out in the Grand Canyon, and if the average total thickness of these sediments is 4,000 feet, the rate of deposition is about 24 feet per day. If the average thickness of the Coconino Sandstones in the Grand Canyon is 315 feet, the sand in this thickness must have been deposited in 12 days (about 2 weeks).

Steven Austin (a geologist who supports the young-earth model) says that the speed at which the sands in the Coconino Sandstone were deposited was between 2 and 4 mph. YEC claim that 10,000 cubic miles of the Coconino Sandstone were moved to the Grand Canyon area. But at 2 mph, only 1 cubic mile of sand can be moved in 12 days. Therefore, if 10,000 cubic miles of sand are moved to this area, that would be equivalent to moving a giant slab of sand that is 84 feet high, 1,000 miles wide, and 630 miles long, sliding into this area at 2 mph. On that basis, even if the Coconino Sandstone were water-laid, the quantitative rate of movement of this volume of sand is wildly unrealistic – 20,000 mph.

At this rate of movement, any footprints of small vertebrates, spiders, scorpions, and millipedes (as illustrated in the Grand Canyon book) could not have been preserved that have been found in the Coconino Sandstone in multiple layers on top of each other. The sand spilling over the crests of migrating dunes under water would have wiped them out so they could not have been found in multiple overlying layers.

YEC believe that conventional geologists say that the sands in the Coconino Sandstone are supposed to be well sorted, well rounded, have steep cross-bedding (30 degrees), no mica or dolomite, mud cracks at its base, vertebrate tracks in dry sand, and raindrop prints, but they make these assertions on the basis of old scientific literature and not on modern studies of desert sand dunes, even though some of the above observations are supported by observations reported in the Grand Canyon book. You can go to the above Helble link to see his comments on all these topics. However, in this article I have chosen to give his discussion only of the sorting and shapes of the sand grains in the Coconino Sandstone.

Modern studies show that in desert sands, roundness of sand grains is rare and most grains are sub-angular to sub-rounded in shape. Therefore, the assertion by Whitmore that conventional geologists say that such does not exist in desert sand dunes is false and out of date.

Comparisons of 291 coastal dune samples with 175 inland dune samples show several differences. The coastal dunes are composed almost totally of very well sorted fine sands. Inland dune samples, by contrast, show much greater range in grain size and sorting values. If the Coconino Sandstone represents what remains of a vast desert sea, a large majority of this area would be from inland dunes; thus, we would expect most of its sand grains to have much greater range in sorting values, and that is what is observed.

Further observation, conclusion, and summary

I have already suggested in two other articles that Noah's supposed flood was a large local flood. See: http://www.csun.edu/~vcgeo005/Collins2.pdf and http://www.csun.edu/~vcgeo005/Nr46Genflood.pdf. Therefore, Tim Helble avers that the biblical statement in 2 Peter 3:6: "and by that means the world of that time was deluged with water and perished" does not necessarily require a literal interpretation claimed by the YEC. The underlined text could actually be a biblical agreement that Noah's flood was local rather than global.

At any rate, the above information gives strong support that, like the Navajo Sandstone, the Coconino Sandstone was deposited by wind rather than under water during a supposed global Noah's flood. Moreover, to create the quartz sand grains that eventually became the chief component of the Coconino Sandstone in the

Grand Canyon area requires millions of years for multiple geologic processes to occur. These processes include: (1) the formation of the granitic rocks by crystallization of silica-rich melts deep in the earth's crust where the quartz is first crystallized, (2) the uplift of the granitic rocks from their deep sources to form high mountains in the east coast of the U.S. and Canada, (3) the weathering of these exposed granitic rocks so that the hard feldspar matrix that surrounds the quartz can be converted to soft clay, (4) the erosion of the weathered granitic rocks by falling rain so that the quartz grains can be released from the clay, (5) the transportation of the loosened quartz grains as sediment by water in streams, (6) during a long period of drought in Permian time, the further transportation of the quartz grains by wind through a combined distance of as much as 3,000 miles to produce the dune sands in the Grand Canyon area, (7) the burial of these dune sands under other sedimentary rocks of Paleozoic and Mesozoic ages that were deposited on top of the dunes, and (8) the uplift of these rocks and eventual erosion by the Colorado River in this area to expose the Coconino Sandstone in the Grand Canyon (Figure 1). All of this time cannot be condensed into 6,000 years for each of these processes to occur, which YEC claim is the age of the Earth.

Acknowledgement

I thank Tim Helble for much of the information contained in this article.