Rapid Cliff Formation at Colorado National Monument, Mesa County, Colorado

Michael Shaver*

Abstract

Williams (1995) and Froede (1996) provided a dramatic example of rapid cliff formation by cliff sapping, a very rapid form of erosion. A comparison is made with a larger set of cliffs, eroded in an earlier time at Colorado National Monument. The author envisions the development of West Central Colorado topography in two phases: first, the retreat of Flood waters, carving the broad valleys (Shaver, 1998); and, second, a period of catastrophic post-Flood erosion, producing features such as the cliffs at Colorado National Monument. Catastrophic sapping may have applications to other sites in the Colorado Plateau region.

Introduction

The Colorado Plateau region features a large number of dramatic canyons. The prevailing uniformitarian interpretation is that such canyon systems are the product of gradual ongoing processes. A Biblical catastrophist interpretation must propose mechanisms capable of producing the canyons in a time frame compatible with a Biblical chronology.

The Uncompahgre Plateau is a northwest-southeast trending uplift in Western Colorado. The Colorado National Monument (CNM) is an area of the Plateau's largest sandstone cliffs near the northwest end of the plateau, on the northeast dipping flank of the Plateau near the Colorado-Utah border west of Grand Junction, Colorado (Figure 1). The park was set aside in 1911 by President Taft as an addition to the growing national park system, and its original 13,749 acres was later enlarged to 17,606 acres (28 square miles). The CNM overlooks the Grand Valley. The setting has been described in Holroyd (1994) and Shaver (1998a). The uniformitarian stratigraphic column is presented for reference as Table I.

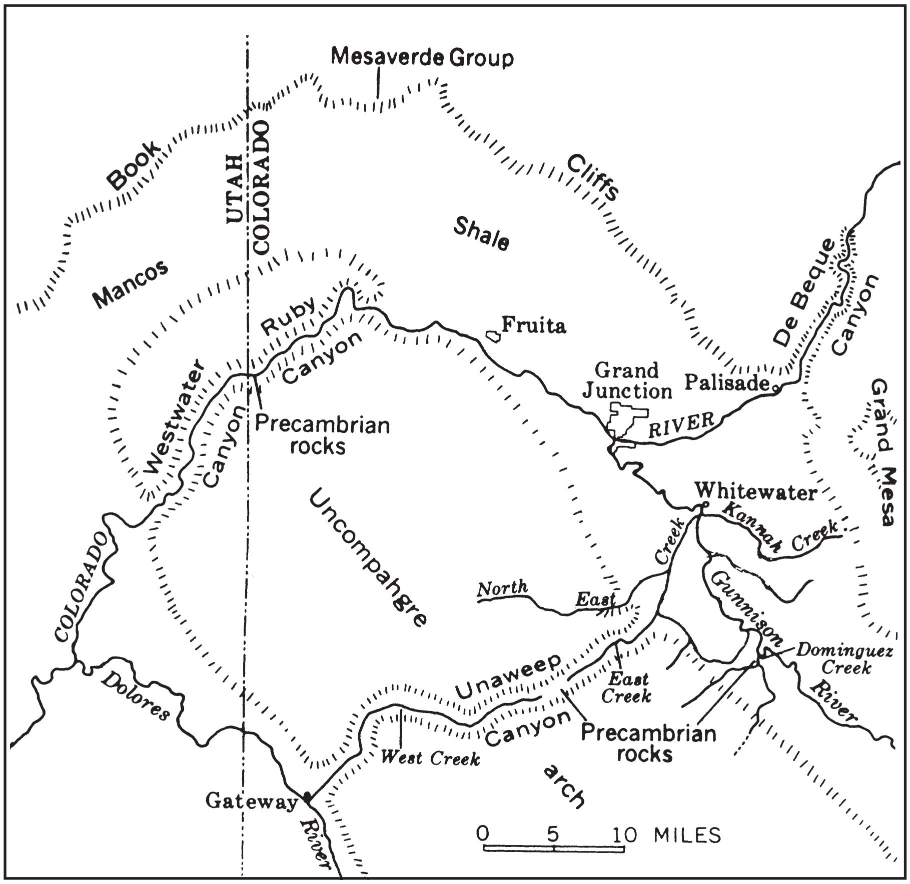

Figure 1. Map of Western Colorado showing geologic features of interest (after USGS, Lohman (1965))

Shaver (1998a) proposed that the Flood deposited the local geologic column and receding Flood waters stripped out the broad valleys, "first order features," including the Grand Valley. An evidence for the rapidity of these events is that the rock exposed at the bottoms of the valleys was apparently unlithified when exposed to river erosion. That erosion left entrenched meanders in several areas, including some on the Dolores River on the west of the

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*Michael Shaver, 1112 Highland Street, Montrose, CO 81401

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Table I. Regional Stratigraphy of Western Colorado, adapted from Lohman (1965), Prather (1982), and Young (1984).

Evolutionary Term for Time Period	Formation in Colorado Monument
Cenozoic	
Eocene	Basalt Green River Wasatch
Cretaceous	Mesa Verde Mancos Summerville Morrison
Jurassic	Entrada
Triassic	Kayenta Wingate
Permian	Chinle
Precambrian	Gneiss

Uncompahgre Plateau, where the river incised into Entrada, Kayenta, Wingate, and Chinle Formations (the same formations as the cliff formers in the park). Henry Morris notes that entrenched meanders are necessarily the product of river action on unlithified sediments (Whitcomb and Morris, 1961, p. 155).

If the large valleys (The Grand Valley, the Uncompahgre Valley) are products of retreating Floodwaters, it is possible that the canyons on the flank of the plateau (trending northeast) are the products of Floodwaters also. However, it is also possible that retreating Floodwaters did not carve the canyons of the CNM, and that they are the products of post-Flood catastrophism.

Cliff Formation at the Colorado National Monument

In the park itself are cliffs of Wingate and Entrada Sandstone, separated by a bench produced by the Kayenta Formation (Figure 2) on which the park Visitor's Center is built. A thin layer of the Chinle Formation forms a distinct red band between the Wingate and the Precambrian crystalline basement, which undercuts the Wingate Sandstone. The Uncompahgre Plateau is a long plateau with many canyons, yet the most spectacular canyon systems are is clearly those within the park. These radiate into the plateau from the Redlands fault.

The Redlands fault runs northwest-southeast along the edge of the Uncompahgre Plateau through the CNM, parallel to the edge of the plateau. It disappears beneath steeply dipping cliff formations on each side of the Monument. The Uncompahgre Plateau side of the fault is higher in elevation than is the valley side, exposing in cross-section up-thrown Wingate Sandstone cliffs. The Wingate Sandstone dips steeply near the fault on the down-thrown side, but is more horizontal on the plateau side.

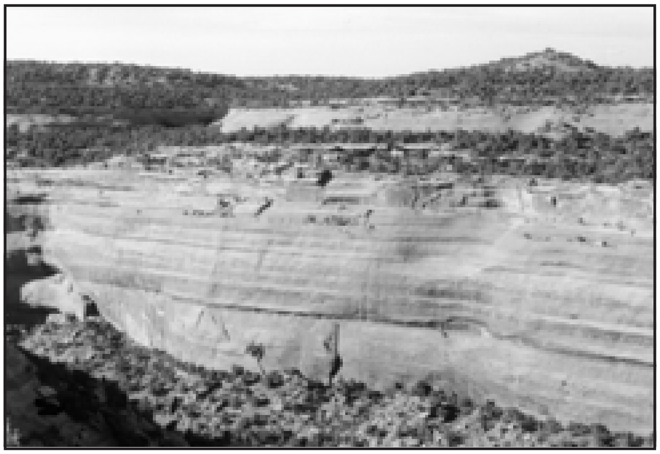

Figure 2. A typical canyon wall at the Colorado National Monument. The canyon bottom is Precambrian crystalline rock overlain by 80 to 100 feet of the Chinle Formation. It is overlain by the largest cliff former, the Wingate Sandstone, approximately 350 feet thick in this photo. It is easily distinguished by its long lateral bands. The bench is formed by the Kayenta Formation, 45 to 80 feet thick in this photo, with juniper trees. The second set of cliffs is Entrada Sandstone, roughly 150 feet thick (thicknesses taken from Lohman, 1965).

Figure 3. Steep monocline (on the left) and faulted edge of Colorado National Monument (distant), with Grand Valley on the right, near the Grand Junction entrance.

The geomorphology of the CNM displays two distinct styles of cliff formation. The first is seen in the steep walls of Wingate Sandstone which parallel the valley and the fault (Figure 3). These cliff walls have undergone little erosional retreat. The second style of cliff formation is seen in long canyon systems which run several miles into the Plateau (Monument Canyon, Ute Canyon, Red Canyon, and No Thoroughfare Canyon). Red Canyon (Figure 4) illustrates this long, narrow style of canyon.

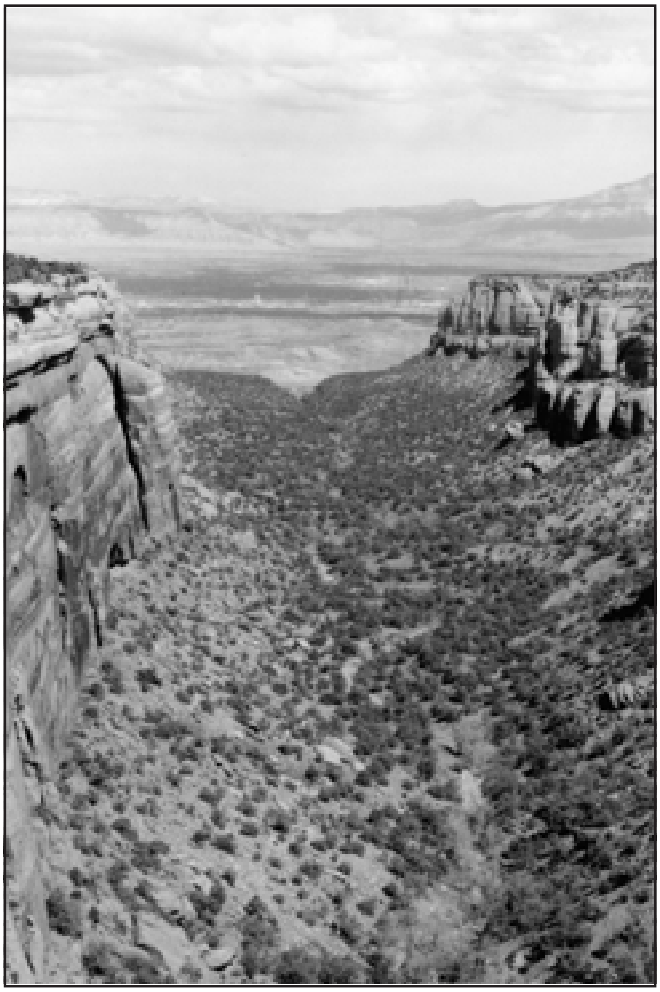

Figure 4. Red Canyon looking northeast toward the Grand Valley. The cliffs are Wingate Sandstone, the profile of the canyon bottom is seen at the end of the canyon. Utah Juniper, the trees in the canyon bottom, are roughly 8 to 10 feet high.

The prevailing uniformitarian theory of gradual erosion by present processes does not easily explain why some canyons were eroded for miles to form narrow, linear features; while other cliffs have retreated only a short distance. One prevalent uniformitarian explanation for cliff formation is the collapse of relatively small sections of canyon and cliff walls (Figure 5). This process is an extrapolation of the current process at work. This process implies that canyon walls would gradually retreat from an initial location over time. According to the prevailing view, and as I told audiences when I was a Ranger naturalist at the park:

> Recession of the cliffs away from the middle of the canyons probably was caused partly by undercutting of the soft Chinle Formation by wind and in places by streams. This allowed slabs of the overlying Wingate Sandstone and younger rocks to break off and fall into the canyons—eventually to break up and be carted off as sand and mud by the streams.
>
> But other processes are probably the ones chiefly responsible for the present shape and width of the canyons. The summer sun heats the cliff faces until they are hot to the touch, but in the desert climate of the Monument the rocks cool rapidly after sundown. Oftentimes the hot cliff faces are chilled rapidly by summer thundershowers.
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> Even more important, perhaps, is the alternate freezing at night and thawing by day on sun facing cliffs during the winter... [Lohman, 1965, p. 50]

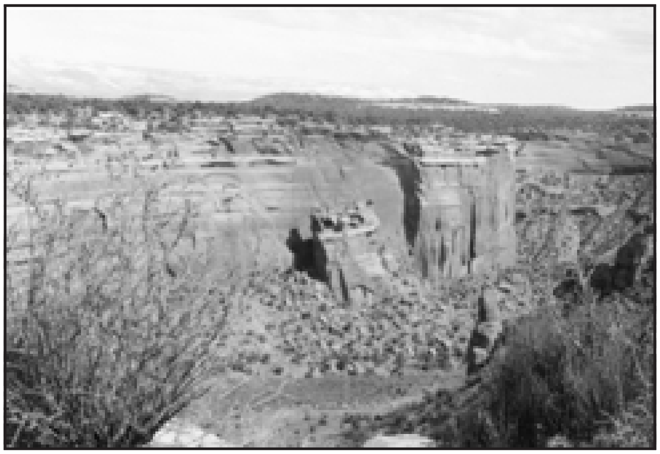
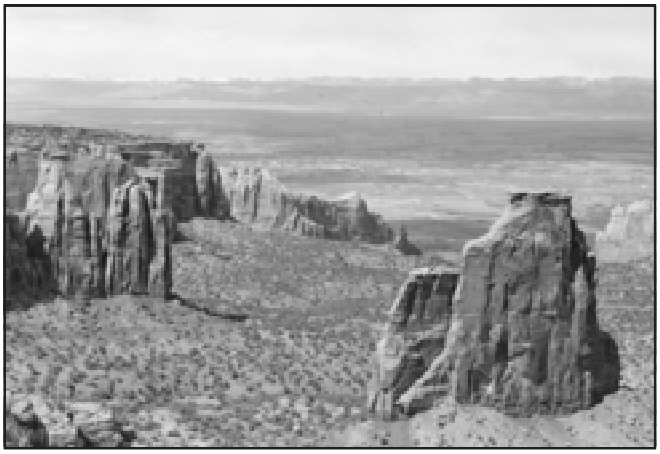


Figure 5. A collapsed section of wall at Fallen Rock Overlook. Note that the feature is so unusual that a special overlook is provided.

These are the prevailing processes in the CNM at the present, and reveal the philosophical bias of the uniformitarian view. These proposed slow processes have problems. The regional climate in the area has not remained constant. It was quite wet recently, judging from the evidence for glaciation on nearby mountains which presently have no glaciers to speak of. A terminal moraine north of the town of Ridgway (90 miles southeast) shows that large glaciers once existed in the San Juan Mountains. These deposits are considered recent by both catastrophist or uniformitarian, and demonstrate recent climatic variation.

Also, a recent a study by Holroyd (1994, pp. 99–109) on a nearby canyon looked at the size and angularity of the boulders and determined that the rubble was the same age at the middle and the edge of the canyon. The conclusion was that the present canyons developed abruptly, and not by the slow processes now leaving rubble. Otherwise there should be older rubble at the center of the valley and younger near the walls where active erosion is taking place. This argues against a gradually developing canyon in which there is a passage of time between the exposure of the canyon middle and the edge, or the beginning and the end. Also, at Fallen Rock Overlook in Ute Canyon



there is a section of a lateral wall, which appears to be collapsing down into the canyon (Figure 5). The Park Service placed a diorama explaining canyon formation by this mechanism. However, this phenomena does not appear to be representative of the canyon system. This site shows local and minor widening of the canyon, whereas the canyon systems are eroded narrow canyons.

Uniformitarian models of erosion do not explain the long-narrow shape of the canyons. The summer sun would heat the north side of Ute Canon and the winter chill would keep ice on the south side, but the canyon grew neither north nor south, but southeast, and uphill. Monument Mesa, which lies undissected between Ute Canyon and Monument Canyon and reaches almost to the fault scarp overlooking the valley, is also under the influence of summer sun and winter chill. Obviously, thermal weathering alone cannot explain canyon formation.

Seasonal streams form waterfalls at the heads of some of the canyons and thereby undercut the cliffs by eroding the softer Chinle Formation. This process may be a reason why the canyons do not end in amphitheaters more often. Prevalent amphitheaters would indicate mass wasting as the dominant process, but the current setting acts to eliminate the evidence of it. However, amphitheaters are prominent at the ends of Kodels Canyon, Fruita Canyon, Gold Star Canyon, the south end of Ute Canyon, and many smaller side canyons and unnamed canyons. This implies mass wasting as a prominent process.

A Catastrophist Proposal

A catastrophist model for cliff formation in the CNM may be found in an article describing rapid canyon formation in Georgia (Williams, 1995, pp. 29–43; amplified by Froede, 1996, pp. 39–43). The post-Flood saturation of rocks and a wet post-Flood climate at CNM would provide conditions for the agent of erosion cited in Georgia: cliff sapping. A diagram of Providence Canyon, Georgia, depicts a canyon system featuring long, narrow canyons (called "fingers" and numbered 1-9) cut into cross-bedded sand, reminiscent of CNM on a smaller scale. The canyons were developed by sapping during historic times with a rapid advance recorded in 1990 during a rainstorm. The largest Providence canyon is a half-mile long, 300 feet wide and 150 feet deep. The sapping process studied in Georgia occurs as follows:

> ...as rainwater permeates the Providence sands, it continues downward until it reaches a lens of kaolin which is impermeable to water penetration. There the groundwater moved laterally toward the canyon wall carrying sediment with it, weakening the wall. The overlying sediments, being undercut, often slump downward, forming a talus cone. [Williams, 1995, p. 34]

The photos from Georgia include Williams' Figure 6a, (reprinted as my Figure 5) show a monolith quite similar in appearance to Independence Monument in the CNM (Figure 6). Williams' Figure 13b looks remarkably like the canyons of the CNM except for scale.

At the CNM, the porous sandstone of the Wingate and Entrada Formations would have been saturated at the end of the Flood. Recharge of moisture would have been high in a wet post-Flood ice age. Water would have percolated through porous sands until reaching the Chinle Formation and Precambrian basement. Groundwater could then have moved along the top of impermeable basement rocks to the edge of the cliffs, emerging as springs along the Monument fault and undercutting the walls, similar to the example in Providence Canyon, Georgia. The spectacular cliffs of the CNM resulted from the presence of the Redlands fault, which exposed the cliff face to sapping. Elsewhere, the porous Wingate Sandstone is not often exposed, and instead the Dakota Sandstone forms less dramatic cliffs.

Springs re-supplied from high elevation may have provided abundant water along the up-thrown side of the fault. This water may have initiated canyon formation. As canyons lengthened, they would have lowered the local water table at the uppermost extension of each canyon, diminishing the tendency for sapping of the lateral walls and of the cliffs closest to the valley. Those cliffs would remain because the groundwater would be converted into rivers in the bottoms of canyons like Ute Canyon, largely stopping the sapping phenomena except at the uppermost end of each canyon. If the cliff-sapping seen in 20th century process in Georgia was more vigorous due to post-Flood, higher energy conditions, then larger-scale, more rapid canyon formation would have occurred in a post-Flood world. An increasingly dry climate and lithification of the rocks would then result in decreasing canyon carving (sapping) and the onset of the present regimen. Desert varnish on the Wingate Sandstone in many locations indicates that the cliffs are relic features.

If the canyons are post-Flood there remains the question of why there is no debris at the foot of the canyons. Again, the Providence Canyon situation may be illustrative. Three figures are presented in the Georgia article, showing a sedimentary deposit from canyon erosion after the 1990 storm. The deposit was six feet high in 1990 (26a), reduced to four and one half the following year (Figure 26b), reduced to one foot four years later (26c). Normal erosive forces have removed much, if not all, of the evidence of the 1990 catastrophe. (Williams, 1995, p. 38)

A lack of rubble is a frequent topic in discussions about the Colorado Plateau in general and this area in particular. Perhaps the post-Flood ice age would flush most of the sand out of the area (the product of sapping of relatively unconsolidated sandstone would be sand, not boulders). In other desert regions, rubble chokes canyons. Browse through photos of the Great Basin region and note the broad fans of rubble surrounding the mountains. Yet the climate is quite comparable. Yet Figures 7 and 8 illustrate the conspicuous lack of talus. Perhaps the difference is the prevalence of sapping in this site, and other processes at work in the Great Basin.

Figure 7 also illustrates Shaver's two orders of canyons (Shaver, 1998a, pp. 218–224), with the entire canyon in the foreground being spectacular yet secondary to the even larger valley between these cliffs and the Book Cliffs in the dim horizon. Similarly, note the scale of the master valley in the background of Figures 4 and 5. The cliffs in the Monument are therefore reckoned by Shaver as the product of post-Flood catastrophism, whereas the master valley would be the product of cataclysm during the Flood retreat.

Conclusion

It may be that both orders of canyons are the products of the retreat of Floodwaters. This author proposed retreating Floodwaters as the mechanism by which the adjacent Grand Valley was developed. It seems that a second order of features might be produced by another means. Other hypotheses may be forthcoming. But at present the example of rapid canyon development in Georgia holds promise in explaining the development of post-Flood canyon systems in the Colorado Plateau.

Those enamored with slow processes are quick to find analogues in present day slow processes. It is interesting that as more examples of rapid processes are witnessed, more analogues can be made to features such as these cliffs.

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Book Review

Creation Evangelism for the New Millennium by Ken Ham

Master Books, Green Forest, AR. 1999, 176 Pages, $12.

Reviewed by Don B. DeYoung

Ken Ham is the director and co-founder of Answers in Genesis (AIG). This growing ministry presently has active branches in six countries. Ken moved from Australia to the U.S. with his family 15 years ago. After several years with the Institute for Creation Research in San Diego, Ken began the AIG operations in northern Kentucky. Activities there include creation conferences, book sales, and a planned major museum/educational center.

Ken breaks new ground with this book, stating that creation evangelism "is one of the most powerful and necessary tools for God's people today" (p.146). He also calls his approach pioneer evangelism or pre-evangelism (p.100). To support this claim he explains that western society today is similar to the godless gentile world of New Testament times. In both Acts 2 and Acts 17:1-4, Paul reasoned with his audience from the scriptures because there was a common ground of familiarity (p.49). In Acts 17:18- 34, however, Paul preaches to the Epicureans and Stoics, whose philosophies were entirely foreign to theism. This time, before teaching the gospel, Paul goes "back to Genesis" to describe the Creator of the universe. Ken Ham concludes that before the seeds of the gospel can be planted today, the "field" must be prepared by removing obstacles, mainly evolution, and introducing the Father as well as the Son.

Ken fills this book with collected testimonies, with his speaking strategies, and with his heart. In one chapter he outlines history as the "Seven Cs": Creation, Corruption, Catastrophe, Confusion, Christ, Cross, and Consummation (p. 114). Ken also describes seven different groups of people that he encounters on the speaking circuit. These groups include (1) Young-earth creationists (2) Gap theorists (3) Progressive creationists and theistic evolutionists (4) Theological liberals (5) Skeptical university students (6) Agnostics and atheists, which are often professors (7) University graduates, often with new age leanings. Although Ken's list is not inclusive of everyone, it is still useful. He then generalizes this list to the family structure, explaining the frequent, sad trend downward to a lower view of scripture as generations pass from grandfolks to grandchildren (p. 143). Ken also makes the case that many Christian colleges have descended through this hierarchy of gradual apostasy.

This book deserves a wide audience. It gives encouraging motivation for the defense of biblical creation. There are many diagrams, including the "trademark" AIG creation-evolution castle picture (pp. 78, 96). The book contains endnotes and further resources, but no index.