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The Origin of Grand Canyon

Part III: A Geomorphological Problem

Michael J. Oard*

Abstract

Though the origin of Grand Canyon is of great interest to sedimentologists and structural geologists, the problem more properly rests within the field of geomorphology. That is because in spite of its imposing size, it is a water gap—one of over a thousand catalogued across the Earth. Like many other geomorphological features, most water gaps are best explained as formed during the retreating stage of the Flood. Clues to the formation of Grand Canyon are provided by the processes that occurred when the glacial Lake Missoula flood overtopped a ridge between Washtucna Coulee and the Snake River in the southeast Channeled Scabland. There are other water gaps present on the Colorado Plateau, and all are readily explained by the distinct processes of the retreating stage of the Flood. None of these features are easily explained by any dam-breach hypothesis.

Introduction

The origin of Grand Canyon has been an insoluble mystery for uniformitarian geologists for nearly 150 years. Their hypotheses—all hampered by their commitment to the uniformitarian principle—fail miserably to explain the observed field evidence (Oard, 2010a). Thus, catastrophist alternatives are well worth exploring.

Because of its high visibility with the public, creation scientists have attempted to explain Grand Canyon within their paradigm to promote the general Flood model. Research to date has yielded no spectacular breakthroughs. Initially, creation scientists attributed the canyon to late Flood erosion (Gish, 1989; Whitcomb and Morris, 1961), but in the 1980s the dam-breach hypothesis was developed (Austin, 1994; Brown, 2001; 2008). The two published versions of this hypothesis posited the catastrophic emptying of two to three post-Flood lakes caused by a dam breach, approximately 200 to 500 years after the Flood. However, these iterations of the dam-breach model do not explain the relevant field data (Oard, 2010b). In particular, neither can explain the absence of evidence for the needed lakes, and neither can explain the erosion of tributary canyons in the same event. Furthermore, the glacial Lake Missoula flood provides a good analogy for a dam-breach event, but there are significant differences between that flood's Channeled Scablands and Grand Canyon (Oard, 2004).

Since both uniformitarian and post-Flood dam-breach models consistently fail to explain the origin of Grand Canyon, another look is warranted at erosion during the Flood. Obviously, this event would have been late in the Flood, and

* Michael J. Oard, Bozeman, MT, mikeoard@bridgeband.com
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the development of a Flood-oriented sequence of geologic events by Walker (1994) provides a good framework (Figure 1). Walker (1994) proposed that the retreating stage of the Flood included two phases: an initial sheet-flow phase and a later channelized-flow stage. This two-stage sequence of events can explain the features of the Colorado Plateau, including Grand Canyon, and can make sense of field data that other models cannot explain.

Geomorphology is the study of the landscape features of Earth's surface. It is the area of geology best suited to examine Grand Canyon. Within the different classes of landscape features, Grand Canyon is best classified as a water gap. A water gap is a deep, perpendicular cut in a ridge, mountain range, plateau, or some other transverse barrier that carries a river or stream (Douglass, 2005). This paper will provide evidence for the late Flood *timing* for the carving of the canyon, based on geomorphology and a comparison with other geomorphological features of the Earth's surface. The next paper in this series will address the widespread sheet erosion event that occurred across the entire Colorado Plateau prior to the erosion of Grand Canyon. This event is called the "Great Denudation" by secular geologists. Large-scale sheet erosion occurred over vast areas of the southwest United States, caused by very broad currents that were flowing east to northeastward. It was only after the Great Denudation that Grand Canyon was eroded by more restricted channelized currents that flowed in the opposite direction. This stage will be addressed in the final paper of this series.

Over the course of this series, I will seek to demonstrate that the key to understanding Grand Canyon in its geological and geomorphological setting is the two-stage nature of the late Flood retreat off of North America. I propose that no other catastrophist or uniformitarian model has the comprehensive explanatory value of this simple Flood explanation.

Geomorphology Demonstrates a Late-Flood Origin

In very few places on Earth can geologists study sedimentary strata or structural features as well as they can in Grand Canyon. However, there is a distinction between the geology that the canyon makes visible and the canyon itself. The origin of Grand Canyon is essentially a problem in geomorphology (Meek and Douglass, 2001) because it is a landform. Geomorphology is the geological science that studies the general configuration of Earth's surface, especially the classification, description, nature, and origin of landforms and their relationships to the underlying geological structures (Bates and Jackson, 1984). Landforms are features that when taken together make up the surface of the Earth (Bates and Jackson, 1984). They include broad features such as mountain ranges, plateaus, or plains, as well as small-scale features such as hills, valleys, slopes, canyons, or alluvial fans. Geomorphology is concerned with geography, topography, shape, and other pertinent features of landforms.

The uniformitarian study of the geomorphology of Grand Canyon has not provided a solution to its origin, as Hill et al. (2008, p. 316) lament:

> The history of Grand Canyon—its age and how it formed as a physiographic unit—has been, and is, one of the great unsolved problems of geomorphology. Past workers have hypothesized practically every direction imaginable for the ancestral route of the Colorado River through the Grand Canyon region. They have set dates for drainage through the canyon as early Eocene, late Eocene, early Miocene, Miocene, Pliocene, and Pleistocene. They have described the Colorado River as being wholly, or in part, antecedent, superimposed, subsequent, consequent, obsequent, or resequent. And, they have debated (without resolution) how the disparate geomorphic sections of Grand Canyon have evolved together to create the total integrated canyon that we see today.

This uniformitarian fog around Grand Canyon is not unique; mysteries abound in the uniformitarian attempt to explain other types of landforms (Oard, 2008a). Many of those mysteries can be solved by applying a new paradigm—that of the Genesis Flood, especially the two phases of the retreating stage (Figure 1), the sheet-flow and the channelized-flow phases.

The secret to understanding landforms is the realization that each of these two distinct phases of Floodwater retreat had its own distinct erosional patterns and that the channelized-flow patterns are superimposed on top of features created by the sheet-flow phase. This is demonstrated clearly with the Colorado Plateau and Grand Canyon. But first, we will delve into the geomorphological evidence that Grand Canyon was indeed carved late in the Genesis Flood.

Since the Flood provides reasonable explanations for geomorphological features on a global scale (Oard, 2008a), and since Grand Canyon is merely one of those features, it stands to reason that the Grand Canyon was carved during the late-Flood period.

Grand Canyon: Just Another Water Gap

A water gap is defined as "a deep pass in a mountain ridge, through which a stream flows; esp. a narrow gorge or ravine cut through resistant rocks by an antecedent or superposed stream" (Neuendorf et al., 2005, p. 715). This definition is similar to that from the older *Dictionary of Geological Terms* (Bates and Jackson, 1984), and both contain genetic mechanisms that should not be part of any geological definition. What is interesting about these genetic terms (antecedent and superposed stream) is that they leave out the most popular uniformitarian mechanism for the formation of water

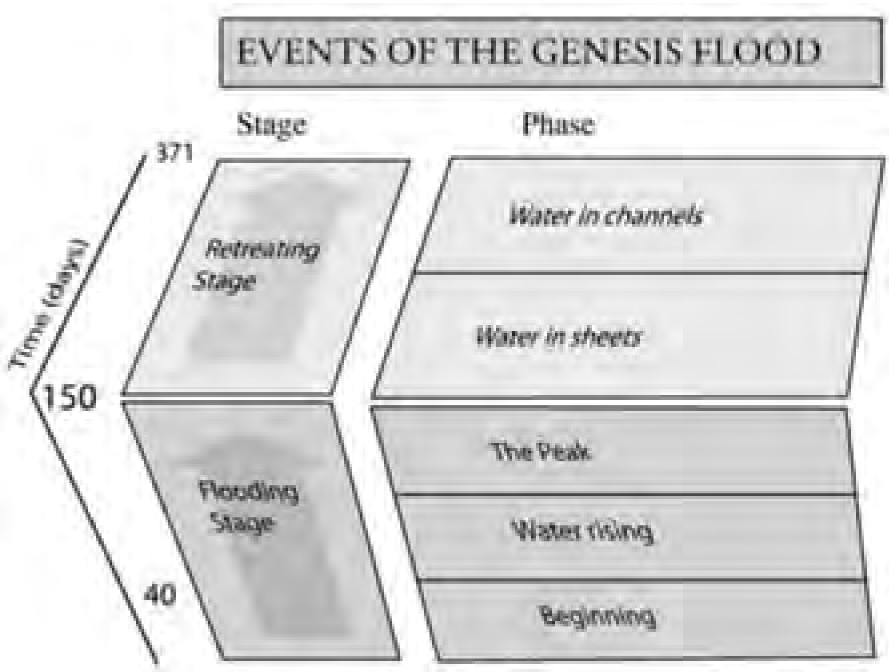

Figure 1. Tas Walker's Biblical Flood model with the stages and phases renamed (from Oard, 2008a).

gaps, that is, stream piracy, and instead use mostly rejected mechanisms for the suggested origin of water gaps.

Another problem with the definition of a water gap is that it is employed only for a gorge through a mountain ridge. In practice, a water gap refers to a gorge through any structural barrier. Such cuts are also called transverse drainage, which would also include a plateau, a series of plateaus, or even an isolated mountain. For instance, John Douglass (2005, p. 1, emphasis mine) states in his PhD dissertation on the origin of water gaps:

> Many of the world's largest river systems follow seemingly anomalous paths, incising gorges across structural and topographic highs. … Examples can be found in the Pyrenees … Apennine Mountains … Decinska Vrchovina Highland … Zagros Mountains … Zambezi River … Himalayan Mountains … Rocky Mountains … the *Grand Canyon*, and the Appalachian Mountains.

As spectacular as it is, Grand Canyon is just another *water gap* through a high barrier, the Kaibab Plateau and the other plateaus to the west. The Colorado River lies about 6,000 feet below the Kaibab Plateau in eastern Grand Canyon. Though few are as visually stunning as Grand Canyon, water gaps are common throughout the world (Oard, 2007a; 2008a). In the uniformitarian paradigm, the Kaibab Plateau supposedly began uplifting and became a barrier to rivers about 70 million years ago (Karlstrom et al., 2007). If the ancestral Colorado River was also that age, as believed by John Wesley Powell and many others, it should have cut through the Kaibab Plateau at a different location from Grand Canyon. That is because the lowest points across the plateau today—about 6,000 feet (1,829 m) msl—are located both north and south of the highest part. The highest point is a little over 9,000 feet (2,743 m). One of the most perplexing questions for uniformitarians is why Grand Canyon was cut at an intermediate height between the low and high points of the Kaibab Plateau.

There are at least a thousand water gaps on Earth, with 300 alone in the Zagros Mountains of Iran (Oberlander, 1965). Figure 2 shows the Shoshone water gap west of Cody, Wyoming, which carries the Shoshone River through a 2,500-foot (762 m) deep gorge. Ironically, this water gap is another thorn in the side of uniformitarian geology; the river could have easily flowed around the south end of the Rattlesnake Mountains, following topography (Figure 3). Water gaps are common in the Appalachian Mountains (Figure 4), and six cut through the Alaska Range from the south to the north (Figure 5) (Oard, 2008b). Though not as well known as Grand Canyon, there are deeper water gaps; the deepest cut through the Himalayas. Water gaps as a whole are easily explained by the runoff of the Floodwater from the continents (Oard, 2007a; 2007b; 2008a).

Thus, the Grand Canyon is not unique; it is one of a class of landforms found all over the world. It is similar to other water gaps on the Colorado Plateau, described below. Therefore, logic suggests that we look for the origin of Grand Canyon by investigating the origin of water gaps as a class, and all of those on the Colorado Plateau in particular. One mechanism that can account for all of these water gaps is late-Flood channelized erosion (Oard, 2008a). Interestingly, no other mechanism explains water gaps as well as the retreating stage of the Flood. Figure 6 presents a schematic of the Flood formation of water and wind gaps. A wind gap is a notch in a ridge or mountain range that was not cut quite deep enough for a river or a stream to run through it. Only wind passes through.

Although Grand Canyon is the longest water gap in the world (277 miles,

Figure 2. Shoshone water gap (view west from the eastern edge of Cody, Wyoming).

446 km), it is not the deepest. Many other water gaps are deeper, even in North America. For example, the Hells Canyon water gap along the Oregon/Idaho border reaches about 8,000 ft (2,438 m) on the Idaho side, making it the deepest canyon in North America (Vallier, 1998). Hells Canyon is a long water gap (90 miles, 145 km) when measured from the Oxbow to the mouth of the Grand Ronde River, but still much shorter than Grand Canyon.

Catastrophic Ice Age Floods Carved Water and Wind Gaps

Catastrophic floods are known to cause water gaps. Bishop (1995, p. 461) stated in regard to the glacial Lake Missoula flood: "Catastrophic divide breaching and drainage rearrangement are prominent features of the Channeled Scablands of northwest USA." One outstanding example is Palouse Canyon, formed when the water of the glacial Lake Missoula flood overtopped a ridge between Washtucna Coulee and the Snake River (Oard, 2003; 2004). The

Figure 3. Buffalo Bill Reservoir (view southeast) west of Shoshone water gap (arrow). Notice how low the land is south of the reservoir. When the sediments were higher in the valley, the river should have easily gone south around the Rattlesnake Mountains, but instead appears to have cut straight east through a 2,500-foot (760 m) deep gorge.

Figure 4. Delaware water gap on Delaware River (view north from Columbia Travel Center, milepost 4, I-80 New Jersey).

Figure 5. Nenana water gap through the Alaska Range.

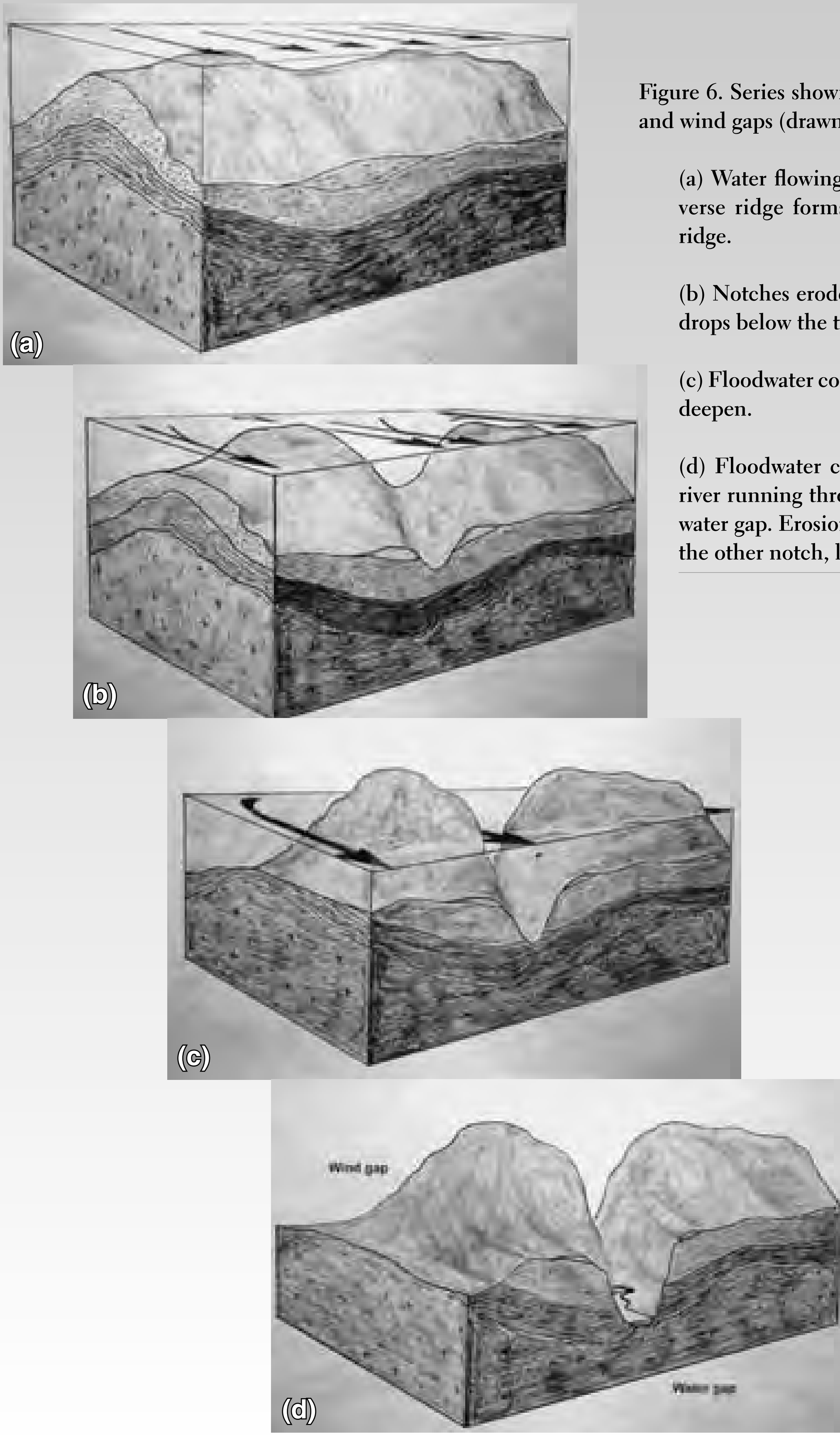

Figure 6. Series showing the formation of water and wind gaps (drawn by Peter Klevberg).

(a) Water flowing perpendicular to a transverse ridge forms shallow notches on the ridge.

(b) Notches erode farther as the water level drops below the top of the ridge.

(c) Floodwater continues to drain as notches deepen.

(d) Floodwater completely drained with a river running through the lowest north, the water gap. Erosion ceased too early through the other notch, leaving a wind gap.

Figure 7. Palouse Canyon.

flood quickly excavated a 500-foot (152 m) deep vertical-walled gorge mostly in basalt lavas (Figure 7). Before the flood, the Palouse River flowed westward down Washtucna Coulee to the Columbia River. Today it takes a left-hand turn and flows south through this gorge into the Snake River. Fifteen miles (24 km) west, another 500-foot (152 m) deep gorge was cut through the ridge, but the channelized erosion of the Lake Missoula flood failed to cut deep enough for a stream to pass through, leaving it a wind gap. Numerous other wind gaps are found in the Channeled Scablands.

The glacial Lake Missoula flood provides an outstanding example of how late-Genesis Flood channelized erosion would rapidly form water and wind gaps. Although the glacial Lake Missoula flood was from a dam breach, that mechanism, which eroded both water and wind gaps in the Channeled Scablands, cannot serve as an analogue for a dam-breach model for Grand Canyon, because the water and wind gaps were not caused by the initial breach through a barrier, such as is posited for Grand Canyon. Instead, the proper analogy is found in that a large flood of water was able to erode these gaps once it overtopped a ridge. This would be similar to the retreating Floodwater flowing perpendicular to a structural barrier (Figure 6). Thus, the Genesis Flood appears to be the only possible mechanism for cutting the numerous water and wind gaps across the Earth—Grand Canyon simply being one water gap in this pattern.

Anomalous Drainage Typical of the Colorado Plateau

The Colorado River is not the only river on the Colorado Plateau that flows through a barrier, which it could have more easily bypassed. Water gaps are common on the Colorado Plateau (Figure 8), and the larger rivers commonly pass through structural barriers (Hunt, 1956). Starting in the northeast and circling in a clockwise direction around the edges of the Colorado Plateau, we will survey these rivers.

Along the northern boundary, the Green River passes through the high Uinta Mountains in a very narrow water gap called Lodore Canyon (Figure 9). This water gap is number 2 on Figure 8. It is 2,300 ft (701 m) deep (Hansen, 1986). Strangely enough, if the river had flowed only a short distance (3 km) east, it could have passed around the eastern end of the Uinta Mountains at a lower elevation (Powell, 2005). To add to the puzzle, the Lodore water gap is only 5 million years old or late Tertiary in the uniformitarian timescale—in other words quite recent relative to the Uinta Mountains (Powell, 2005).

Before passing through Lodore Canyon, the Green River also enters the Uinta Mountains farther west but then turns and flows back out of the mountains, ending up only half a mile (804 m) down a valley from where it entered (Figure 10), forming Horseshoe Canyon (number 1 on Figure 8), first described by John Wesley Powell (1895, p. 137):

> Where the river turns to the left above, it takes a course directly into the mountain, penetrating to its very heart, then wheels back upon itself, and runs out into the valley from

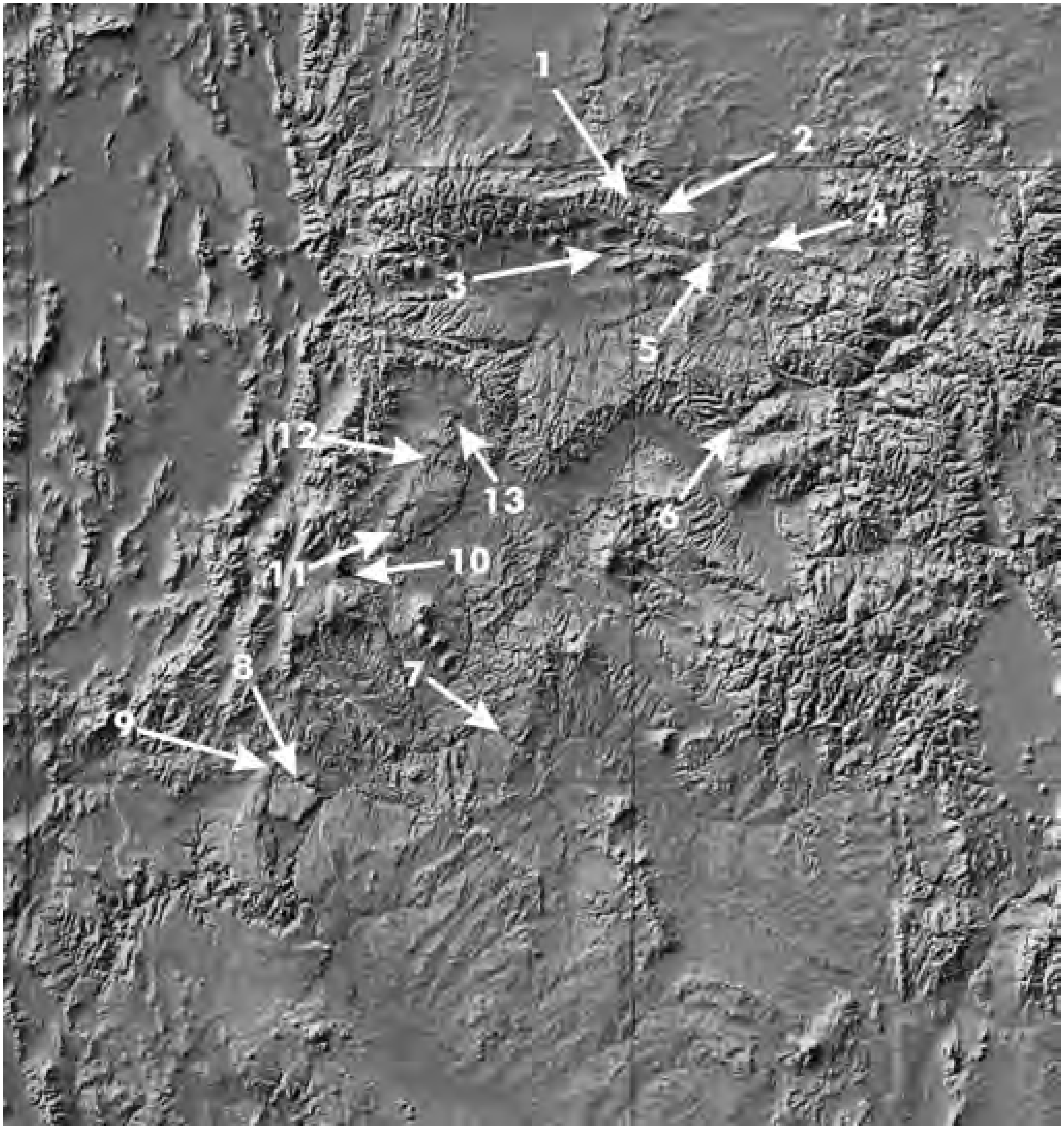

Figure 8. Thirteen major water gaps on Colorado Plateau. A major water gap is a gorge through a ridge, mountain range, or some other barrier when the river could have gone around the obstruction at a lower altitude. Map background provided by Ray Sterner and drawn by Peter Klevberg.

which it started only half a mile below the point at which it entered; so the canyon is in the form of an elongated letter U, with the apex in the center of the mountain. We name it Horseshoe Canyon.

After Lodore Canyon and before passing Dinosaur National Monument, the Green River cuts a canyon over 2,500 ft (762 m) deep through the Split Mountain anticline (Figure 11 and number 3 on Figure 8). Part of the

Figure 9. Lodore Canyon, Green River, through the eastern Uinta Mountains (courtesy of USGS).

Figure 10. Horseshoe Canyon (from Powell, 1895, p. 136). Notice how the Green River flows into the Uinta Mountains and then comes back out in the valley half a mile away.

course of the river runs along the long dimension of the anticline.

Moving east, the Yampa River on the northeastern Colorado Plateau emerges from the Rocky Mountains foothills into open country and then "crosses two anticlinal upwarps [numbers 4 and 5 of Figure 8] with apparent disregard for rock structure" (Hunt, 1956, p. 68; also see Hansen, 1986, pp. 64–67). An anticline is a fold in sedimentary rocks that is generally convex upward and whose core contains older rock. One anticlinal ridge is Cross Mountain, Colorado, in which the Yampa River passes through in a 1,000-ft (305 m) deep, vertically-walled gorge. Hard rocks that have been elevated should be able to deflect a river, but that is not the case with the Yampa River. Although it could have easily gone around these anticlines through softer beds, it did not.

Grand Canyon is not the only place the Colorado River follows an unexpected course. The river enters the Colorado Plateau at Rifle, Colorado, about 60 miles (97 km) northeast of Grand Junction. There it crosses the Grand Hogback (Hunt, 1956) (number 6 on Figure 8). In southeast Utah, it flows through valleys marked by eroded anticlines that are cored (at depth) by salt. Instead of following the low topography, the river cuts at right angles across the valleys. Baars (2000, p. 66) exclaimed:

> For some unknown reason the major rivers did not flow along the valleys, as is customary. Instead, such large rivers as the Colorado and the Dolores cut sharply across the valleys in strange fashion. The Colorado River crosses Moab Valley near the town of Moab at nearly right angles, and the Dolores River was found to do the same unusual trick in another valley southeast of Moab. This incongruity caused the pioneers to name the latter valley "Paradox Valley" for the paradoxical geomorphic phenomenon.

Downstream, below its junction with Green River, the Colorado obliquely crosses the Henry Mountains basin (Hunt, 1956).

The San Juan River is another example of this unusual drainage (number 7 on Figure 8). It crosses the crest of

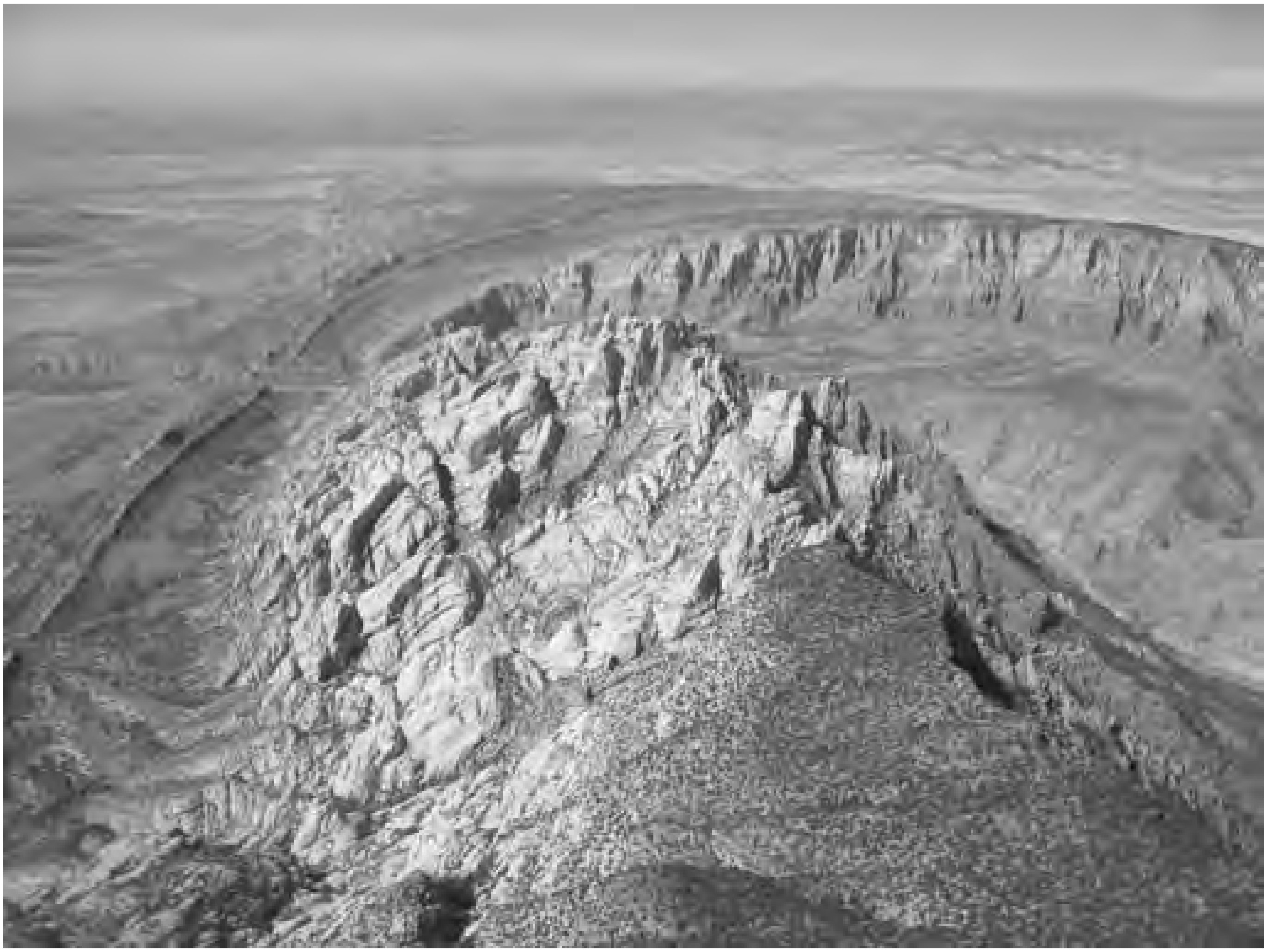

Figure 11. Aerial photo of the western Split Mountain anticline. The Green River, which passes through the anticline, could have easily passed around to the north and west. The anticline is greatly eroded based on the tilted erosional remnants seen around the anticline. The top of the anticline has been significantly eroded (view west, photo courtesy of Tony Kostusik).

the Monument Upwarp, including the anticlines on the upwarp. Baars (2000, p. 92, 93) is mystified:

> The San Juan River, a major tributary of the Colorado River, flows across the width of the prominent Monument Upwarp with the same arrogance with which the Colorado flows across the Kaibab uplift through Grand Canyon. The San Juan was not as accomplished at dissecting the earth as the Colorado, but carved canyons of 1,500- to 2,000-foot depths for many miles as it crossed the uplifted structure … The river crosses upturned beds of Mesozoic and Permian formations without difficulty.

In the process, the San Juan River carved entrenched meanders across the crest of the uplift, of which the Goosenecks are the most famous (Figure 12).

In the western Colorado Plateau, the Paria Plateau rises up to just over 7,000 ft (2,134 m) just west of the northern Kaibab Plateau. House Rock Valley separates the two plateaus. The Paria River starts in Utah east of Bryce Canyon National Park and flows south, cutting through the higher Paria Plateau (number 8 on Figure 8) before entering the Colorado River just east of Lee's Ferry. The river could have gone around the plateau at lower altitudes. A small stream starts on the high plateaus of south central Utah and moves southeast through the Kaibab Plateau in a gulch 1,500 feet (457 m) deep (number 9 on Figure 8). The stream crosses House Rock Valley without deflection and enters another gorge in the Paria Plateau and enters the Paria River within the Paria Plateau (Babenroth and Strahler, 1945). The origin of this drainage into

Figure 12. The goosenecks on the San Juan River through the Monument Upwarp

the Paria Plateau is highly problematical (e.g., Babenroth and Strahler, 1945, p. 145).

In the northwest Colorado Plateau, the upstream section of the Fremont River and several associated streams flow across the Waterpocket Fold in Capital Reef National Park (Harris et al., 1997) (number 10 on Figure 8). Starting from the north, the Price, San Rafael, and Muddy Rivers (numbers 13, 12, and 11, respectively on Figure 8) all cut across the San Rafael Swell instead of going around the anticline (Baars, 2000; Hunt, 1956).

Baars (2000, p. 195) summarized the anomalous drainage pattern on the Colorado Plateau:

> Many enigmas remain. The primary problem in a nutshell is: How can a river carve its path directly into the very crest of a major uplifted area and come out the victor?

The Colorado Plateau is geomorphologically unique in that river after river crosses the larger uplifts, showing no regard for the convention or the laws of nature. Instead of flowing around the high structural features, as any respectable river would do, the rivers of the plateau flow directly into the uplift. They carve impressive channels across the highest parts, and emerge on the opposite flank as if this were the easiest thing to do.

He eliminates stream capture, one of their main hypotheses for the origin of water gaps (see Oard, 2010a) as the explanation for the San Juan River crossing the Monument Upwarp:

> For example, why are the entrenched meanders of the "Goosenecks of the San Juan River" perched on top of the Monument Upwarp, where headward erosion and piracy should

> have been most active? Headward erosion of stream courses does NOT produce meanders of this type (Baars, 2000, p. 199, emphasis in original)!

In summary, the Colorado Plateau is littered with water gaps; Grand Canyon is just the most impressive. The distribution of these water gaps (Figure 8) shows that flow late in the Flood was focused on the southwest Colorado Plateau. The same mechanism that carved Grand Canyon also eroded other water gaps, probably at the same time. That is another major problem for the dam-breach hypothesis; even if it could explain Grand Canyon, it could not explain all the other water gaps on the plateau, much less those on other continents. Runoff from a global flood, however, is a very reasonable explanation for these globally distributed, unique geomorphological features.

Deep Canyons Carved by Late-Flood Channelized Erosion

Not every canyon in the world is a water gap, but some are of a scale equal to or greater than Grand Canyon. That volume of erosion demands large volumes of water with elevated current velocities, operating at a scale unknown today. Only the Flood can provide a reasonable explanation, and the stubborn refusal of uniformitarian geologists to even consider it as an alternative model demonstrates how tightly they are bound to their subjective paradigm—quite the opposite of the cool Enlightenment rationality that they project to the public.

There are many deep canyons of the world, some with vertical walls, which start at high elevations near ridge tops and descend to lower elevations, sometimes to sea level. The vertical walls strongly suggest the youth of these features (Oard, 2008a). A magnificent example is Copper Canyon in the Sierra Madre Occidental Mountains of the state of Chihuahua, northwest Mexico (Fisher, 2001), about 600 miles (966 km) south of Grand Canyon. Copper Canyon is deeper than Grand Canyon and about 100 miles (161 km) long, including some meanders. The region is arid, though summer thunderstorms are common.

Chihuahua contains four other canyons—all deeper than Grand Canyon. Both Grand Canyon and Copper Canyon are cut in high terrain and descend westward to lower elevations, near the Gulf of California in the case of Copper Canyon. However, there is one major difference: Grand Canyon cuts through high terrain, while Copper Canyon starts on a high ridge near the mountain divide and follows the topography down toward the ocean. Unlike Grand Canyon, it is not a water gap, though the depth of erosion is the same.

The location and features of Copper Canyon are incompatible with a dam-breach event. Yet these amazing features both require vast volumes of energetic water flowing over large areas at high altitudes—a good description of the late-Flood runoff.

Summary

Grand Canyon is a water gap, a landform common to many other places on Earth, though few are as spectacular or well known. Because it is a landform, its origin is a problem for the discipline of geomorphology. Grand Canyon is not unique; more than 1,000 water gaps have been documented across the globe. But geomorphologists cannot credibly explain the canyon or other water gaps. That is because their uniformitarian paradigm forces them toward low-energy, longtime explanations, usually involving the rivers currently flowing through these water gaps.

The Flood paradigm allows us to examine the water gaps independent of the rivers that flow through them. This simple transition solves many of the problems that have tied uniformitarians in knots for 150 years. Furthermore, the two-stage retreat of the Flood's water off the continents provides an answer for many other puzzling mysteries. At Grand Canyon, it provides a mechanism for both the Great Denudation of the Colorado Plateau and the erosion of Grand Canyon and its tributaries—as well as all the other mysterious water gaps scattered across the plateau. The relative youth of Grand Canyon and the other water gaps further supports the late-Flood interpretation, and the existence of so many water gaps with vertical walls suggests that uniformitarian dates of these features are far too old.

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