The Uinta Mountains and the Flood

Part II. Geomorphology

Michael J. Oard*

Abstract

During the late stages of the Flood, uplift and erosion of the Uinta Mountains created planation surfaces. The highest is the Wild Mountain upland surface. A lower broad pediment, the Gilbert Peak erosion surface, is seen as erosional remnants on the north, east, and south sides of the mountains and is best observed on the north side. Later significant erosion of the uplifted core created the Bishop Conglomerate, a formation of large quartzite boulders covering much of the Gilbert Peak erosion surface. Afterwards, the Gilbert Peak surface was dissected and many water gaps were cut, providing courses for the Green and Yampa Rivers. The final geomorphic event in the Uintas was post-Flood glaciation. Thus, most major geomorphological features found in the Uinta Mountains are readily explained by the recessive stage of the Flood. Implications of this interpretation include: (1) a very late Cenozoic post-Flood boundary in this region, and (2) Flood, not post-Flood, deposition of the Green River Formation.

Introduction

Geomorphology offers much evidence of the Flood. Features inexplicable to uniformitarians are readily explained by the Flood's recessional stage (Walker, 1994) and its two phases: (1) the abative phase, or sheet-flow phase, when wide currents were flowing off the continents, and (2) the dispersive phase, or channelized-flow phase, when currents became narrow and were forced to channel around mountains and plateaus as the continents continued uplifting (Figure 1). Flood recession eroded thousands of feet of rock (Figure 2) and created dramatic landforms, including erosional escarpments, planation surfaces, pediments, erosional remnants, lag deposits of resistant cobbles and boulders, the vast continental margin sedimentary aprons, and their incised submarine canyons (Oard, 2008a). These features are difficult if not impossible to reconcile with the theories of secular geology.

One area that illustrates this diluvial geomorphology is the Uinta Mountains. The geology of the area is best explained by Flood processes (Oard, 2012), and its landforms are best explained by Flood runoff. The timing of these features constrains the post-Flood boundary and consequently places the deposition of the controversial Green River Formation during the Flood, not afterwards (Oard and Klevberg, 2008).

Large Erosional Event

The Uinta Mountains of northeast Utah and northwest Colorado (Figure 3) run east-west for 125 miles (200 km)

* Michael J. Oard, Bozeman, MT, mikeoard@bridgeband.com

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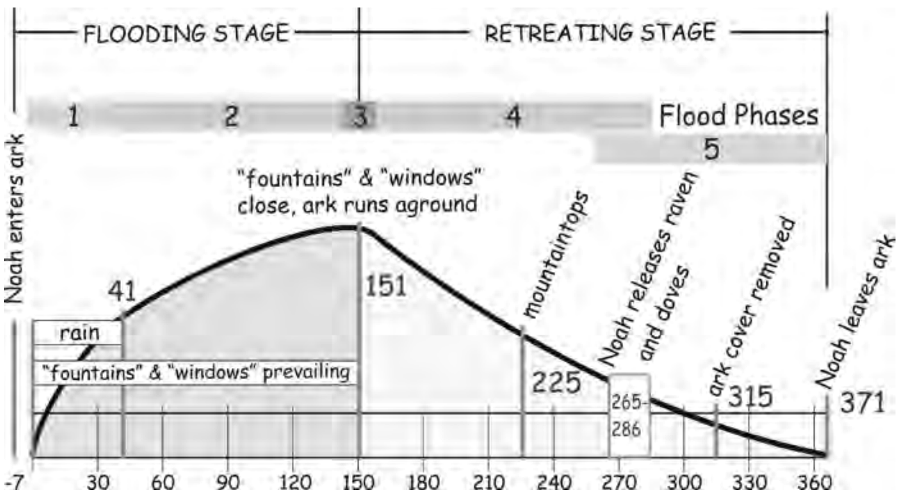

Figure 1. Walker's biblical geological timescale of the Flood related to events in the Flood, including the rise and fall of the water (drawn by Dr. John Reed).

and about 40 miles (65 km) north-south. They were uplifted by as much as 40,000 feet relative to the adjacent Green River and Uinta Basins (Hansen, 2005). As a result, significant erosion ensued. The Paleozoic, Mesozoic, and early Cenozoic strata (terms used for convenience) were eroded off the axis of the Uinta Mountains, exposing Precambrian quartzite, which forms the core of the Uintas (Figure 4). Uneroded, tilted Phanerozoic rocks on both limbs of the Uinta anticline (Figure 5), some at very high angles, show late uplift of the mountain range. Some less resistant rocks were eroded into parallel strike valleys. Uplift and erosion are said to have occurred in the Cenozoic. From a diluvial point of view, both uplift and erosion indicate processes consistent with the recessional stage of the Flood.

Wild Mountain Upland Planation Surface

Summit flats, or planation surfaces, occur on many ranges in the Rocky Mountains (Small and Anderson, 1998). Their origin has been a mystery to uniformitarian geomorphology for over 100 years (Madole et al., 1987; Mears, 1993). Most think these surfaces formed in the mid- to late Cenozoic, but there is no convincing explanation or mechanism for these elevated erosional surfaces.

The summit flats on top of the Uinta Mountains cover 75 mi^2 (193 km^2) and occupy 43% of the unglaciated areas above 11,000 feet (3,400 m). They likely represent erosional remnants of a single preexisting large planation surface (Munroe, 2006). A lower planation surface is also present, called the Gilbert Peak erosion surface (see below). The summit flats and highest elevations of the Uintas remained unglaciated during the Ice Age, as shown by pattern ground, polygonal-shaped cracks filled with debris, and uneroded blockfields, a thin accumulation of angular blocks of the bedrock (Munroe, 2007). Both features are indicative of a cold climate in unglaciated areas. Instead, glaciers were restricted to the high valleys with

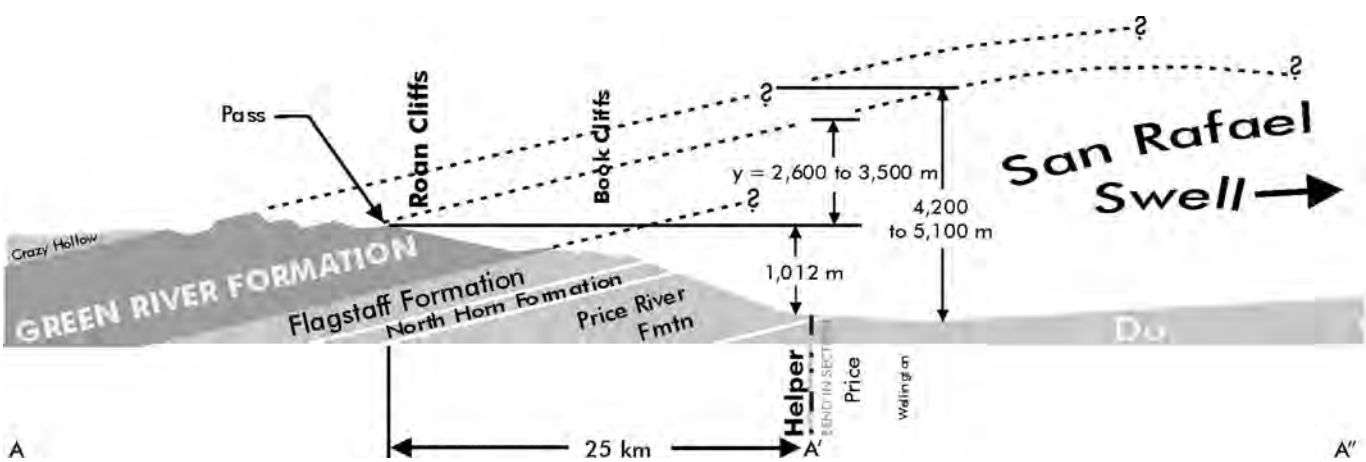

Figure 2. Cross-section of the sedimentary rocks of the north limb of the San Rafael Swell (drawn by Peter Klevberg). Dashed lines with question marks show the strata projected up over the San Rafael Swell, assuming no change in thickness. Du means diluvial undifferentiated. Note that the total erosion is about 14,000 to 17,000 feet (4.2 to 5.1 km).

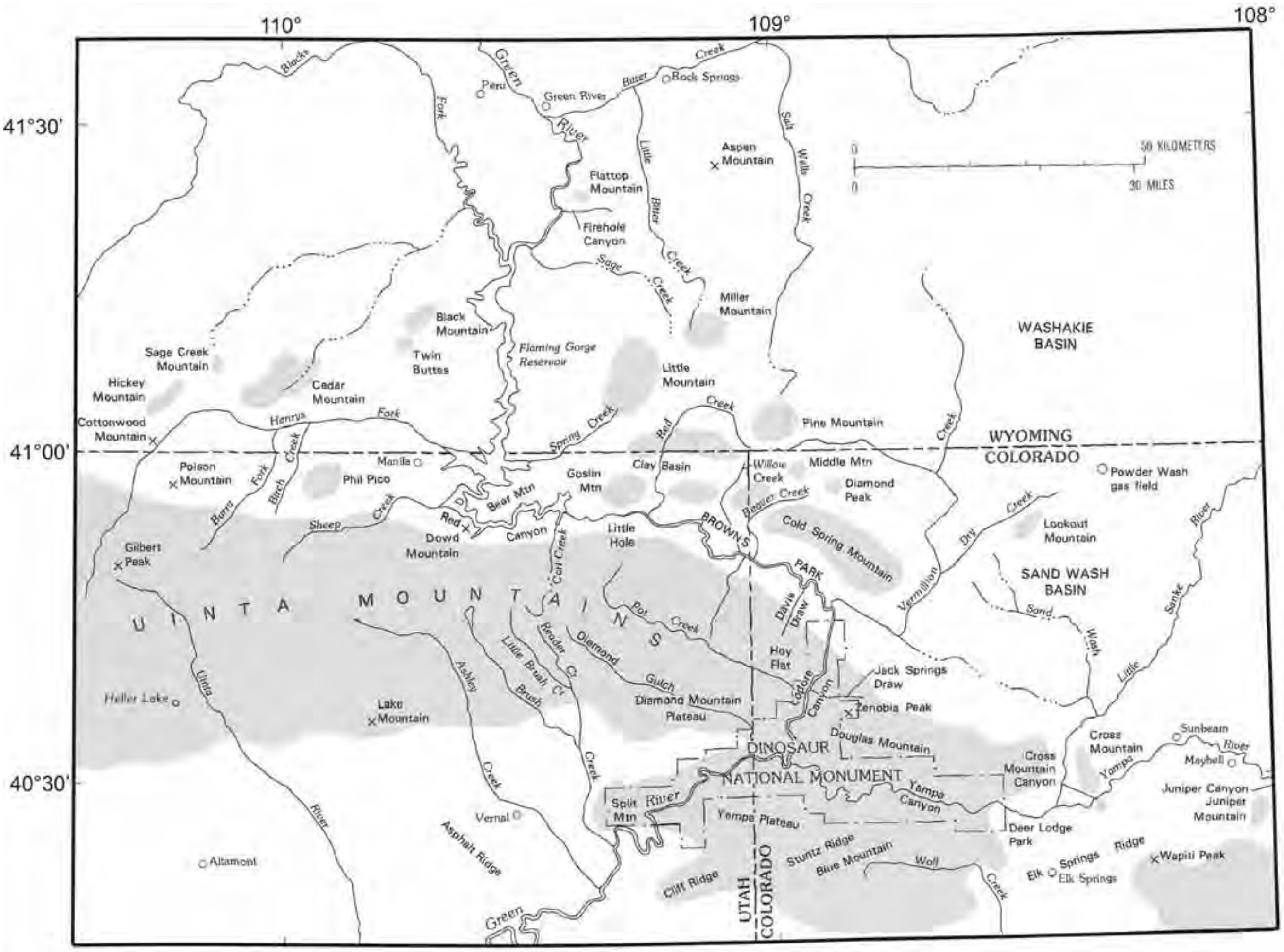

Figure 3. Regional setting of the Uinta Mountains with principal features. Grey represents mountains areas (from Hansen, 1986, p. 4).

Figure 4. The eroded Precambrian quartzite core of the western Uinta Mountains.

lobes extending down to lower valleys.

Hansen (1986) named the summit flats the Wild Mountain upland surface. Like practically all planation surfaces, it truncates the underlying formations without regard to rock structure or hardness. The planation surface follows the eastward plunge of the Uintas anticline and likely extends as far as Cross Mountain, a north-south ridge just east of the Uintas (Figure 6).

Initial confusion over the number and names of the planation surfaces has gradually been resolved. Wilmot Bradley (1936) thought there were four, and he called the *highest* the Gilbert Peak

Figure 5. Northward dipping sedimentary rocks on the north flank of the Uinta Mountains.

erosion surface. But he also recognized that extensive faulting and warping had made the identification and correlation of surfaces difficult. Some have suggested that there is only one planation surface—the Gilbert Peak—but there seem to be two distinct planation surfaces.

Following their paradigm of earth history, secular geologists assume that planation surfaces form as a result of slow erosion over millions of years in a stable tectonic setting.

> It is generally accepted that the end result of a long period of erosion under relatively stable tectonic conditions results in a surface of low relief, called a peneplain or pediplain (Zhang, 2008, p. 171).

The terms "peneplain" and "pediplain" are names for the end products of erosion and represent two different hypotheses of the origin of erosional surfaces. However, these terms have been almost universally discarded.

However, planation surfaces are yet another instance where geological theory conflicts with geological fact. Planation surfaces are flat or nearly flat erosion surfaces. We do not observe erosion forming flat surfaces today; in fact, many planation surfaces today are being dissected by erosion (Oard, 2008a). Thus, contrary to the actualist principle of geology, large, flat planation surfaces formed only at some time in the past and are not forming today. No theory based on uniformitarian principles has been able to explain this phenomenon.

Furthermore, every secular hypothesis addresses the formation of large, rolling-to-flat erosional surfaces near sea level. Elevated planation surfaces, such as those found in the Rocky Mountains, would then have formed prior to uplift.

Figure 6. The Wild Mountain upland surface at the top of Cross Mountain, a north-south mountain just to the east of the Uinta Mountains. The lower flat surface is the Gilbert Peak erosion surface capped by Bishop Conglomerate

But the evidence suggests otherwise. In other words, these surfaces formed at high elevations after uplift. There are virtually no mechanisms in the universe of observed geological causes that could account for these elevated planation surfaces (Calvet and Gunnell, 2008).

In an attempt to solve this problem, two hypotheses have been advanced. One is called the *piedmont backfilling and graded pediment hypothesis*. It posits infilling of adjacent basins to the height of the mountains (Babault et al., 2005), followed by erosion of the mountains to a flat surface at the same elevation as the top of the debris. The backfilled debris is a surrogate for "sea level" in the old hypotheses. Then the debris is eroded back down into today's valleys. This hypothesis has been applied to the Pyrenees Mountains of northern Spain. However, it has been criticized for lack of evidence, especially that there is no indication that adjacent basins were ever filled to the elevation of the planation surface (Gunnel and Calvet, 2006). Also, this theory would not apply to lower elevations near sea level. Even in the Pyrenees, the theory strains credulity. The planation surface on the axis of the eastern Pyrenees Mountains is believed to be Miocene in age (early late Cenozoic). In other words, the planation surface has not been eroded at all, while at the same time thousands of feet of sedimentary rock and conglomerate were supposedly erased from the semiarid Ebro Basin to the south. This theory does not seem reasonable.

The second hypothesis is called the *antiplanation hypothesis*, but it is also referred to as the *periglacial* or *cryoplanation* hypothesis. It proposes that the flat surfaces formed at elevation and very recently, during the last ice age. Its mechanism is freeze-thaw weathering by late spring snow banks that locally flatten rough terrain. In that sense, it can be considered a corollary of the weathering hypothesis, and like that theory it has many problems (Oard, 2011b). The observed process results in the formation of cirques and small flat terraces on ridges and hillslopes but rarely on the summits of mountains or hills (Nelson, 1998).

Munroe (2006) applies this theory to the Wild Mountain upland surface of the Uintas, but he does not explain the mechanism in detail. Others are critical of the antiplanation hypothesis because it "bestows on periglacial processes [cold climate weathering] formidable powers of rock beveling that have been vigorously disputed" (Calvet and Gunnell, 2008, p. 152). It also cannot explain planation surfaces at variable elevations, which would be subject to differential weathering. Also some mountaintop planation surfaces were not in mountains that were glaciated in the valleys. Calvet and Gunnell (2008, p. 154) summarize the problems with this hypothesis:

> The periglacial hypothesis is inconsistent because (i) it cannot explain any specifically observed local occurrences, and (ii) collectively it does not have the capacity to explain all occurrences across the region.

In summary, the origin of these planation surfaces is still a major conundrum, especially if the idea of reduction of a rough land to sea level is tossed out.

> The question of erosion surfaces in mountain belts is a geomorphological conundrum as old as geomorphology itself. Given that in the Rocky Mountains, this issue still remains polarized after >100 years of controversy between an "uplifted peneplain" school and an "antiplanation" school, we feel that healthy debate should be extended to the Pyrenean orogeny (Gunnell and Calvet. 2006, p. 1).

The Gilbert Peak Erosion Surface

The Gilbert Peak erosion surface is the second, lower planation surface. It is actually a large dissected pediment most prominently displayed on the north side of the Uintas (Hansen, 1986). It was named by Wilmot Bradley (1936) based on his investigation of extensive remnants on the north and west slopes of Gilbert Peak on the north flank of the western Uintas. It slopes gradually northward, and traces are found about 60 miles (100 km) north (Figure 7). Some of the erosion surface, especially that close to the mountains, is bare rock (Figures 8 and 9), but most is capped by Bishop Conglomerate (see discussion below).

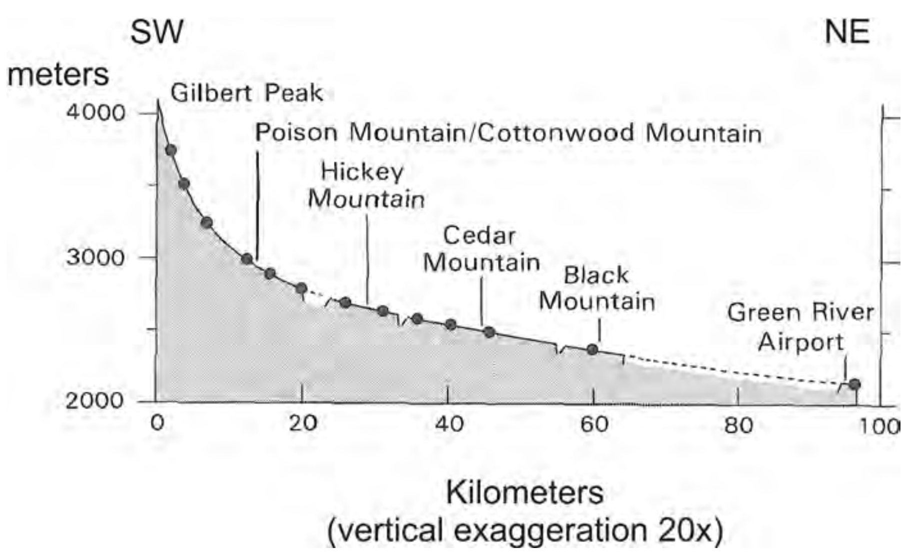

Figure 7. Location of remnants of the Gilbert Peak erosion surface from around Gilbert Peak northward to the town of Green River (from Hansen, 1986, p. 10).

Figure 8. The Gilbert Peak erosion surface with little Bishop Conglomerate on top in the background along the northern edge of the Uinta Mountains. View north across Red Canyon cut into the Uinta Mountain Group quartzite and the path of the Green River, now occupied by the water of Flaming Gorge.

Figure 9. A lake on the Gilbert Peak erosion surface with the higher northeastern Uinta Mountains in the background.

Figure 10. Diamond Mountain in the southeast Uinta Mountains where the Gilbert Peak erosion surface truncates south dipping strata at about a 15° angle.

The Gilbert Peak erosion surface truncates hard and soft rocks of all ages (Bradley, 1936; Hansen, 1986). Figure 10 shows truncated strata at Diamond Mountain Plateau, a remnant of the Gilbert Peak erosion surface. It is also capped by Bishop Conglomerate. Hansen (1986, p. 10) states:

> The Gilbert Peak surface truncates hard and soft rocks alike, with little regard for lithology or structure, although resistant rocks stand well above the surface locally as hogbacks or monadnocks.

The monadnocks are usually close to the mountains. But modern-day erosion preferentially erodes soft rocks, resulting in the dissection of the landscape, not the formation of planation surfaces.

Erosion after the formation of the Gilbert Peak erosion surface, especially on the north side of the Uintas, dissected the pediment into erosional remnants capped by the Bishop Conglomerate. There are no soil horizons preserved beneath the Bishop Conglomerate (Bradley, 1936). In other words, formation of the planation surface occurred at the same time or was quickly followed by the deposition of the Bishop Conglomerate, and that deposition itself would have been rapid, given the current strength necessary to transport its cobbles and boulders.

The Gilbert Peak erosion surface before dissection was well developed on the north side of the Uinta Mountains. Because of faulting and erosion, the surface is at a lower altitude next to the mountains than farther north away from the mountains. The age of the surface is regarded as Oligocene by uniformitarian geologists (Hansen, 1986), yet it is little eroded on the top.

> The tops of these mesas [just north of the Uinta Mountain axis] are slightly dissected by differential erosion, mostly along shaly zones, but viewed from a distance, most of them appear as almost perfectly flat plains. Cold Spring Mountain

Figure 11. Dutch John bench, an erosional remnant of the Gilbert Peak erosion surface, which is so flat that an airport was built on top of it (view west).

Figure 12. The north edge of Dutch John bench, showing the northward tilt of the Uinta Mountain Group quartzite (view west).

> is especially noteworthy, but Dutch John Bench alone is almost pristine, virtually unaltered by erosion since middle Tertiary time. Being bare of gravel, except locally, all these remnants must have been near the mountainward limit of the pediment (Hansen, 1986, p. 12).

Such pristine features indicate youth and not an age of Oligocene (about 30 Ma). Figure 11 shows the flatness of the erosional remnant of the Gilbert Peak erosion surface on Dutch John Bench, where there is an airport. Figure 12 shows that the erosion surface bevels northward dipping quartzite of the Uinta Mountain Group.

It is interesting that the eastern Pyrenees Mountains are generally similar to the eastern Uinta Mountains in having a dissected mountaintop planation surface and a lower altitude pediment along the edge of the dissected mountains (Calvet and Gunnell, 2008).

The Bishop Conglomerate

Cobbles and boulders of the Bishop Conglomerate cover most of the Gilbert Peak erosion surface (Rich, 1910). In the eastern Uinta Mountains, this formation is predominantly composed of red Uinta Group quartzite eroded from the heart of the mountains (Figures 13 and 14). The conglomerate ranges up to about 650 feet (200 m) thick on the southeast end of the Diamond Mountain Plateau in the southeast Uinta Mountains (Hansen, 1986). Boulders up to 6.5 feet (2 m) long are found only a few miles from their nearest possible source. The boulders generally decrease in size away from the Uinta Mountain axis, although Hansen (1986) reported a 6.5 feet (2 m) boulder of the quartzite on Miller Mountain, 15 miles (24 km) north from the nearest possible source. The boulders are commonly rounded to subrounded, having been eroded by water. Figure 15 shows a subrounded boulder about 6.5 feet (2 m) long axis on the Gilbert Peak erosion surface north of Blue Mountain, southeast Uinta Mountains.

The Bishop Conglomerate was probably once nearly continuous along the north, east, and south sides of the Uinta Range (Hansen, 1986). Present-day rivers and the Browns Park Formation (that infilled the syncline from the collapsed east dome of the Uintas) (Figure 16) postdate the Bishop Conglomerate (Bradley, 1936; Hansen, 1986, p. 8), although it is possible that some of the Bishop Conglomerate was deposited late during the deposition of the Browns Park Formation.

Water Gaps

The Green and Yampa Rivers flow through numerous water gaps in the Uinta Mountains (Oard, 2010a). A water gap is "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). In other words, a water gap is a perpendicular cut through a mountain range, ridge, or other structural barrier, forming a gorge through which a river or stream flows. The dictionary definition unfortunately strays from description and mentions two theories of origin. Also, that definition is too narrow. It does not mention gaps cut through just one mountain and those bisecting plateaus or a series of plateaus. More extensive water gaps are more difficult to explain. For the purposes of this paper, a water gap is an eroded gap carrying a stream or river through a structural barrier. The most interesting water gaps are those that pass through high terrain when there appears to have been an easier, lower route around the barrier.

The Green River flows through a number of water gaps in the Uinta Mountains. From Green River, Wyoming, the river flows south, straight toward the Uinta Mountains, rather than following the topography to the east. At the northern slopes of the Uintas, it flows through the front of the range, entering Browns Park.

Probably the strangest water gap is Horseshoe Canyon. The river starts through one of the tilted ridges of the northern Uintas, then turns and flows back north, ending up only half a mile (1 km) down a valley from where it entered (Figure 17). Horseshoe Canyon was first described by John Wesley Powell in 1895.

> 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 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

Figure 13. Bishop Conglomerate on the Gilbert Peak erosion surface on top of Blue Mountain, extreme southeast Uinta Mountains.

Figure 14. Bishop Conglomerate on top of the Gilbert Peak erosion surface on Diamond Mountain.

Figure 15. Subrounded boulder of Bishop Conglomerate about 6.5 feet (2 m) long axis on the Gilbert Peak erosion surface north of Blue Mountain, southeast Uinta Mountains.

Figure 16. Browns Park, the collapsed eastern axis of the Uinta Mountains, which is filled with up to 1,965 feet (600 m) of sandstone, volcanic tuff, and conglomerate (view northwest).

> in the center of the mountain. We name it Horseshoe Canyon (Powell, 1961, p. 137).

The Green River then flows through Browns Park (Figure 16), but its course is not influenced by the topography of the valley. Had the river simply flowed a few miles to the east, it could have *easily passed around* the eastern end of the Uinta Mountains at a much lower elevation (Powell, 2005). Instead, the river flows *through* the eastern Uintas, in a major water gap with entrenched meanders in hard quartzite (Bradley, 1936; Powell, 2005). This water gap is named Lodore Canyon, or Gates of Lodore (Figure 18), a narrow slot canyon with walls 2,300 feet (701 m) high.

> But in the Canyon of Lodore, not only is the valley not wider than the river; there is no valley. Call Lodore what you will—arroyo, canyon, chasm, cleft, defile, gorge, gulch, rift—a "valley" it is not (Powell, 2005, p. 48).

To add to the puzzle, the Lodore water gap is considered young, only about 5 million years old, within the uniformitarian timescale (Powell, 2005).

The unexpected course of the Green River through the Uintas has generated several theories, but none are satisfactory. John Wesley Powell, who first floated down the Green River through Lodore Canyon and into the Grand Canyon in 1869, was puzzled over the course of the river.

> Powell was struck by the manner in which the Green River *ignored and often bypassed* low-lying open valleys, only to *turn headlong into solid bedrock canyons*, such as the Canyon of Lodore on the east flank of the uplifted Uinta Mountains (Ranney, 2005, p. 63, emphasis added).

Bradley stated that the river ignores both the topography and structure and that its meanders are not affected by hard or soft rock.

> Likewise Sears has shown that the course of the Green River upstream and downstream from Lodore Canyon was superimposed through the Browns Park formation. Its present course is *almost independent of topography and structure*. It flows in wide, well-formed meanders whose amplitude is approximately the same where the river flows through hard Uinta Mountain quartzite as where it flows through the soft Tertiary rocks (Bradley, 1936, p. 189, emphasis added).

But that is not all. After the Green River meets the Yampa River in the heart of the southeast Uinta Mountains, it passes through the southern anticline of the southeast Uinta Mountains called Split Mountain in a canyon over 2,500 feet (760 m) deep (Figure 19). Moreover, part of the course of the river runs *along* the long dimension of the anticline.

The Yampa River on the northeastern Colorado Plateau emerges from

Figure 17. Horseshoe Canyon (from Powell, 1961, p. 136). The Green River flowing from left to right enters the northern Uinta Mountains and then flows back out into the same valley only half a mile away.

Figure 18. Lodore Canyon of the Green River entering the eastern Uinta Mountains in a slot Canyon 2,300 feet (701 m) high. The river easily could have gone around the mountains toward the east. The canyon is considered only 5 Ma within the uniformitarian timescale.

Figure 19. Aerial photo of the western Split Mountain anticline. The Green River passes through the anticline, flowing at times along the eroded axis. The river easily could have passed around the north and west ends (view west, photo courtesy of Tony Kostusik).

Figure 20. Water gap of the Yampa River through Cross Mountain, a north-south mountain 1,000 feet (300 m) high east of the Uinta Mountains.

the Rocky Mountains foothills into open country, and then "crosses two anticlinal upwarps with apparent disregard for rock structure" (Hunt, 1956, p. 68). One anticlinal ridge is Cross Mountain, Colorado (Figure 6), in which the Yampa River passes through in a 1,000-foot (300-m) deep, vertically walled gorge (Figure 20). 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 easily could have bypassed these anticlines on softer rocks, it did not.

John Wesley Powell explained the water gaps as antecedent; river courses predated uplift, which was sufficiently slow to allow the river to erode its channel vertically and maintain its course. But the Green and Yampa Rivers postdate the Bishop Conglomerate, which means the mountains predated the rivers (Hansen, 1986). Although the antecedent stream hypothesis has been long discredited, it is still presented to the public in the Utah Field House of Natural History State Park Museum at Vernal, Utah (Figure 21).

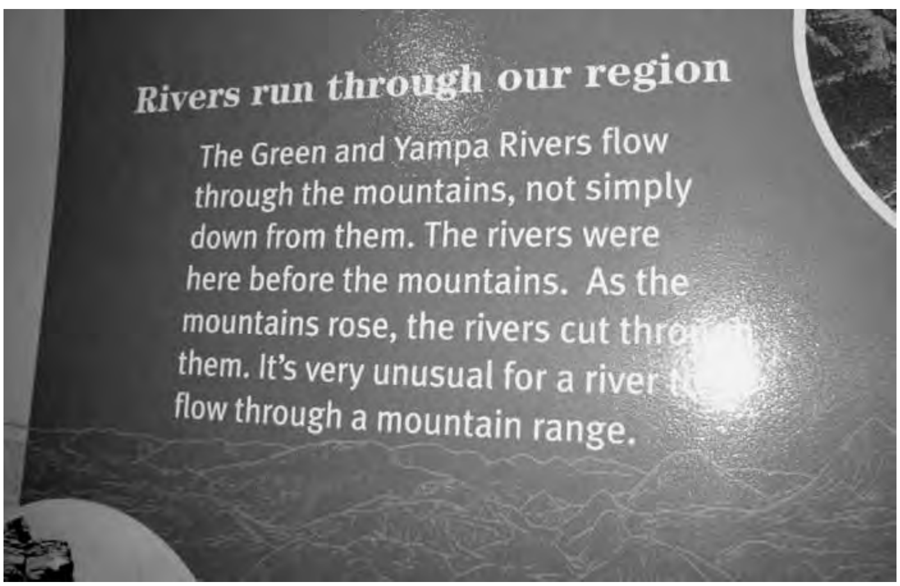

Figure 21. Sign in the Utah Field House of Natural History State Park Museum at Vernal, Utah, claiming that the Green and Yampa River water gaps were formed by antecedent rivers—a hypothesis long discredited.

Hansen (1986) advocated the stream capture hypothesis for the Green River and superimposition for the Yampa River through Juniper and Cross Mountains. But he presented no evidence for either. He recognizes the conundrum.

> For more than 100 years geologists have pondered the course of the Green River through the Uinta Mountains. Most rivers flow away from mountains, not toward them. But the Green, draining the mountains and plains of southern Wyoming, cuts sharply into the Uinta Mountains at the Wyoming-Utah State line, then flows 175 km east and south across the range through Utah and Colorado without regard to topographic relief or geologic structure (Hansen, 1986, p. 62).

Flood Explanation

Secular geology is stymied by the facts, but these geomorphological features are readily explained by the recessional stage of the Flood (Oard, 2006, 2008a). The mountaintop Wild Mountain upland planation surfaces could have formed early during Flood runoff, or it could have formed early in the Flood, covered by sediments, and then re-exposed. Such a planation surface would be called an exhumed surface. The Gilbert Peak pediment likely formed when the water was forced to flow at high speed around the mountains as they were emerging from the Floodwater.

Pediments are readily explained by rapid currents flowing parallel to mountain ranges, eroding the rock at the edge (Oard, 2004). Most hypotheses for the origin of pediments postulate water coming out of the mountains and somehow scraping the foothills down to a flat surface. We do not observe pediments being formed today. Instead, water forms valleys and canyons, destroying the pediments, not forming them. It is obvious that pediments formed by water flowing parallel to the mountains since exotic rocks from upstream are sometimes found on pediments, as noted by Crickmay (1975). I have observed them on many pediments. Rocks from the adjacent mountains also are laid on the pediment since Floodwater was also draining and eroding off the mountains. So rocks on top of the pediment come from both the adjacent mountains and upstream.

Also, the phenomenon of pediment passes, in which pediments form on opposite sides of the mountains but merge at the top at different angles (Howard, 1942a, 1942b), indicates that pediments were *not* formed by streams issuing from the mountains. At the top, there is no mountain left for streams to issue and erode the sides of the mountain. Pediment passes provide strong evidence that pediments were carved by currents flowing parallel to the mountains.

The reason why the Uinta pediment was more developed on the north side—running the length of the Uinta Mountains and extending north over 60 miles (100 km)—was because the water flow was less restricted north of the Uinta Mountains while the Wasatch Mountains would have impeded flow along the south side of the Uinta range. The flow was very likely moving east when the pediment formed since the

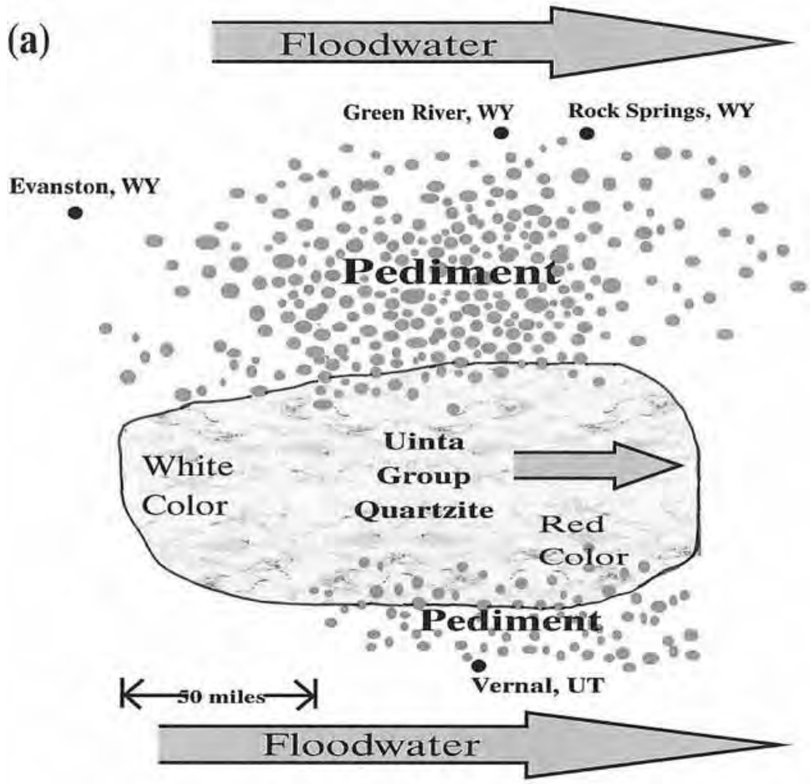

Figure 22a. Schematic of the plan view (from above) of the formation of pediments (Gilbert Peak erosion surface) capped by Bishop Conglomerate on the north and south side of the Uinta Mountains during channelized Flood runoff (drawn by Melanie Richard).

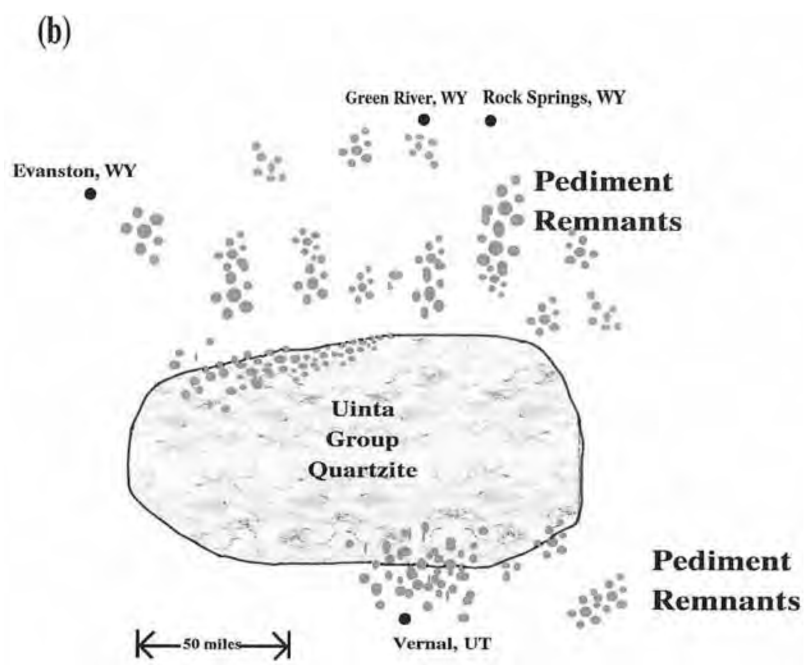

Figure 22b. Schematic of the subsequent dissection of the pediments into erosional remnants (drawn by Melanie Richard).

pediment slopes down to the east, and the Green River was deflected east upon approaching the Uinta Mountains. Moreover, the Bishop Conglomerate shed from the mountains was not deposited northwest of the Uinta Mountains (Reheis et al., 2009, p. 18) while it was spread northeast of the range (Hansen, 1986). This would imply that as the cobbles and boulders of the Bishop Conglomerate were spread northward, they were shunted east by an east-flowing Flood current. Figure 22a shows a schematic of the origin of the cobble-and boulder-capped pediments on the north and south side of the Uinta Mountains during Flood runoff and the subsequent dissection of the pediments into erosional remnants (Figure 22b).

The water gaps would form later, as the receding Floodwater transitioned from its early sheet-flow mode to channelized flow. This is supported by the relative ages of the gaps, which formed after the planation surfaces and after deposition of the Bishop Conglomerate around the Uinta Mountains. Water gaps would have developed when receding Floodwater shifted to channelized flow, rapidly cutting canyons and gorges across elevation features (Oard, 2008b, 2010a). It was also during this time that the Gilbert Peak erosion surface would have been dissected into the present erosional remnants.

The Flood/Post-Flood Boundary

One implication of this study is that the post-Flood boundary at the Uinta Mountains is equivalent to secular geologists' late Cenozoic. Geologists date the 40,000 feet (12 km) of differential uplift of the Uinta Mountains and subsidence of the adjacent basins, the massive erosion of tens of thousands of feet of strata from the top, and the formation of the Wild Mountain upland surface to the mid- and late Cenozoic. The Gilbert Peak erosion surface, the spread of the Bishop Conglomerate, and the cutting of the water gaps occurred in the late

Cenozoic. Oard (2012, Figure 14) shows this sequence.

The Uinta Mountains are not unique; other ranges in the Rocky Mountains had a similar history, implying that the post-Flood boundary is in the very late Cenozoic across the region. Although there are bound to be problem areas within geology and paleontology, I have generally found the same boundary worldwide, based on numerous criteria (Oard, 1996, 2007).

This strongly suggests that extensive post-Flood catastrophes, other than those associated with the Ice Age, did not occur. Thus, events from the Cenozoic rock record are those of the late stages of the Flood. In addition to significant erosion and tectonism, the manner in which planation surfaces, pediments, long-transported boulders, erosional remnants, water and wind gaps, the continental shelf and slope, and submarine canyons all formed indicates the work of the Flood. The proposed Cretaceous/Tertiary boundary, or even in the early Cenozoic, making all or most of the Cenozoic post-Flood, does not seem tenable (Oard, 2010b, 2010c, 2011a). The idea that even the Mesozoic and Paleozoic are post-Flood (Tyler, 2006) is problematic and unlikely (Reed et al., 2009).

Flood Deposition of Green River Formation

Another implication of the Uinta Mountains geomorphology affects debates between diluvialists over the age of the Green River Formation. If the post-Flood boundary described above is correct, then the Green River Formation must have been deposited during the Flood, not in a post-Flood lake. This is further shown by a significant observation. North of the Uinta Mountains, the Bishop Conglomerate, which rests atop the erosional remnants of the Gilbert Peak erosion surface, also overlies and has eroded into sedimentary rocks of the Green River and Bridger Formations (Hansen, 1986) (Figures 23 to 30). The

Figure 23. Remnant of Gilbert Peak erosion surface on Little Mountain north of Uinta Mountains (view north from north edge of the Uinta Mountains across intervening eroded valley).

Figure 24. Remnant of Gilbert Peak erosion surface on Little Mountain north of Uinta Mountains (view west from erosion surface on Miller Mountain).

Figure 25. Remnant of Gilbert Peak erosion surface on the south edge of Miller Mountain north of Uinta Mountains (view west with Little Mountain in the background).

Figure 26. The Bishop Conglomerate capping the Gilbert Peak erosion surface on Miller Mountain. The erosion surface truncates dipping beds of the Green River Formation (view southeast).

Figure 27. The Bishop Conglomerate capping the Gilbert Peak erosion surface on the south end of Miller Mountain.

Figure 28. Close-up of a subrounded boulder of the Bishop Conglomerate on the south end of Miller Mountain.

Bridger Formation is a predominantly volcanic layer overlying the Green River Formation. If the Gilbert Peak erosion surface and Bishop Conglomerate were formed by the Flood, then it stands to reason that underlying strata were also. This supports previously published evidence of significant erosion (requiring the energy of the Flood) of the outcropping of the Green River Formation at the San Rafael Swell (see Figure 2) (Oard and Klevberg, 2008).

Figure 29. Remnant of the Gilbert Peak erosion surface on Cedar Mountain, north of the Uinta Mountains (view north).

Figure 30. The volcanic Bridger Formation of Cedar Mountain, capped by Bishop Conglomerate.

Summary

The Uinta Mountains formed late in the Flood when significant differential vertical movement occurred, resulting in the concomitant uplift of the mountains and downwarping of adjacent basins. During and after this uplift, erosion on a large scale created geomorphological features not easily explained by secular theories, but that are readily integrated with the events of the recessional stage of the Flood. In chronological order these include (1) the Wild Mountain upland surface at the tops of the highest mountains; (2) the Gilbert Peak erosion surface, mainly a pediment best developed on the north side; (3) cobbles and boulders of the Bishop Conglomerate deposited on top of the Gilbert Peak surface; (4) the dissection of the Gilbert Peak surface into erosional remnants; and (5) the many water gaps on the Green and Yampa Rivers. The tectonics, erosion, and landform development fit in very well during the recessional stage of the Flood, suggesting that the post-Flood boundary is in the very late Cenozoic in this area (and probably for the region). Thus, the Green River Formation, found both north and south of the Uinta Mountains would also be a Flood deposit and not from a post-Flood lake.

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