Creation Research Society Quarterly 2018 55:81–97.

Genesis Flood Drainage through Southwest Montana:

Part III: Water Gaps

Michael J. Oard*

Abstract

Uniformitarian science has been unable to explain wind and water gaps, but they are easily accounted for by the recessional stage of the Flood. Eight water gaps and three wind gaps in southwest Montana confirm that the three major and one minor uniformitarian hypotheses fall short, while the Flood provides a reasonable explanation. This model is further supported by other features examined—large slack water and eddy gravel bars, whose size and placement require drainage of great proportion, like those formed by the Lake Missoula Flood.

Introduction

Part I summarized the recessive stage of the Flood in Southwest Montana, focusing on the erosion of nearly 1,000 m of valley fill during the channelized phase (Oard, 2018a). This erosive drainage also formed pediments in special flow situations (Oard, 2018b), showing that the patterns of pediments supported the Flood interpretation. In contrast, uniformitarian hypotheses failed to explain pediments. In this paper, we will again contrast the two paradigms with regard to water and wind gaps, noting how the Flood interpretation is strengthened by local gravel bars in slack water areas similar to those formed in the Lake Missoula Flood (Oard, 2004).

What Are Water and Wind Gaps?

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). In other words, a water gap is a perpendicular cut through a mountain range, ridge, or other rock barrier that carries a stream or river. This definition unfortunately includes two theoretical ideas regarding their origin: (1) the "antecedent stream" hypothesis, which proposes a stream maintaining its course during slow uplift (cf. Neuendorf et al., 2005, p. 27), and (2) the "superimposed stream" hypothesis, which cuts down into rocks of different lithology (cf. Neuendorf et al., 2005, p. 645). Ironically, these two primary mechanisms have since been ruled out for most water gaps by geologists. Uniformitarianism cuts deep, influencing even definitions that should be purely descriptive.

A wind gap is defined as: "A shallow notch in the crest or the upper part of a mountain ridge. Usually, it is at a higher level than a water gap" (Neuendorf et al., 2005, p. 723). To qualify as a wind

---

* Michael J. Oard, M.S. Atmospheric Science, Bozeman, MT

Accepted for publication May 30, 2018

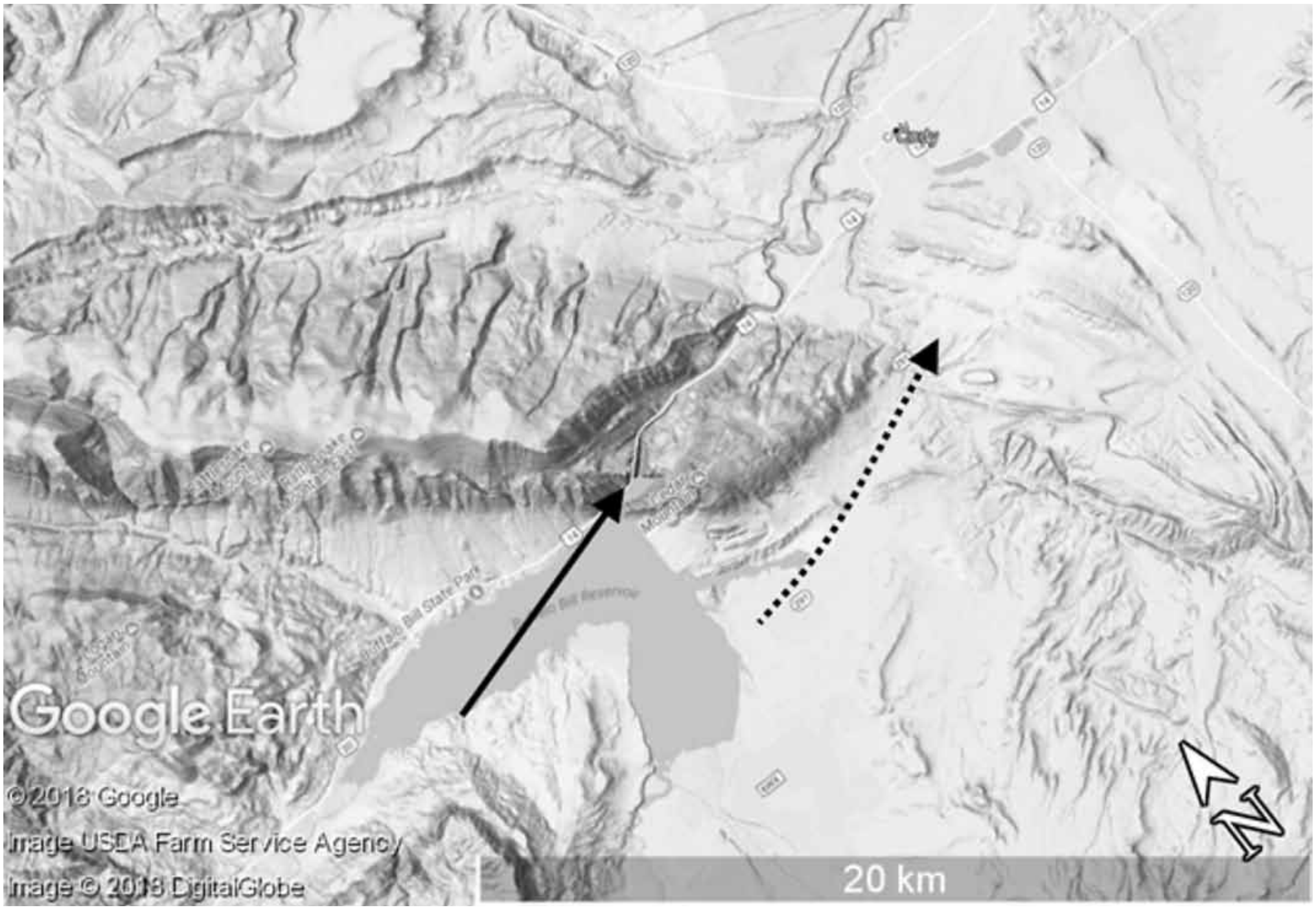


Figure 1. Shoshone water gap through Rattlesnake Mountains, Wyoming. Solid arrow shows direction of river flow. Dotted line shows low area to the south of the gorge. (Courtesy of Google Earth)

Figure 2. The water gap shown in Figure 1 (view west from Cody, Wyoming). The Shoshone River flows east toward the viewer.

gap, the notch must be *erosional* and not caused by faulting, folding, or another non-erosive factor. Many wind gaps began as water gaps, but uplift of the barrier or the lowering of local base level (and resulting erosion at lower elevations) has left them high and dry. Only wind now passes through the gap, which is why it is called a *wind* gap.

Water gaps are puzzling to uniformitarian thinking because over time, one would expect a river or stream to be diverted *around* the ridge, mountain, mountain range, or plateau instead of cutting through the barrier. Modern rivers are quite sensitive to slight changes in elevation and divert easily to reduce their gradient. A notable example of a water gap is the Shoshone water gap that cuts through the Rattlesnake Mountains west of Cody, Wyoming (Figures 1 and 2).

The Rattlesnake Mountains are a narrow range east of Yellowstone Park, along the western Bighorn Basin. They are cored by granite, which is covered by a drape of sedimentary rocks, uplifted with the granite to form the mountain range. The Shoshone River flows east from Yellowstone Park. It continues without deviation through the Rattlesnake Mountains, through a 760-m-deep gorge.

Why did not the river simply flow around the mountains, a mere 3 km to the south as shown in Figure 1? Figure 3 is a view to the southeast across Buffalo Bill Reservoir, formed by a 100-m dam in the gap. The narrow water gap through the Rattlesnake Mountains is shown by the arrow. The wide gap to the south (right in Figure 3) is so low that engineers had to build another dam to keep the reservoir from spilling south. An irrigation canal flows from this southerly dam into the Bighorn Basin. When the valley sediments were higher in the past, the river should have *easily* gone south around the Rattlesnake Mountains.

One water gap that potentially could be explained by uniformitarian geology is the Columbia River Gorge between Oregon and Washington (Figures 4 and 5). It is a deep, narrow gap through the volcanic Cascade Mountains, which uplifted. It is possible to claim that the river was antecedent (see below) and the mountains uplifted slowly enough for the river to cut downward, but modeling shows uplift usually defeats the river (Douglass and Schmeeckle, 2007). If uplift caused a lake to form, there should be evidence of such a lake and its breach. But thousands of significant water gaps that cannot be attributed to antecedence or lake spillover occur all across the earth.

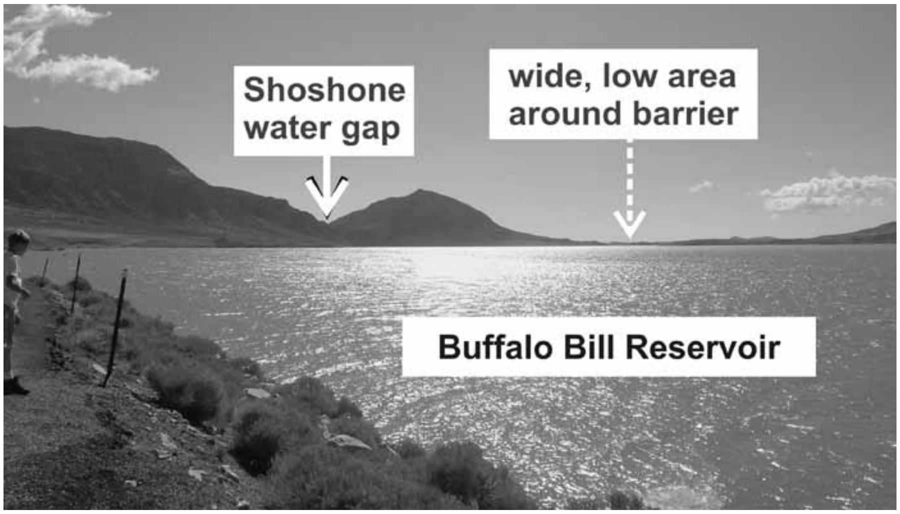


Figure 3. View to southeast across Buffalo Bill Reservoir showing actual (Shoshone water gap) and expected flow paths. See Figure 1 for aerial view.

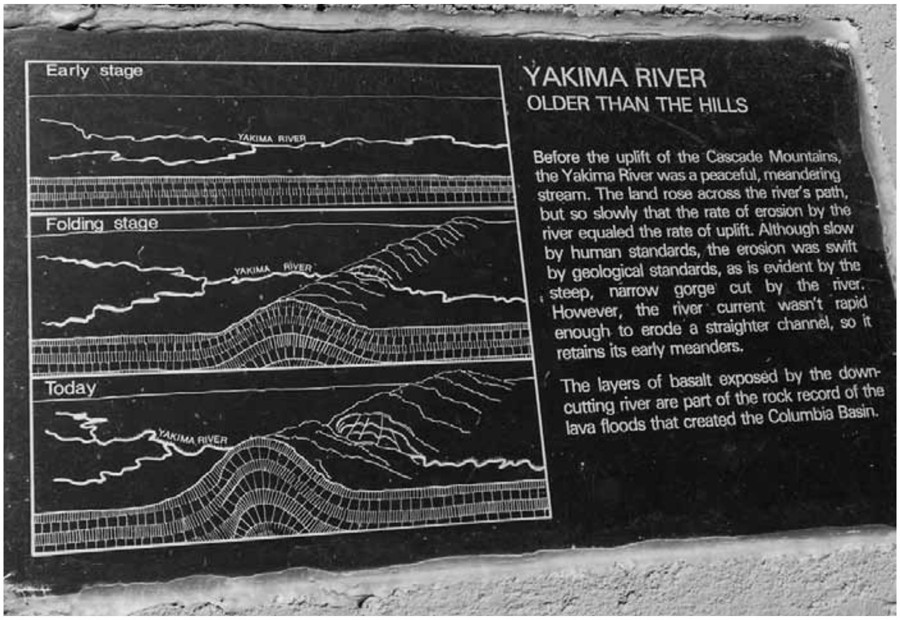
Figure 4. The Cascade Mountains of northern Oregon and Washington with the Columbia Gorge through the mountains, shaded up to 420 m asl. (Courtesy of ESRI).

Water and Wind Gaps Challenge Uniformitarian Explanations

Water and wind gaps remain uniformitarian challenges (Oard, 2008, 2013). Crickmay, a uniformitarian geomorphologist, colorfully describes his frequent troubles assuming rivers cut all water gaps, as many geomorphologists suppose:

> Admittedly a fascinating picture, a river runs over low, open plains directly towards seemingly impassable mountains but, undiverted by their

Figure 5. The Columbia River flowing westward through the Columbia River Gorge between Washington and Oregon.



YAKIMA RIVER
OLDER THAN THE HILLS

Before the uplift of the Cascade Mountains, the Yakima River was a peaceful, meandering stream. The land rose across the river's path, but so slowly that the rate of erosion by the river equaled the rate of uplift. Although slow by human standards, the erosion was swift by geological standards, as is evident by the steep, narrow gorge cut by the river. However, the river current wasn't rapid enough to erode a straighter channel, so it retains its early meanders.

The layers of basalt exposed by the down-cutting river are part of the rock record of the lava floods that created the Columbia Basin.

Figure 6. Plaque of the antecedent river hypothesis of the Yakima River through a lava ridge. The Yakima River supposedly came first and then the ridge slowly uplifted while the river eroded the ridge at the same location.

> presence, passes through them by way of a narrow defile, or water gap, to a lower region beyond. (Crickmay, 1974, p. 154)

There are three major uniformitarian hypotheses for the origin of water and wind gaps: (1) the antecedent stream (or river) hypothesis, (2) the superimposition hypothesis, and (3) the stream piracy hypothesis. A minor hypothesis, the overspill hypothesis, is rarely invoked. These will be briefly summarized.

The Antecedent Stream Hypothesis—Largely Rejected

The antecedent stream hypothesis proposes preexisting rivers *before uplift* of a landscape of low relief. Upon uplift, the river stubbornly stays its course, downcutting into rising land. Uplift is sufficiently slow that the erosional rate equals or exceeds it (Figure 6). This hypothesis applies mainly to *large* rivers because only they supposedly have enough erosive power to match the rate of uplift (Ahnert, 1998, p. 201). This hypothesis seems to have been the first developed in the 1800s to explain water gaps. It was commonly invoked into the late twentieth century.

Despite its early appeal, the hypothesis faces many difficulties. Newer geological information has shown that many structural barriers are "older" than the stream. Others question the balancing of erosion rates with tectonic rates and the difficulties in avoiding stream deflection (Ranney, 2005). If erosion were ever slower, the river should have diverted, and no transverse gorges formed. Twidale (1976) clung to the hypothesis but had to admit that antecedent streams were rare. Another problem is the absence of evidence of upstream lakes. If a river is flowing through an enclosed basin and the adjacent mountains rise too fast, there should be lake deposits upstream from the barrier, but they are rarely found. Worse, many water gaps are aligned, showing that this delicate balance was maintained across multiple rising barriers. Aligned water gaps are found in the Appalachian Mountains; out of 653 in the Susquehanna River basin, 19% of them aligned (Lee, 2013). Even small tributary streams, which are supposedly too weak to carve water gaps, cut through Appalachian ridges.

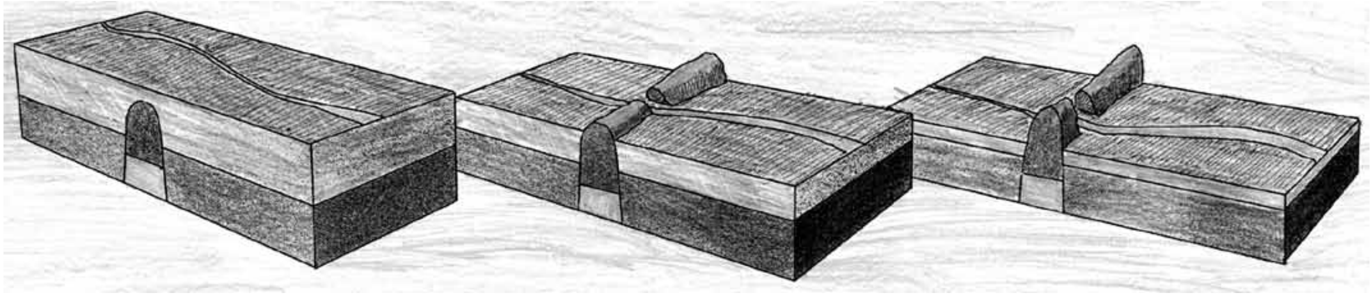


Figure 7. Block diagram of the superimposed stream hypothesis. The stream maintains its course as most of the covermass (top layer) is eroded. (Drawn by Bryan Miller, formerly of Master Books)

The Superimposed Stream Hypothesis—An Act of Desperation

Problems in the antecedent stream hypothesis led to alternatives being explored. A prominent one is the superimposed (or superposed) stream hypothesis. Under this scenario, a landscape is buried by renewed sedimentation, usually a marine transgression. When eventually uplifted, rivers and streams eroded down through the flat sediments and their course did not change although the covering sediments are all eroded away (Figure 7). Geomorphologists default to this hypothesis if they find *any* remnant of the vanished sedimentary cover (Twidale, 2004). Eroded sedimentary rock can usually be found in at least some areas.

This hypothesis requires two difficult tasks. First, rivers must maintain the *same* course as they downcut into both resistant and nonresistant formations. Second, at the same time, the drainage system must somehow remove all the sedimentary cover over the old landscape (Douglass and Schmeeckle, 2007). There is usually little or no evidence for either.

The Stream Piracy Hypothesis—The Final Fallback Position

The third major hypothesis explaining water gaps is the stream piracy or stream capture hypothesis. Summerfield (1991, p. 410) explained: "River capture occurs when one stream erodes more aggressively than an adjacent stream and captures its discharge by intersecting its channel." Figure 8 shows this process. This is currently the most popular "default" mechanism to explain transverse drainage (Douglass, 2005). The required higher rate of erosion of the piratical stream has been attributed to: (1) a steeper gradient of flow, (2) greater discharge, (3) less resistant riverbed, and (4) higher precipitation.

There are certain features of a stream attributed to stream piracy, but these have alternative explanations (Oard, 2013). To demonstrate stream piracy, it must be shown that a tributary of the pirate stream was incised to a significantly lower level than its victim. But erosion is an ongoing process, and capturing "snapshots" of its progress is difficult. There is usually little definitive evidence for the process of piracy. Geomorphologist John Douglass (2005, p. 81) concludes:

> The *paucity of definitive evidence of piracy* [*sic*] *transverse drainages* suggests that this mechanism does not occur commonly, especially in regions dominated by extensional tectonics. (Emphasis mine)

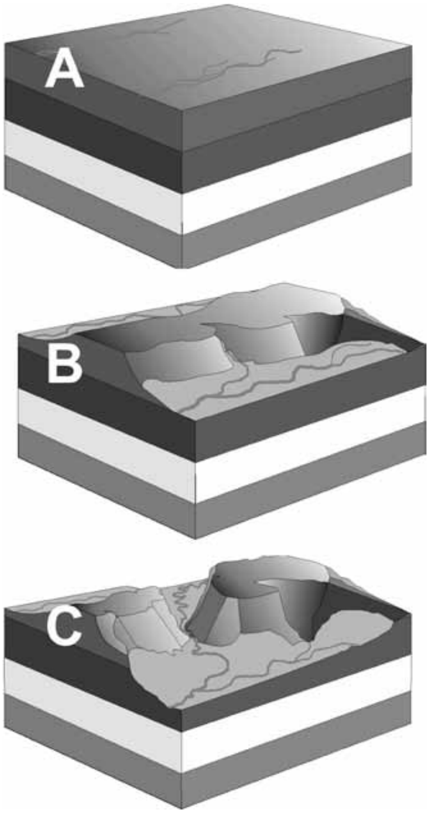


Figure 8. Block diagram of river capture: (A) Two parallel streams begin (B) eroding valleys and creating a ridge, through which (C) one stream's tributary erodes, allowing capture of the other stream. (Drawn by Peter Klevberg)

Overspill Hypothesis

A rare event, but one that must be addressed, is the overspill hypothesis, where a lake overtops a ridge and cuts a new canyon. Though rare, it is real. However, its application to the past is not clear. It can be used to explain some Ice Age channels as proglacial lakes over-

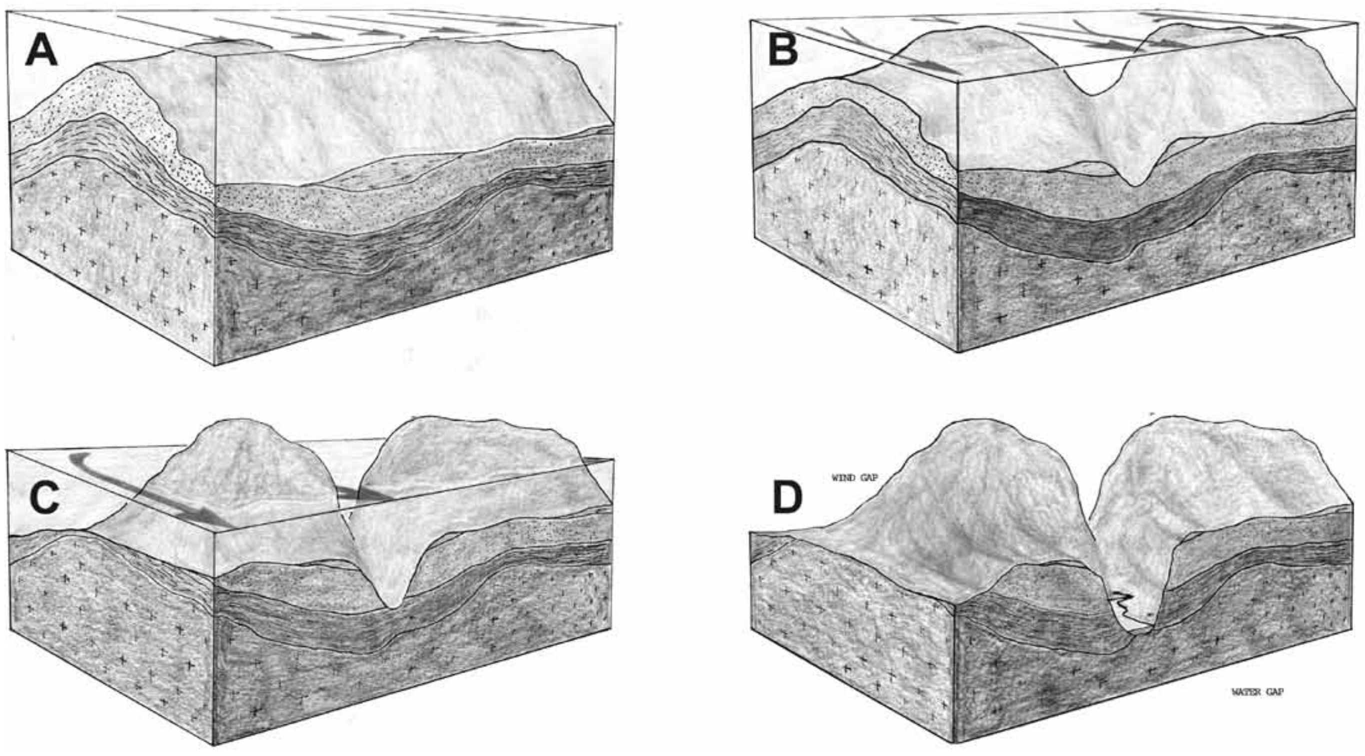


Figure 9. Schematic showing the formation of water and wind gaps. (A) Water flowing perpendicular to a transverse ridge forms shallow notches on the ridge. (B) Notches erode deeper as the water level drops below the top of the ridge. (C) Floodwater continues to drain as notches deepen. (D) Floodwaters are completely drained with a river running through the lowest notch, the water gap. Erosion ceased too early through the other notch, leaving a wind gap. (Drawn by Peter Klevberg)

topped a barrier as the lakes filled. It has been applied to Grand Canyon by both secular geomorphologists and Flood geologists, despite numerous problems described by Oard (2014).

The Grand Canyon cuts a series of plateaus; the Kaibab Plateau being the easternmost, the highest, and the first one to be transected. But the Kaibab was breached at about 2,250 m elevation, rather than lower points that exist both to the north and south of the current canyon. These lower elevations are 1,725 m to the north and 1,900 m to the south. One would expect a lake to breach low points, not high ones. Also, there is little evidence of the supposed lake or lakes east of the Kaibab Plateau. There are no shorelines and no lake-bottom sediments. Glacial Lake Missoula and the many lakes of the southwest United States Ice Age left abundant evidence (Oard, 2004). Some claim that the Bidahochi Formation in the northeast part of the Little Colorado River drainage includes lake-bottom sediments, but they are sited high up the sides of the drainage basin. The minor parts of the formation that might be considered lacustrine are claimed to be from a small, dried-up lake (Dickinson, 2013). Finally, when the flow breached the Kaibab Plateau, the canyon did *not* form down the topographic slope as should be expected but was cut with meanders along *the same altitude* over a downstream distance of 70 km along the southwest edge of the Kaibab Plateau. That is why I join practically all secular scientists in rejecting the idea (Dickinson, 2013).

Little If Any Evidence for Uniformitarian Hypotheses

In summary, no uniformitarian hypothesis adequately explains water gaps. Most uniformitarian geologists simply invoke one of the inadequate mechanisms routinely, without comment or evidence. Some invoke two or more at the same time, as if multiplying improbability will somehow make something probable. Oberlander (1985, p. 155) expressed dismay at the lack of evidence for the origin of water gaps:

> Large streams transverse to deformational structures are conspicuous

Figure 10. Narrow-walled, meandering Palouse Canyon downstream from Palouse Falls, Washington.

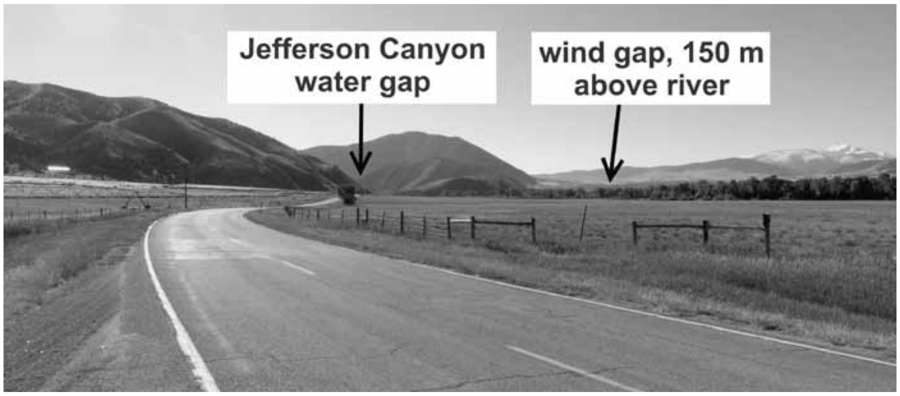


Figure 11. Jefferson Canyon water gap runs through a ridge 640 meters above the Jefferson River and wind gap to the south (view southeast). The water should have easily flowed around the higher mountains through the present-day wind gap.

> geomorphic elements in orogens [mountain ranges] of *all ages*. Each such stream and each breached structure presents a geomorphic problem. However, the *apparent absence of empirical evidence* for the origin of such drainage generally limits comment upon it. (Emphasis mine)

John Douglass (2005, p. 20, 40) added:

> Despite more than two centuries of study, our understanding of transverse drainage development [origin of water gaps] remains very much in its infancy … No general theory building has allowed transverse drainage research to move beyond a compilation of empirical data with *intuitive explanations being the norm*. (Emphasis mine)

Water and Wind Gaps Easily Formed during Flood Runoff

Most water and wind gaps, especially the deep ones, provide clear, powerful evidence for the channelized flow phase of the Flood (Oard, 2008, 2013). It is a sufficient mechanism because large volumes of water were flowing over, then through, barriers as the Floodwaters drained from the continents (Figure 9). The best present analog is the Lake Missoula Flood, which rapidly cut large water and wind gaps in eastern Washington (Oard, 2004). For example, Palouse Canyon is a 150-m deep water gap carved when the Lake Missoula Flood overtopped a ridge (Figure 10).

Water and Wind Gaps of Southwest Montana

Water and wind gaps are common across the continents of the earth. There are about a dozen significant water gaps in Southwest Montana but only a few wind gaps of note.

The Perplexing Jefferson Canyon Water and Wind Gap

One of the most obvious water gaps is Jefferson Canyon (Figure 11, left arrow). The Jefferson River cut hard limestone, about 640 m above the current river, when it could have easily gone south a short distance around the barrier, where the potential channel is only 150 m above the river (Figure 11, right arrow), which can be considered a wind gap. Figure 12 is a Google Earth cross section across the resulting water and wind gaps.

David Alt (1984, p. 7), retired professor of geology at the University of Montana in Missoula, finds this water gap perplexing and writes:

> The very existence of Jefferson Canyon is an interesting puzzle.

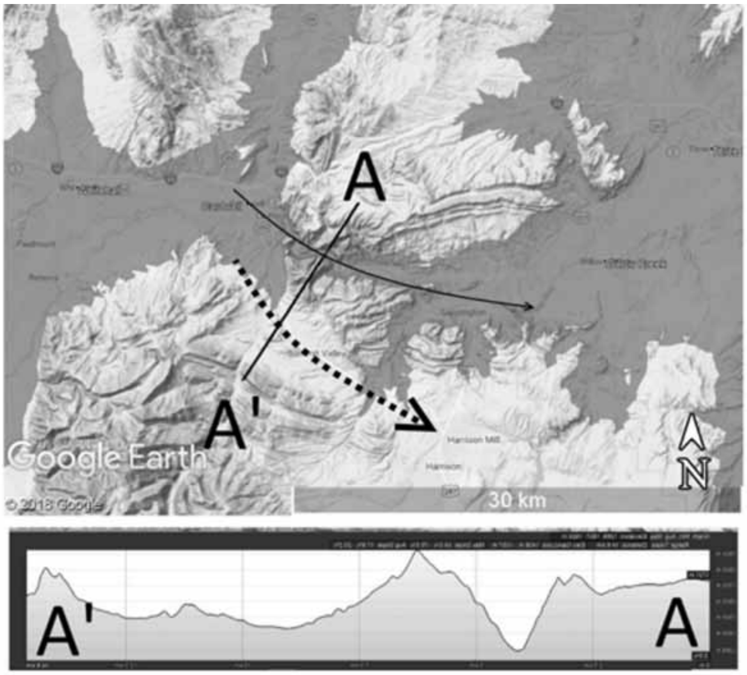


Figure 12. Map and cross section through the water (solid arrow) and wind (dashed arrow) gaps at the Jefferson River near Cardwell, Montana. Shaded area shows a hypothetical water level of about 1,400 m asl. River flows left to right. (Image courtesy of Google Earth)

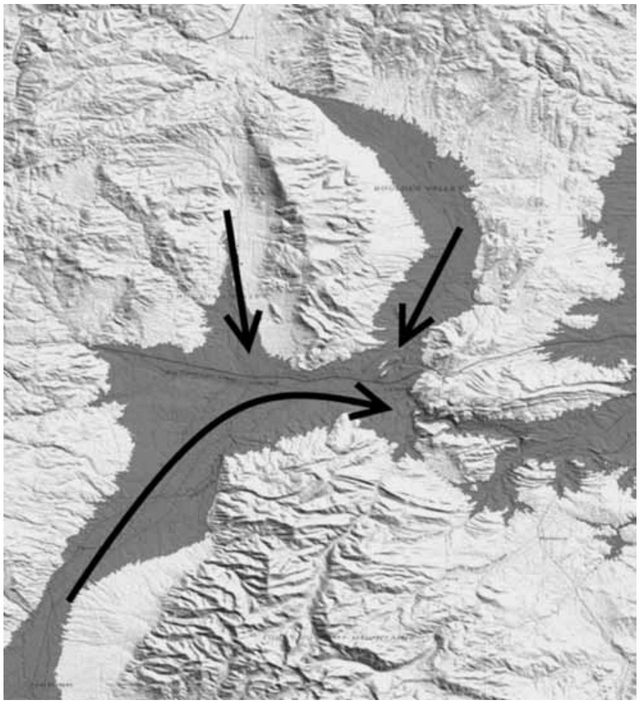


Figure 13. Late Flood channelized currents could have formed the Jefferson River water gap. Shading shows currents (arrows) when the water level would have been about 1,450 m (asl). Energy from the converging currents carved the canyon at the end of the long arrow. (Courtesy of Google Earth)

> Why should a river flowing through a broad valley floored with soft sediment that offers no real obstacle to its passage suddenly enter a narrow canyon where it has to saw its way through hard bedrock?

He assumes the river carved the canyon. Alt goes on to say that such water gaps are numerous in Montana:

> Numerous other Montana rivers do exactly the same sort of thing: the Missouri River at Gates of the Mountains, for example, and the Madison River where it abruptly turns east just north of Ennis and slices a narrow gorge right through the Madison Range. (Alt, 1984, p. 7)

He later exclaims:

> It is one thing to understand that rivers can erode bedrock and quite another to figure out how they can cut a deep canyon right through a range of mountains. Why didn't the river detour around the mountains instead of cutting a canyon through them? How did running water manage to cut right through a formidable range of mountains that would appear to have been an obstacle in its path before the canyon was cut? We can be quite sure that river didn't attack the mountains by flowing up one side and then down the other because rivers can't run uphill, not even a little bit. (Alt, 1984, p. 65)

The case of the water gap at the Gates of the Mountains, near the Missouri River's exit onto the edge of the High Plains (see Part I, Figure 10c and d, north of Helena), is described by Alt (1984, p. 146):

> What explanation is there for the Missouri River eroding its canyon right through the middle of the Adel Mountains, instead of going around the edge of the volcanic pile?

A better explanation for the Jefferson Canyon water gap is that it was carved by a receding Flood channel, running rapidly down the Jefferson River Valley, forming pediments (Part II), and then

Figure 14. Madison River water gap is separated from a wind gap by a broad, rounded ridge.

forced east. This turn is a gentle bend that points toward Jefferson Canyon (Figure 13). Perhaps the momentum of the large, fast current prevented it from making the sharp turn southeast through the wind gap, and it instead eroded a water gap in this location.

An alternative explanation is that water can breach a transverse barrier at more than one point, but with time the water flows faster through one, rapidly deepening the one at the expense of the others. So, the main one becomes a water gap and the others wind gaps. This was shown in a modeling experiment by Douglass and Schmeeckle (2007) with both the water and wind gaps formed at the same time. This was shown by the Lake Missoula flood as the water crossed a ridge in south central Washington and breached the ridge at four locations, but with time, the water deepened what is now Palouse Canyon the most (Figure 10).

Some small hills lie just to the west (Figure 11 and 13), which could be due to a lack of erosion caused by the convergence with another Flood current flowing south down the Boulder River Valley.

The Madison River Water and Wind Gap

Alt alluded to the Madison River water gap, which cuts the northwest side of the Madison Range (Figure 14). There is a low wind gap west of the water gap (Figure 14). This gneiss ridge blocks the exit of the Madison Valley. The uniformitarian model suggests that when the sediments were higher in Madison Valley, the Madison River should have cut the water gap where the wind gap is now located, since the wind gap is lower than the tops of the mountains surrounding the water gap (Figure 14). This is a puzzle to secular scientists.

I suggest that a Flood current flowed north down the Madison River Valley, and initially overtopped and rounded the gneiss ridge (Figure 15). As it exited the Madison Valley, it carried a large amount of quartzite clasts, which were subsequently deposited on a dissected planation surface about 25 km north (Part II, Figures 13 and 14). This planation surface is located at the tip of the arrow in the top panel of Figure 15. As the Floodwater fell, the strongest flow was diverted to the east side of the valley, possibly by the convergence of a current flowing out of North Meadow Creek (Figure 15).

The Six Water Gaps Associated with Sixteenmile Creek

Sixteenmile Creek flows eastward into the Missouri River near Toston, Montana (Figure 16). It flows through six significant water gaps, if we include the

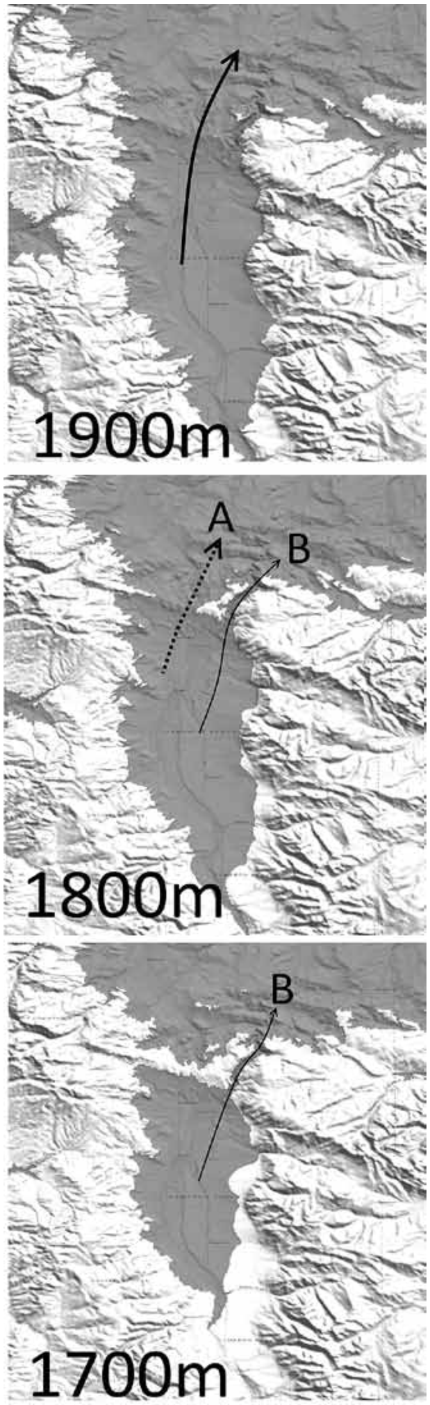


Figure 15. As late Flood channels diminished from about 1,900 m asl (top) to about 1,700 m asl (bottom), the Madison River water gap was eroded. Note flow (middle) over both future wind (dotted line A) and water (solid line B) gaps. At 1,700 m asl, flow has ceased over the wind gap and exits through narrow, eroding water gap. (Courtesy of ESRI)

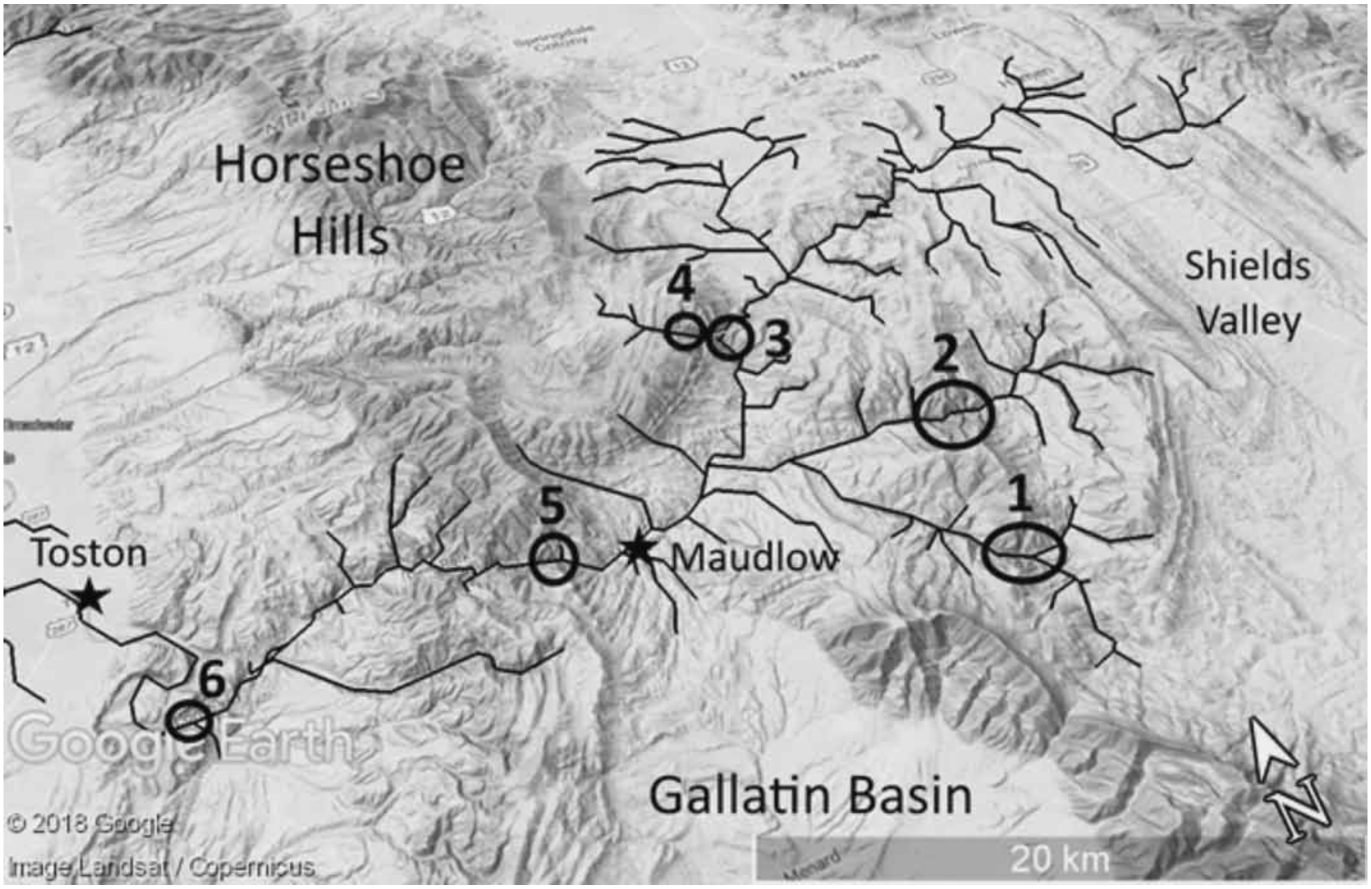


Figure 16. Drainage of Sixteenmile Creek showing water gaps (courtesy of Google Earth). The path of the North Fork that starts in the Crazy Mountains (upper right) flows across the broad north-south Shields valley and through a 600-m deep water gap (3).

Figure 17. North Fork of Sixteenmile Creek flowing west through Ringling and heading for the foothills and mountains in the distance. Why did it not divert around them?

gap just southeast of Toston (Figure 16). The North Fork of Sixteenmile Creek originates in the Crazy Mountains and flows west, perpendicular to a broad north-south valley (Figure 17). How can such a small creek keep flowing west through high mountains and not be diverted either north or south down the wide valley? The South, Middle and North Forks of Sixteenmile Creek all pass through 600-m-deep water gaps (Figures 18 to 20, numbers 1 to 3 respectively on Figure 16).

Figures 21 and 22 show the water gap of the Middle Fork. Figure 23 shows a view northwest of the South Fork water gap through the northern edge of the Bridger Mountains. Absent the water

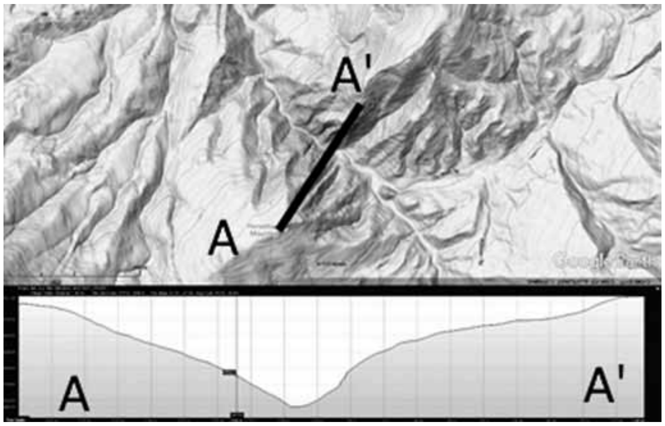


Figure 18. Cross section through the South Fork of Sixteenmile Creek (number 1 on Figure 16; courtesy of Google Earth).

Figure 21. Middle fork of Sixteenmile water gap (number 2 on Figure 16; view west from east side of the gap).

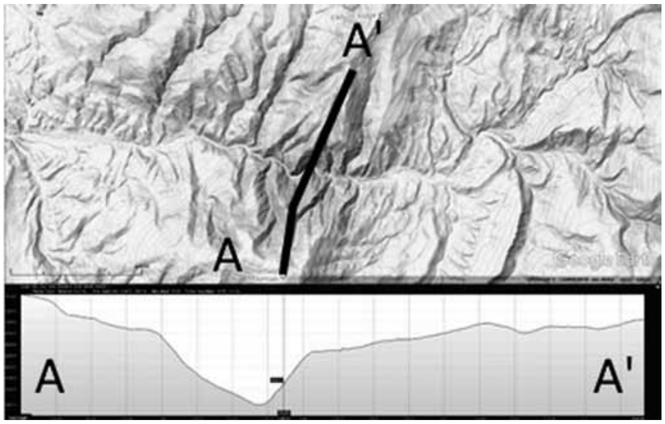


Figure 19. Cross section through the Middle Fork of Sixteenmile Creek (number 2 on Figure 16; courtesy of Google Earth).

Figure 22. Middle fork of Sixteenmile water gap (number 2 on Figure 16; view east through the heart of the gap).

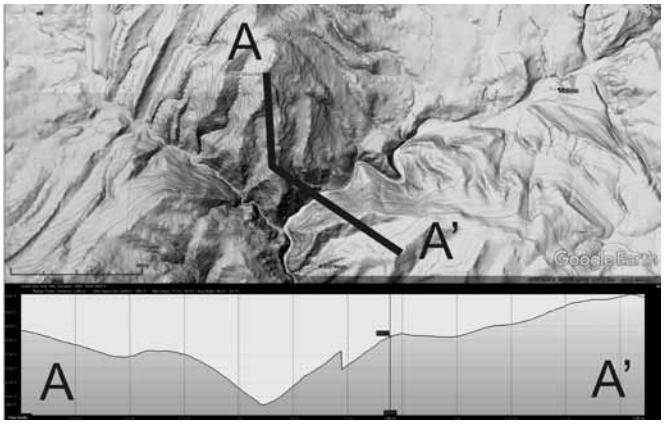


Figure 20. Cross section through the North Fork of Sixteenmile Creek (number 3 on figure 16; courtesy of Google Earth).

Figure 23. South Fork of Sixteenmile water gap (number 1 on Figure 16; view northwest from western foothills of the Shields River Valley).

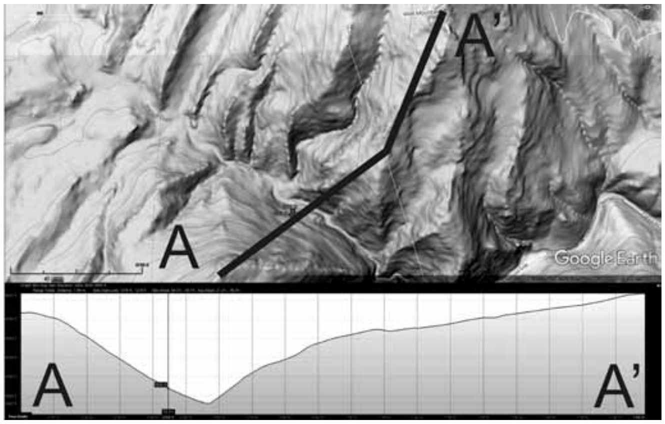


Figure 24. Cross section through water gap north of the North Fork of Sixteenmile Creek (courtesy of Google Earth).

Figure 25. Sixteenmile Creek just east of Maudlow (view west in direction of the flow).

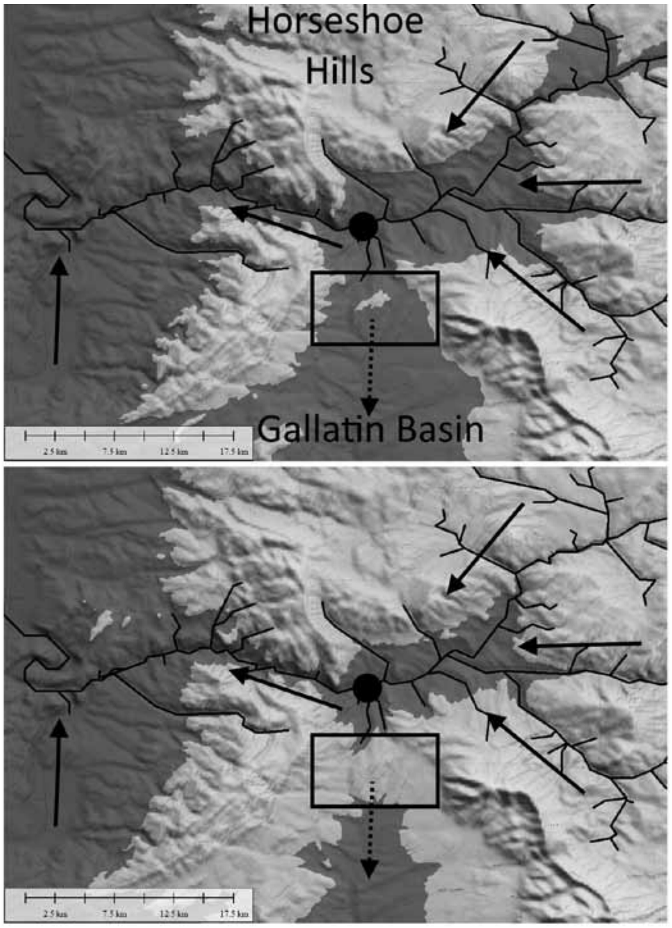


Figure 26. Arrows show converging water flow east of Maudlow (black dot) with flow continuing west through the northern Horseshoe Hills and south into the Gallatin Basin. Top: Draining Flood channels at 1,630 m asl. Note the light patch within the box indicating rising land as flow splits into western and southern components. Bottom: At a water level of 1,530 m asl, flow to the south is blocked and becomes a wind gap. Flow continues west, cutting a water gap through the northern Horseshoe Hills. (Imagery courtesy of ESRI)

gaps, all three forks should have flowed east from the crest of the mountains, becoming tributaries of the Shields River (South and Middle Fork) and the South Fork of the Smith River (North Fork). Instead, they flow west through significant water gaps. This does not conform with uniformitarian principles.

The fourth water gap, (number 4 on Figure 16) seen just to the left of the cross section through the North Fork water gap (number 3 on Figure 16), is a 425-m-deep gorge through the mountains to the north of the North Fork (Figure 24). Water from the valley to the north should have passed to the east through a lower area and out into the South Fork of the Smith River.

The three forks of Sixteenmile Creek converge just east of Maudlow, Montana (Figure 16). The creek is good size at this point (Figure 25). When the Flood currents were higher, the flow probably first flowed over the Horseshoe Hills, where it converged with another current flowing northwest through the eastern Gallatin Valley. The Horseshoe Hills are well rounded, as if well scoured by powerful currents. As the Floodwater fell, the southern and central Horseshoe Hills became exposed (Figure 26, top), and a water gap began to form through the northern Horseshoe Hills, west of the converging Sixteenmile Creek currents. The increase in volume and velocity cut the water gap. A slower current was likely flowing south from the Maudlow area (Figure 26, top), between the exposed Horseshoe Hills and Bridger Mountains, before that route was cut off (Figure 26, bottom).

Figure 27. Gravel bar on south side of the valley just east of Maudlow (arrows) and west of converging currents from the Middle and North Fork of Sixteenmile Creek.

Figure 28. Rounded to subangular rocks in the bar in Figure 27.

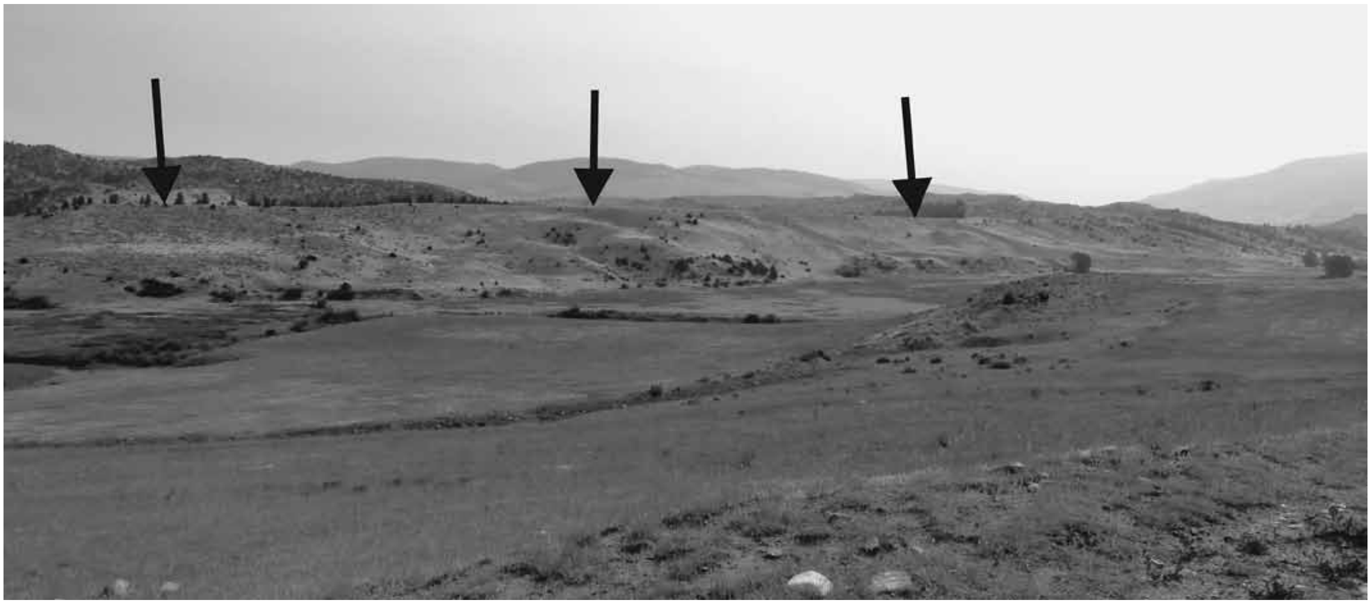


Figure 29. Gravel bar forming a 60-meter high terrace on the north side of the valley (arrows).

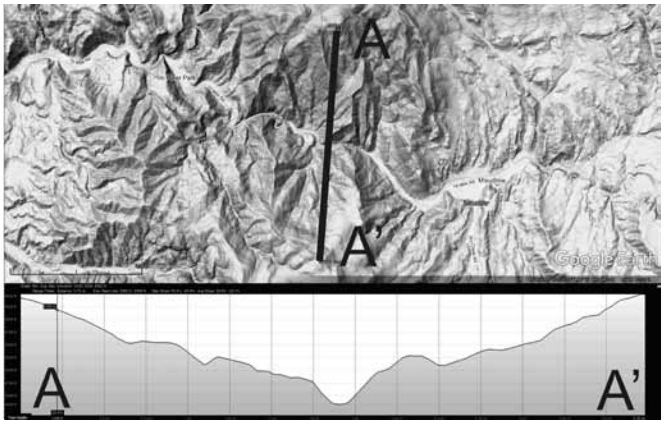


Figure 30. Cross section through northern Horseshoe Hills water gap, which is over 600 m deep (number 5 on figure 16; courtesy of Google Earth).

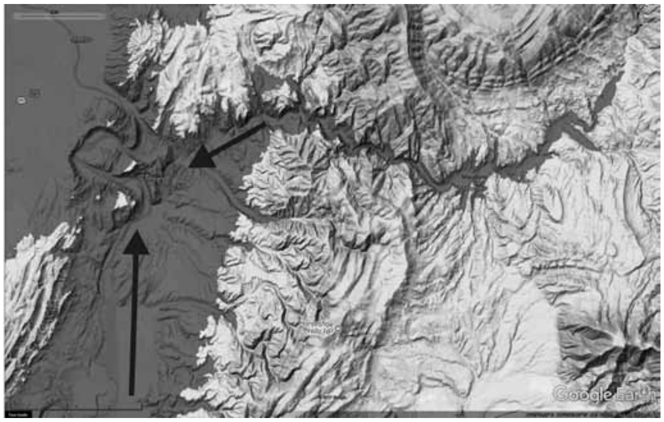


Figure 31. Convergence of two currents southeast of Toston, Montana, when water level would have been about 1,400 m asl (courtesy of Google Earth).

As the waters continued to drop, a slackwater area would have formed around Maudlow (Figure 26, bottom), creating slackwater gravel bars near the convergence of the three forks. There is a 60-m-high gravel bar on the south side (Figures 27 and 28) and a 60-m terrace of coarse gravel on the north side (Figure 29). It is highly unlikely that these gravel bars could have formed under present conditions over long periods of time by these small streams, since the converging flows passed through water gaps only about 10 km away and the area was not glaciated during the Ice Age. These gravel bars mirror those created by the Lake Missoula Flood in eastern Washington (Oard, 2004).

As the Floodwater drained from the area, a deep-water gap was cut through the northern Horseshoe Hills, leaving behind a wind gap south of Maudlow, between the Horseshoe Hills and the Bridger Mountains (Figure 26, bottom). Water drained

Figure 32. Portion of a 60-meter high eddy bar west of the Horseshoe Hills water gap.

Figure 33. In-situ course gravel within the eddy bar west of the Horseshoe Hills water gap (rock hammer for scale).

Figure 34. The top of the dissected eddy bar west of the Horseshoe Hills water gap.

Figure 35. The entrance of the Missouri River into the water gap through a north-south ridge about 245 m high southeast of Toston, Montana (view northwest).

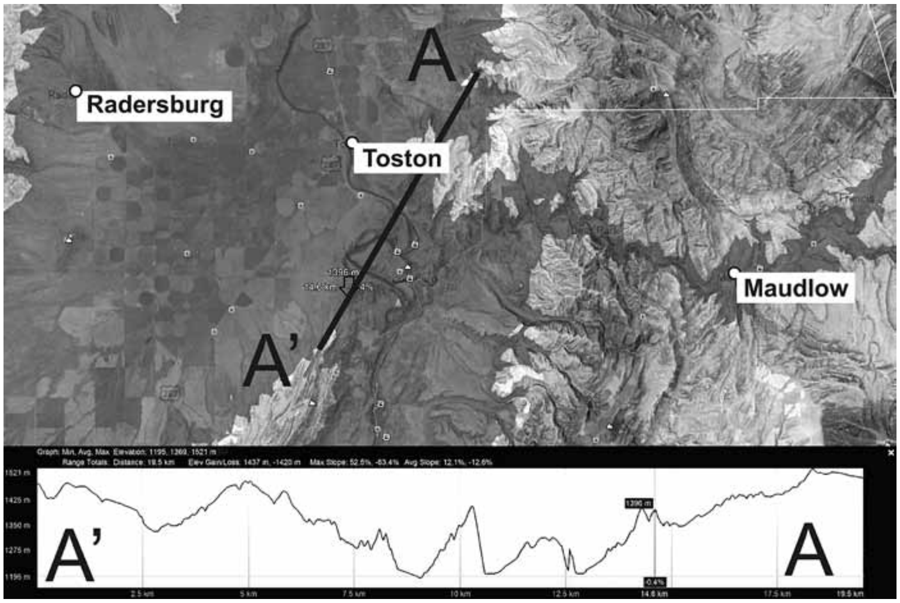


Figure 36. Cross-section through water gap (number 6 on figure 16) meandering through a ridge, showing water level about 1,400 m asl (courtesy of Google Earth).

through the northern Horseshoe Hills water gap (Figure 30) and converged with another current moving north, before crossing a 250-m-high north-south ridge (Figure 31). Figure 36 is a cross-section through the water gap (number 6 on figure 16) meandering through a ridge, showing water level about 1,400 m asl (courtesy of Google Earth).

This convergence produced another bar about 60 m high (Figures 32 to 34) west of the water gap through the Horseshoe Hills, similar to eddy bars that formed during the Lake Missoula flood when currents joined.

These converging currents carved a 250-m-deep water gap through a ridge (Figure 35), which is number 6 on figure 16. The water gap is a meander cut into the top of the ridge (Figure 36), something not explicable by slow, gradual processes. In that case, the Missouri River should have passed west of this ridge through a low area in the southern Townsend Valley. Instead, another mysterious water gap was carved. It is possible that the meander in the water gap was formed by an eddy caused by the converging currents.

Conclusions

Water and wind gaps are difficult to explain by uniformitarian theory but make sense in the recessive stage Flood framework, as illustrated by eight water gaps and three wind gaps in Southwest Montana. This model is reinforced by the presence of large gravel bars, up to 60 m in height, associated with slackwater areas along Sixteenmile Creek. These bear remarkable similarity to those formed during the catastrophic Lake Missoula Flood in Eastern Washington.

Acknowledgments

I thank the Creation Research Society for a grant to do this research. I also appreciate my wife, Beverly, for editing the first draft of the manuscript. Finally, I thank several anonymous reviewers for improving the manuscript.

References

Ahnert, F. 1998. *Introduction to Geomorphology*. Arnold, London, UK.

Alt, D.D. 1984. Profiles of Montana Geology: A Layman's Guide to the Treasure State. *Montana Bureau of Mines and Geology Special Publication* 89. Butte, MT.

Crickmay, C.H. 1974. *The Work of the River: A Critical Study of the Central Aspects of Geomorphology*. American Elsevier Publishing Co., New York, NY.

Dickinson, W.R. 2013. Rejections of the lake spillover model for initial incision of the Grand Canyon, and discussion of alternatives. *Geosphere* 9(1): 1–20.

Douglass, J.C. 2005. *Criterion Approach to Transverse Drainages*. PhD diss., Arizona State University, Tucson, AZ.

Douglass, J., and M. Schmeeckle. 2007. Analogue modeling of transverse drainage mechanisms. *Geomorphology* 84:22–43.

Lee, J. 2013. A survey of transverse drainage in the Susquehanna River basin, Pennsylvania. *Geomorphology* 186:50–67.

Neuendorf, K.K.E., J.P. Mehl Jr., and J.A. Jackson. 2005. *Glossary of Geology*, fifth edition. American Geological Institute, Alexandria, VA.

Oard, M.J., 2004. *The Missoula Flood Controversy and the Genesis Flood*. Creation Research Society Books, Chino Valley, AZ.

Oard, M.J. 2008. *Flood by Design: Receding Water Shapes the Earth's Surface*. Master Books, Green Forest, AR.

Oard, M.J. 2013. *Earth's Surface Shaped by Genesis Flood Runoff* (ebook); http://Michael.oards.net/GenesisFloodRunoff.htm.

Oard, M.J. 2014. A *Grand Origin for Grand Canyon*. Creation Research Society Books, Chino Valley, AZ.

Oard, M.J. 2018a. Genesis Flood drainage through southwest Montana: part I, mountain and valley erosion and deposition. *Creation Research Society Quarterly* 54:251–265.

Oard, M.J. 2018b. Genesis Flood drainage through southwest Montana: part II, the formation of pediments. *Creation Research Society Quarterly* 55:24–43.

Oberlander, T.M. 1985. Origin of drainage transverse to structures in orogens. In Morisawa, M., and J.T. Hack (editors), *Tectonic Geomorphology*, pp. 155–182. Allen and Unwin, Boston, MA.

Ranney, W. 2005. *Carving Grand Canyon: Evidence, Theories, and Mystery*. Grand Canyon Association, Grand Canyon, AZ.

Summerfield, M.A., 1991. *Global Geomorphology*. Longman Scientific & Technical, New York, NY.

Twidale, C.R. 1976. *Analysis of Landforms*. John Wiley & Sons Australasia Pty Ltd, New York, NY.

Twidale C.R. 2004. River patterns and their meaning. *Earth-Science Reviews* 67:159–218.

Walker, T. 1994. A biblical geological model. In Walsh, R.E. (editor), *Proceedings of the Third International Conference on Creationism*, technical symposium sessions, pp. 581–592. Creation Science Fellowship, Pittsburgh, PA.