Creation Research Society Quarterly 2018 55:24–43.

Genesis Flood Drainage through Southwest Montana:

Part II: The Formation of Pediments

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Abstract

The origin of pediments is a uniformitarian mystery. Four hypotheses are described and analyzed. Pediments and one planation surface in southwest Montana are described and analyzed. Patterns in valley pediments suggest that they were formed by large-scale, high-velocity, down-valley Flood currents.

Introduction

Part I of this series summarized late Flood drainage, erosion, and deposition in southwest Montana (Figure 1), through both sheet- and channelized-flow phases of Walker's (1994) recessive stage (Oard, 2008, 2013, 2018; Oard and Reed, 2017). Initially, water flowed off the continents in great sheets, and these currents eroded the rising western Rocky Mountains. As mountains surfaced, sheet flow eroded their tops, and the debris was deposited in large fans and in sinking valleys and basins. When the sheet flow transitioned into channelized flow down the southwest Montana valleys, it deeply eroded the newly deposited valley fill and cut numerous pediments.

What Is a Pediment?

A *pediment* is "a broad sloping rock-floored erosion surface or a low relief plain typically developed by subaerial agents (including running water), in an arid or semiarid region at the base of an abrupt and receding mountain front or plateau escarpment" (Neuendorf et al., 2005, p. 477). This formal definition is broad and disputed (Dohrenwend, 1994, p. 322; Thomas, 1994, p. 244). More simply, a pediment is an erosion or planation surface that lies at the foot of a mountain, mountain range, ridge, or plateau. An *erosion surface* is "a land surface shaped and subdued by the action of erosion, esp. by running water. The term is generally applied to a level or nearly level surface" (Neuendorf et al., 2005, p. 217). A *planation surface* is virtually the same, except that an erosion surface is a rolling surface of low relief, while a planation surface is flat to nearly flat. Figure 2 shows a 160 km^2 pediment at the foot of the western Tobacco Root Mountains of southwest Montana. Figure 3 shows its east-west cross section, and Figure 4 shows an aerial view.

Both pediments and planation surfaces are often cut across tilted sedimentary rocks or into granite and commonly capped by a thin veneer of water-abraded, resistant rocks. For instance, the pediment along the east side of the Ruby Valley (Figure 5) bevels the valley-fill sedimentary rocks, dipping about 3° toward the east (right in figure). The rocks on top of the pediment (Figure 6) are mostly well-rounded coarse quartzite gravel originating from central Idaho. The clean beveling and the exotic rocks provide powerful evidence for *down-valley* fast Flood currents.

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Accepted for publication May 22, 2018

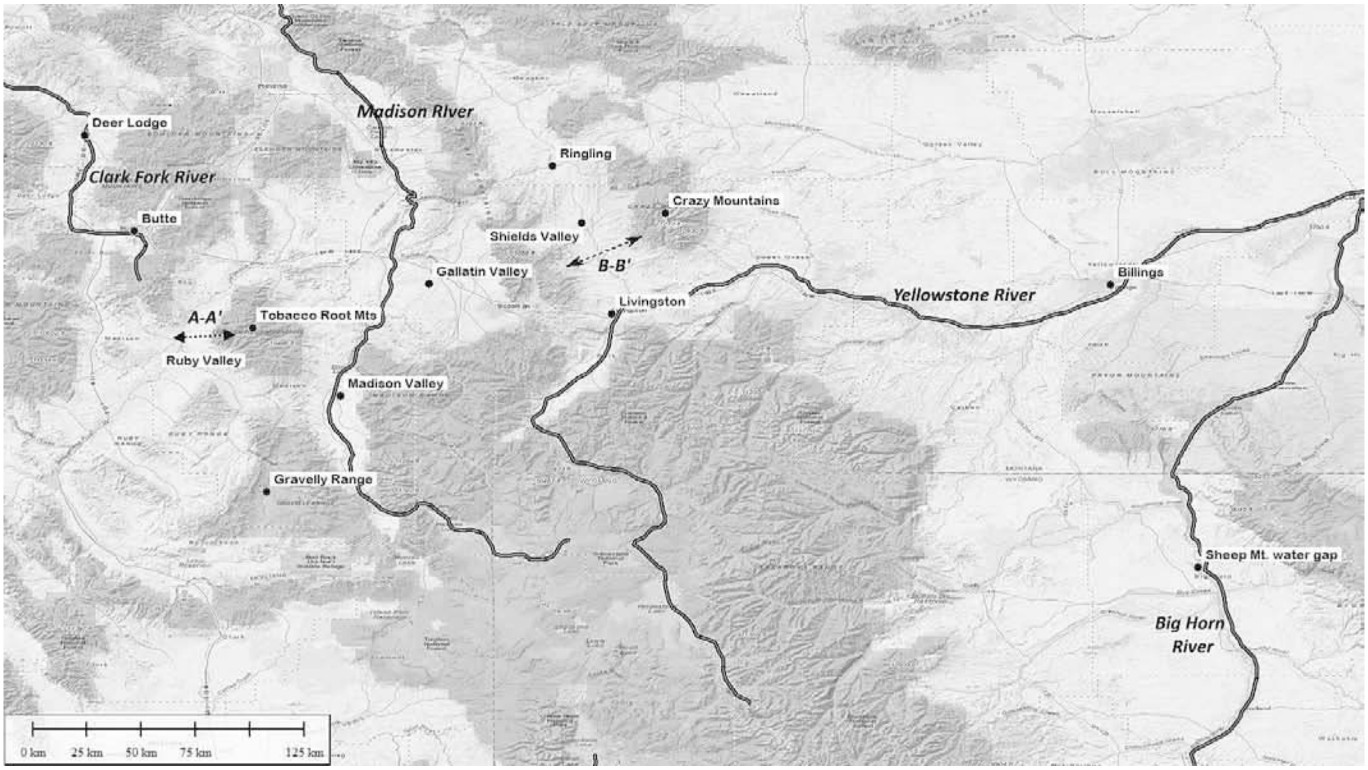

Figure 1. Location map of places mentioned in article. The thick lines indicate some of the major rivers. Dashed double-arrow lines indicate locations of profiles in Figures 3 and 21 (imagery courtesy of ESRI).

Figure 2. Pediment along the western slope of the Tobacco Root Mountains, northeast of Twin Bridges, Southwest Montana. The pediment is about 20 km long parallel to the mountain front, 8 km wide perpendicular to the front, and about 300 m higher than the adjacent river.

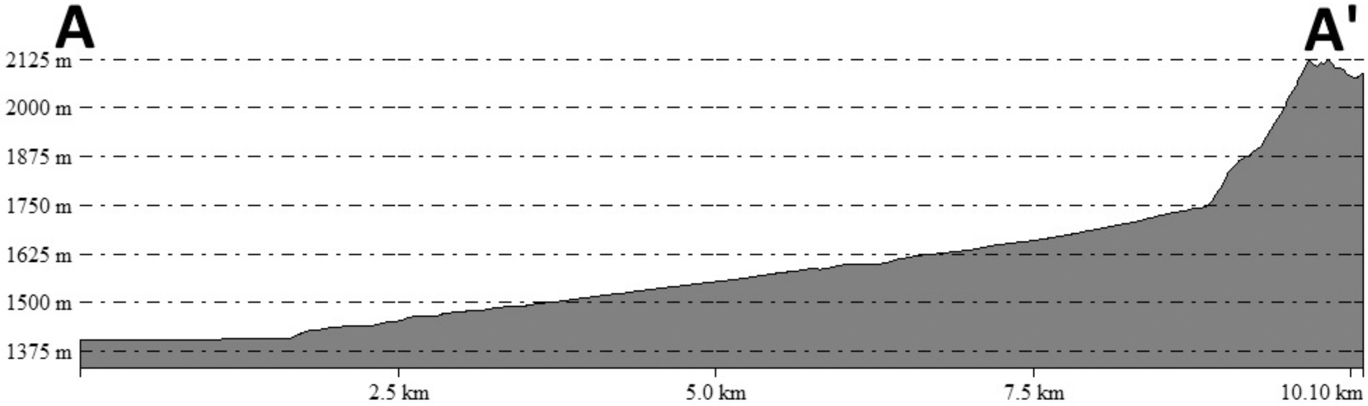

Figure 3. Profile across the pediment west of the Tobacco Root Mountains (general location shown in Figure 1 above).

Geologist Grove Karl Gilbert first described pediments in 1877. Some geologists thought they were alluvial fans, since fans have a similar appearance and location (Twidale and Bourne, 1998). But the hard rock surfaces below the gravel veneer proved Gilbert right (Rich, 1935). Alluvial fans are *deposits* of debris from a mountain valley, pointing to the valley entrance. *Bajadas* are coalesced alluvial fans that may appear to be pediments but are depositional and generally exhibit dips between constituent fans (Figure 7), while pediments are planar and erosional.

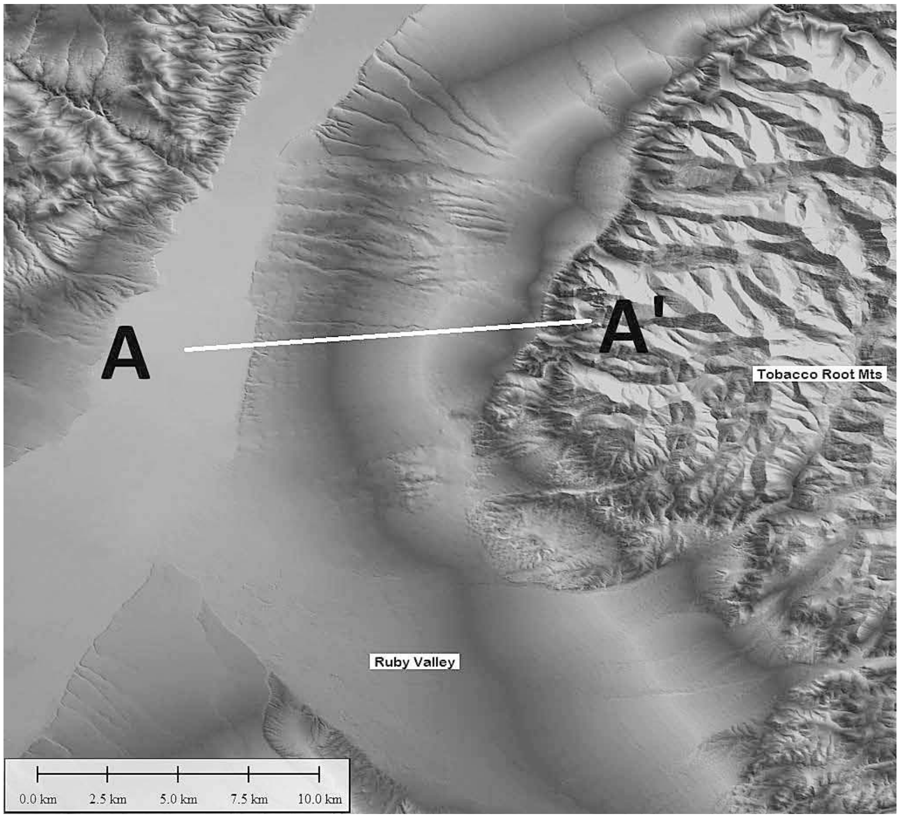

Figure 4. Aerial view of the pediment in Figure 2, showing location of the profile in Figure 3. In this and succeeding maps, elevations change shading every 100 m in order to emphasize topography (imagery courtesy of ESRI).

Although pediments are generally flat, they slope gently away from the elevation they abut (Figure 3), with a slightly concave upward profile, steepening sharply toward the mountain intersection (Hadley, 1967). The slope near the mountain front generally ranges from 1° to 6°, then flattens as the coarse gravel cap thickens. This sharp angle is called the *piedmont angle* or *junction* (Dohrenwend, 1994). Its origin has been the cause of much speculation (Hadley, 1967). It does not appear to be related to pediment size, drainage area above the pediment, or lithology (Cooke, 1970).

Pediments can be large; one in Arizona covers 615 km^2 (Tuan, 1959). The gravels capping the pediments are generally rounded, signifying *erosion by water*. Coarse gravel in a current would erode and smooth the pediment, similar to a planation surface (Crickmay, 1975; Twidale, 1981). If pediments were formed by streams flowing from tributary

Figure 5. Pediment in the Ruby River Valley along the western slope of the Gravelly Range of Southwest Montana. Note that the sedimentary beds of the valley fill sediments dip right (east), while the pediment surface dips left (west) and shears the sedimentary layers evenly.

Figure 6. Coarse gravel veneer capping the pediment shown in Figure 4. Note that the rocks are rounded to sub-rounded, and most of them are exotic quartzite.

Figure 7. A bajada of coalesced alluvial fans east side of Madison Valley, Southwest Montana. Low areas between fans shown by arrows.

Figure 8. Multiple pediments on soft rock (arrows) at the Painted Hills, John Day Fossil Beds National Monument, north-central Oregon.

valleys—a common uniformitarian hypothesis—we would expect a mixture of water-deposited and debris-flow sediments, with angular and sub-angular rocks atop the pediment. This is rarely the case.

Pediments are *not* forming today but instead are being dissected and destroyed by present-day erosion (Twidale, 1978). A few researchers believe they form today but have not observed it. Oberlander (1989, p. 70) stated:

> Until recently, these planar surfaces were assumed to be actively expanding in deserts. The processes creating such surfaces have long remained a matter of speculation and controversy.

Running water in deserts does not form pediments; it either incises them or deposits debris on their surfaces (Garner, 1974). Crickmay (1974, p. 127) commented:

> There is no reason to suppose that any kind of wasting ever planes an area to flatness: decrepitation always roughens; *rain-wash, even on ground already flat and smooth, tends to furrow it* [emphasis mine].

Sometimes there is no coarse gravel veneer or the pediment is carved on soft or unconsolidated rocks (Figure 8). These pediments must be young, since erosion at present rates (Reed and Oard, 2017) would quickly destroy them.

Southwest Montana Pediments and Planation Surfaces

Pediments are pervasive in the valleys of southwest Montana. They exhibit many interesting features that point toward their formation in powerful, waning Floodwater channels. This is what makes them so difficult for uniformitarians; pediment formation is inherently a rapid, transient, dynamic

Figure 9. Pediment erosional remnant in foreground (arrow), Shields River Valley east of Wilsall, Montana.

process. They would have formed as the *last* fast, erosive currents weakened, as indicated by gravel bedload falling out (Oard, 2004). Decreasing size of the currents would have led to lateral shifts across valleys, forming pediments on one side, while eroding the other. If the currents shifted back, newly formed pediments could have been eroded too (Figure 9). Sometimes remnants appear along valley sides, but in other cases they are separated from the sides due to small, fast currents hugging the mountain. As the flow dropped, pediments might form at lower levels, resulting in multilevel pediments and remnants in one valley (Figure 10). Once formed, pediments were later dissected by smaller currents exiting tributary valleys or by post-Flood erosion. Water and wind gaps (Part III) typically formed concurrently with pediments.

Pediment gravel caps in the Rocky Mountain region, like Grand Mesa, Colorado (Figure 11), combine local and exotic rocks. That pediment is covered with quartzite gravels transported from more than 100 km to the east. A pediment west of the Sandia Mountains of New Mexico, just east of Albuquerque (Figure 12) is capped by quartzite cobbles and boulders transported tens of km from the north. The valley pediments of southwest Montana are commonly capped by quartzite cobbles and boulders from central Idaho. These exotics are a *key* to the origin of pediments.

Although there are many pediments, only one planation surface exists in the valleys of southwest Montana. This single surface is in the southwestern Gallatin Valley, north of the Madison Valley (Figure 13). Like pediments, it is capped by well-rounded, coarse quartz-

Figure 10. Remnants of two pediment levels (arrows), Shields River Valley east of Wilsall, Montana. The Crazy Mountains are in the background.

ite gravel (Figure 14), and was dissected by a waning channel about 2 km wide that excavated 250 m of fill. The Madison River now flows through that valley. The planation surface and its gravel cap extend east from the Madison River.

Failed Uniformitarian Hypotheses for the Origin of Pediments

None of the three dominant uniformitarian explanations of pediments—lateral planation, sheetflooding, and weathering—can match the power of the Flood explanation (Oard, 2013). A newer idea—Crickmay's "superflood" hypothesis—comes closer because it is more empirical and looks to high-energy events. However, it is ultimately uniformitarian, and thus veers away from its own implications. As an aside, Whitmore (2013) suggested pediments could have formed in post-Flood catastrophes by mass wasting off nearby mountains. But pediment features do not conform to this explanation. There is rarely any mass wasting debris associated with pediments—it is found at basal depositional terraces. Nor can mass wasting explain the ubiquitous, rounded, exotic gravel or the extensive flat surfaces.

Figure 11. Dissected pediment along Grand Mesa, Colorado (arrow). Pediment has quartzite coarse gravel transported from up the Colorado River Valley.

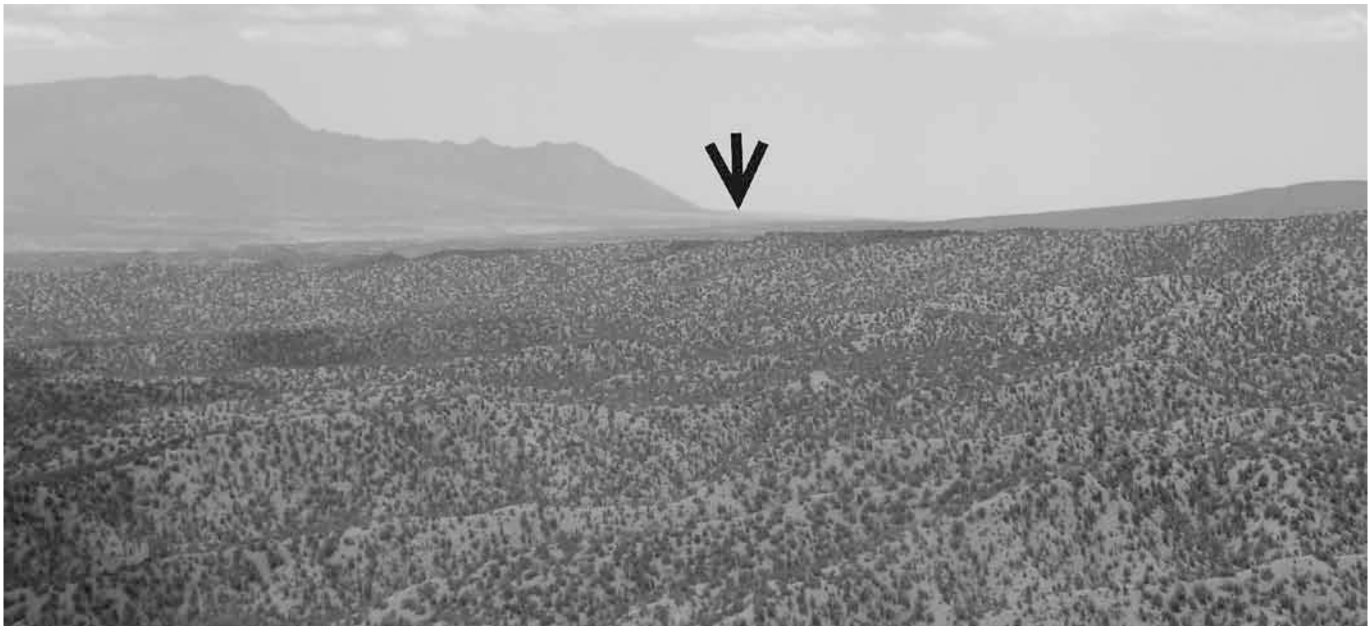

Figure 12. The Sandia Mountains (left background) with a pediment to the west (arrow) near Albuquerque, NM (view south). Pediment has quartzite coarse gravel transported from about 100 km to the north.

Figure 13. Planation surface remnant (arrow) in the southwest Gallatin Valley, Montana. The northern Madison Range is in the background.

Lateral Planation Does Not Work

A popular early hypothesis suggested meandering streams from mountain tributaries eroded pediments as they swept laterally across valleys between tributaries. The repeated back and forth meandering supposedly eroded a flat surface. But observation shows that most tributary streams *dissect*, not plane, when they erode, or they deposit debris on existing pediments. This theory cannot explain the gravel veneer of pediments. Further it leads us to expect pediments to extend out from a tributary valley. However, they commonly lie *between* tributary valleys (Figure 15) or near the top of a mountain ridge (Figure 16), such as those located south-southeast of Deer Lodge, Montana (Figure 17).

Figure 14. The quartzite gravel cap on planation surface in Figure 13.

Sheetflooding Cannot Plane

Another theory proposed that sheetflooding from heavy thunderstorms spread at right angles from the mountain front. Over time, multiple floods would erode and smooth the surface. This hypothesis was popular many years ago but has few advocates today (e.g., Vincent and Sadah, 1995). Shallow sheetflooding over a limited area has been observed during thunderstorms in dry environments (McGee, 1897), but such sheetfloods are rare; linear streams are more common (Ritter, 1978). Sheetfloods quickly

Figure 15. A dissected pediment that is eroded out from the tributary valley with remnants still out from the ridges (arrows) between tributary valleys, upper Clark Fork River near Deer Lodge, Montana.

Figure 16. Upper level pediment that starts near the tops of the mountains, upper Clark Fork River Valley near Deer Lodge, Montana (arrow).

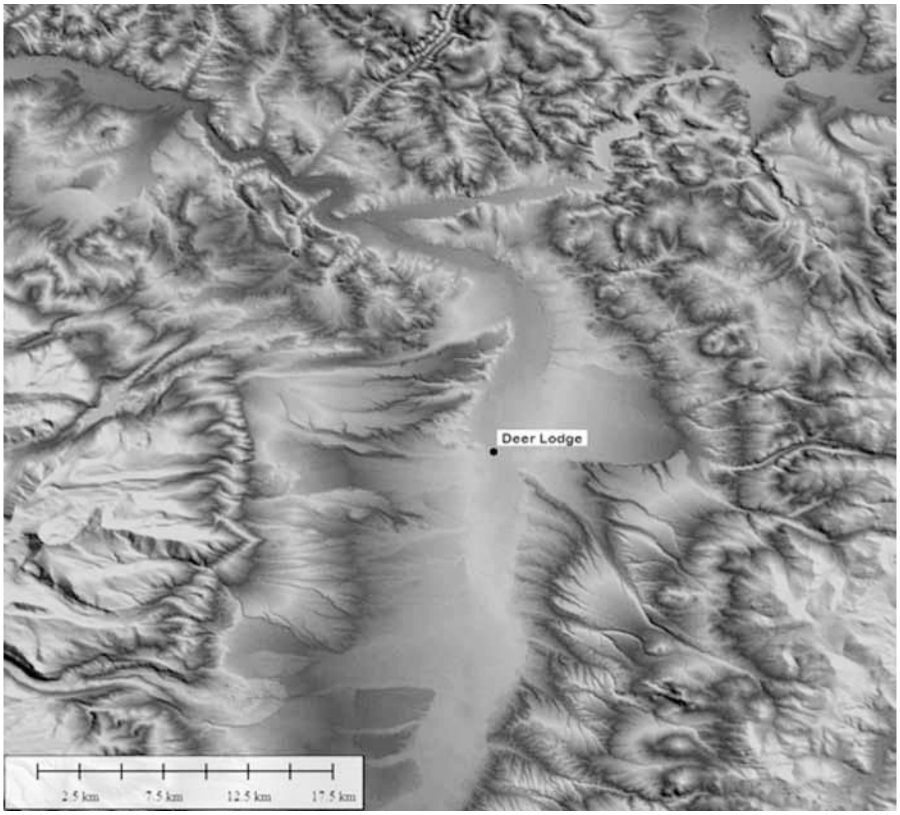

Figure 17. The Deer Lodge Valley, Montana, showing dissected pediments on either side (view north). For the location of Deer Lodge, see Figure 1 (imagery courtesy of ESRI).

transform into a channelized drainage network which would dissect, not plane, a surface (Bloom, 1978). The fatal flaw is the necessity of assuming a *preexisting* flat surface. Without it, there would be no surface to support sheetflooding. Many investigators have noted this. Oberlander (1989, p. 72) stated:

> Early proposals that erosive sheetfloods could form pediments are defeated by the fact that sheetfloods require planar surfaces and are a consequence rather than a cause of planation.

Weathering Cannot Form Pediments

Finally, many geologists think weathering can form pediments, just as they mistakenly think it can for planation and erosion surfaces (Figure 18). Most geomorphologists lean toward this hypothesis. In it, pediments and planation surfaces form in two stages: (1) a landscape is chemically weathered over time, creating a subsurface *weathering front*; and (2) the weathered debris is removed by sheet wash, stream erosion, or other

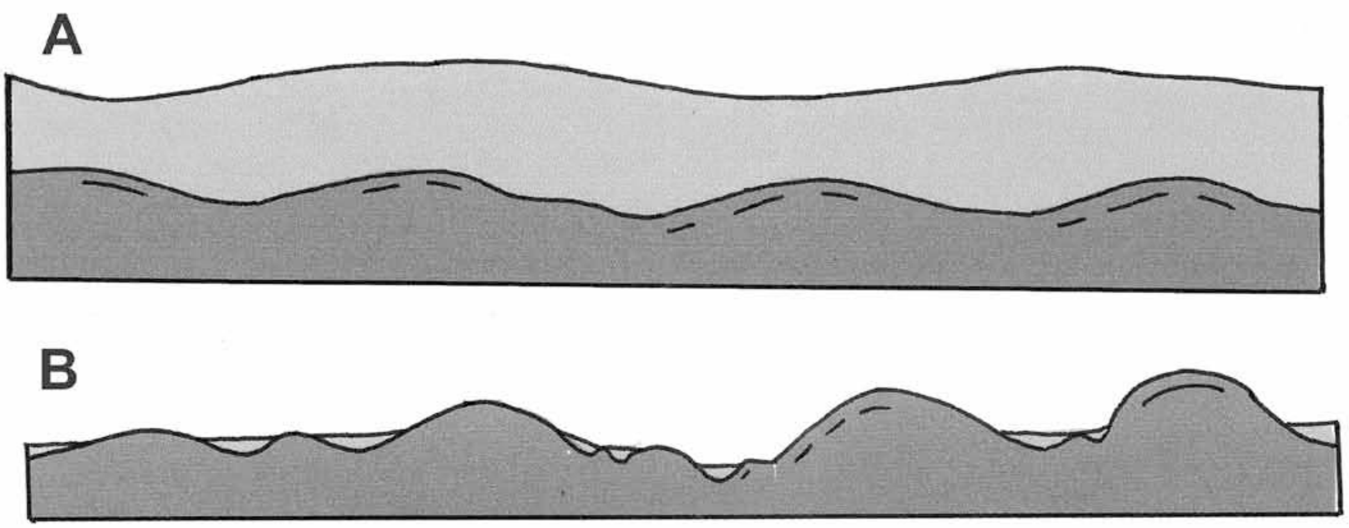

Figure 18. Schematic of the weathering hypothesis in forming an erosion surface (etchsurface). From Thomas (1994, p. 291), redrawn by Mrs. Melanie Richard. A = deep weathering, with a subsurface boundary between weathered and unweathered bedrock being the level below the surface. It is called the "weathering front." B = the weathered material is almost totally eroded to form the "etchsurface."

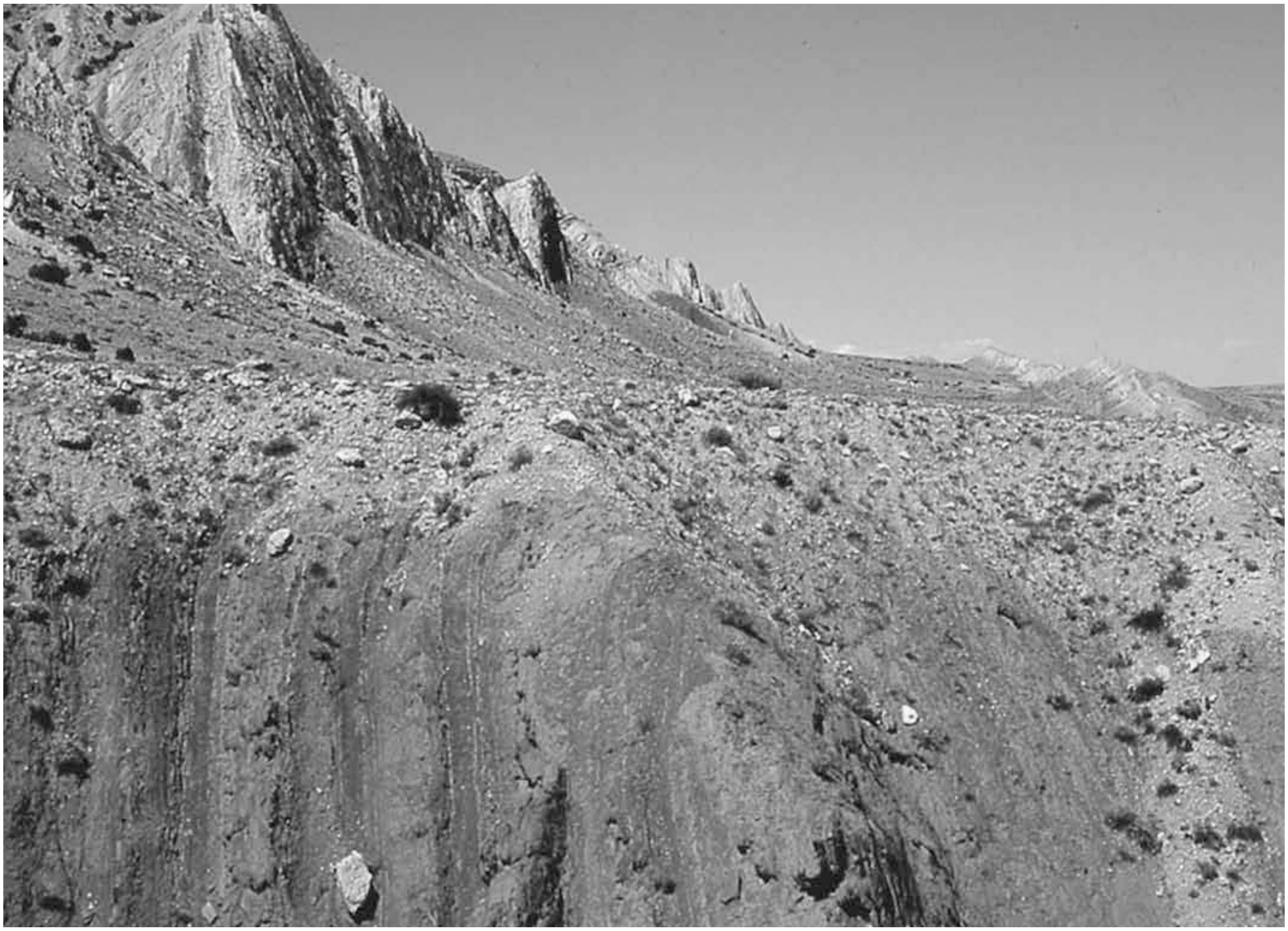

Figure 19. Coarse gravel veneer capping a pediment on vertical strata on the east limb of an anticline at the Sheep Mountain water gap, Bighorn Basin, north of Greybull, Wyoming (for location, see Fig. 1). A minor proportion of the rocks on this dissected pediment are exotic quartzites cobbles and boulders, some with percussion marks, from at least 500 km away to the west in central Idaho.

mechanisms, exposing the weathering front as a bedrock surface. Both stages can take place simultaneously.

But weathering does not form flat surfaces over large areas, and this theory cannot explain the gravel veneers. Weathering processes are acting on pediments today, but do these weathering processes wear down relief to form a pediment? Dohrenwend (1994, p. 343) admitted:

> Although subsurface weathering processes have strongly influenced pediment development in many areas and profoundly modified pediment surfaces in many others, it would appear unlikely that these processes actually 'control' pediment development, at least in arid and semi-arid environments.

Crickmay's Superflood Hypothesis

A maverick theory that brushes against the truth is Crickmay's "superflood" hypothesis. Though grounded in observation, it is believed by few, if any, geomorphologists today (Twidale, 1993), possibly because of its catastrophic implications.

Crickmay was a geomorphologist not afraid to follow the data or challenge mainstream ideas. Most of his ideas are summarized in his book, *The Work of the River* (Crickmay, 1974). He concluded that water formed most of earth's geomorphology, including pediments. He wrote that rounded rocks found on planation surfaces and pediments were evidence of water action, since rocks are nearly always rounded by water.

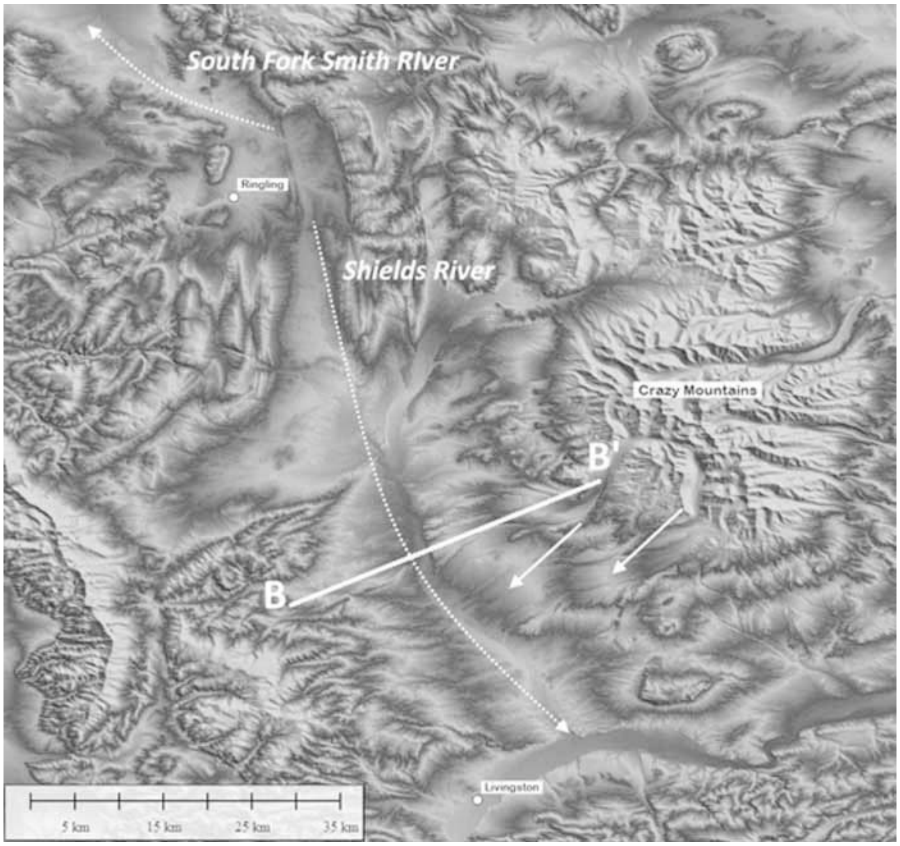

Figure 20. Shields River Valley, Montana. Dotted lines indicate rivers, solid line indicates profile B-B', arrows point to different levels of pediments (see Figure 27 for two levels) (imagery courtesy of ESRI).

Crickmay also noted the presence of *exotic* rocks in pediment-topping gravels (Figures 6 and 19) and concluded that pediments formed by currents flowing *parallel* to the mountain front, *down valley*, not *out* of the mountains from tributary valleys and across the foothills. This contradicted all existing hypotheses, making him unpopular with many peers, but his arguments were hard to dispute.

Other geomorphologists undoubtedly knew of exotic rocks on pediments, since they are easily observed, but amazingly only Crickmay and Twidale (as far as I know) published this fact. These exotics contradict all three major hypotheses. Many geologists avoid catastrophism, and only invoke it when obvious, and minimize it and separate it from any other catastrophe with the smothering blanket of deep time. This observational bias is why creation geologists must do their own fieldwork.

Other problems exist. *Many* superfloods would be needed to form the vast number of pediments and could still not explain pediments at high elevations, some hundreds of meters above the valley. Crickmay suggested a "900-year event" superflood. Given observational scope, we should see one in some locales every year. Even a 900-year event would be unlikely to form pediments or transport gravel over long distances, much less significantly erode the valley fill. Furthermore, such a flood could not form pediments and pediment remnants hundreds of meters above the valley bottom. Nor would they be powerful enough to erode pediments into the hard

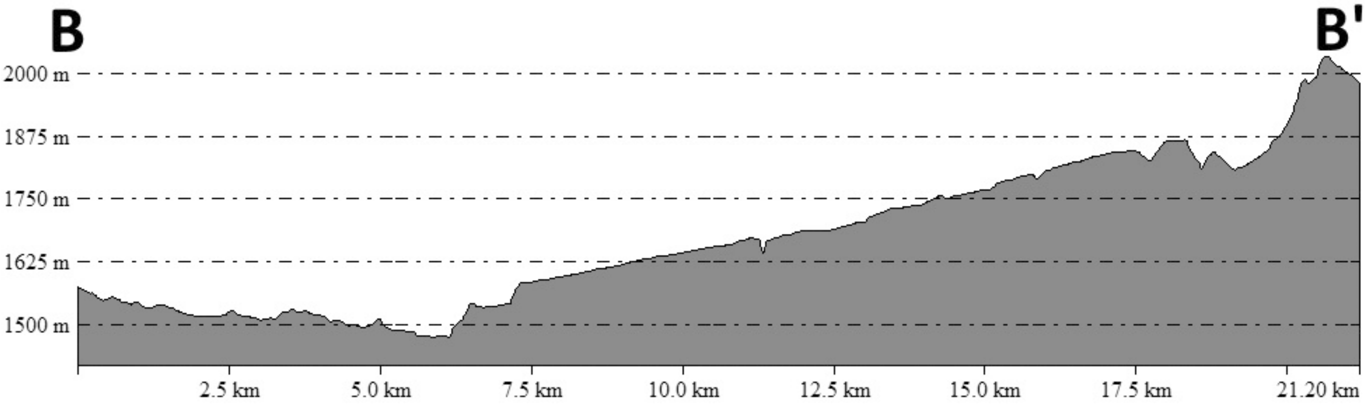

Figure 21. Profile of line B-B' in Figure 20 showing pediment on east side of river valley.

rock underlying many. Finally, multiple superfloods would likely erode and deposit sediment as *cut and fill structures, terraces, and floodplains on the side of a mountain and not form pediments*.

Crickmay was close to the truth, but his uniformitarian bias prevented him from visualizing the entire valley filled with fast-moving water. But he made the crucial conceptual leap of currents running parallel to the mountain front. This idea does explain the transport of exotics over some distance.

Pediments are not forming today and their unique characteristics cannot

Figure 22. Low pediments at the north end of the Shields River drainage valley (view southeast). Crazy Mountains in the distance.

Figure 23. View southeast of pediment east of Wilsall, Montana

Figure 24. View south on coarse gravel pediment just east of Wilsall. Absaroka Mountains in the background.

Figure 25. Top of a gravel pit on edge of the pediment shown in figure 19.

Figure 26. Largest rock in gravel pit is about 30 cm long.

Figure 27. View east of two large pediments, south side of the Crazy Mountains (left) and the Yellowstone River Valley, Montana (right off the picture). One large pediment in the foreground (arrow) and a second, little higher one in the background (arrow in distance).

Figure 28. Upper Clark Fork Valley, Montana. Notice strongly defined, dissected pediments on the east side of the valley below Deer Lodge, giving way to strongly defined pediments on the west side of the valley near Deer Lodge (imagery courtesy of ESRI).

be explained by uniformitarian geology (Dohrenwend, 1994; Oberlander, 1989). Dohrenwend (1994, p. 321) exclaims:

> Pediments have long been the subject of geomorphological scrutiny. Unfortunately, the net result of this long history of study is not altogether clear or cogent and has not produced a clear understanding of the processes responsible for pediment development.

Note all the weasel words. Simply translated, uniformitarian geologists are clueless as to the origin of pediments, to the point they call it the "pediment problem" (Oberlander, 1974). Once again, uniformitarianism hinders, not helps.

Pediment Patterns in Southwest Montana

Pediments in southwest Montana attest to rapid down-valley flow during the recessive stage of the Flood. Currents eroded valley fill and the sides of the mountains (Fields et al., 1985). In the Shields and Upper Clark Fork Valleys, pediments exist high up along the valley sides, suggesting the erosion of hundreds of meters of valley fill. Alt (1984, p. 7) stated:

> However, we can be sure that the valley-fill sediments were formerly much deeper because they lie beneath the dry benches [pediments] that rise as much as 800 feet [244 m] above the river level along the flanks of the mountains.

These pediments show down-valley flow patterns that support formation by fast, waning currents that filled the whole valley first, then shrank and slowed, and began shifting laterally across the valley.

The Shields River Valley, Montana

The Shields River Valley runs about 60 km from just south of Ringling to Livingston (Figure 20). Figure 21 is a cross section, showing the large pediment on the east side. The divide between the Shields River and the South Fork of the Smith River is a hilly, wide valley. As the valley descends south, the terrain flattens and pediments appear after about 5 km (Figure 22), mainly on the east side—the west flank of the Crazy Mountains. Two pediments are observed in this location (Figures 9 and 10), which merge down valley. The altitude of the pediments above the river rises slightly toward Livingston (Figure 23). Pediments are rare on the west side, probably because of east-west ridges (Figure 20) that would have slowed flow and created turbulence. The fastest flow would have been on the east side, where pediments are ubiquitous. Figure 24 shows a gravel-capped pediment just east of Wilsall, and Figure 25 shows a gravel pit on its edge. Both the eroded surface and the gravel cap are volcanic; gravel ranges from rounded to sub-angular. The largest rock observed was about 30 cm long (Figure 26).

Since pediments likely formed in waning, yet still-powerful flow conditions, the absence of pediments near the saddle at Ringling suggests lower

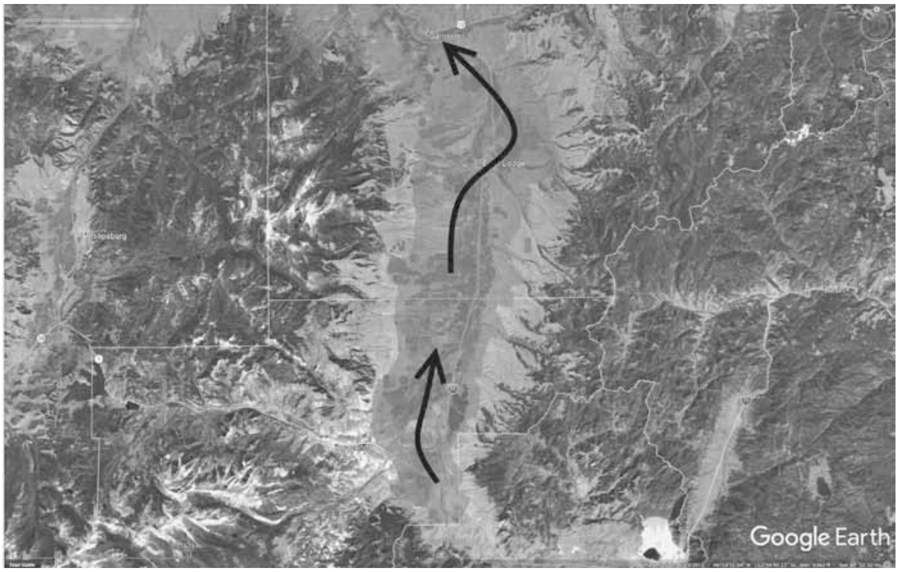

Figure 29. Channelized Flood flow down (toward the north) of the upper Clark Fork Valley, Montana (courtesy of Google Earth). Flow turns northwest between Dear Lodge and Gold Creek and flows down the Lewis and Clark fault zone toward Missoula, Montana.

flow there. As the Flood current flowed south down the Shields River Valley, it picked up speed. Since there were no obstacles to slow the flow on the east side, pediments first formed at high altitudes. Most of those were then eroded as water levels dropped and the valley floor was eroded. As a result, an extensive pediment formed at lower elevations. As that current was joined by another moving north out of the Paradise Valley, south of Livingston, the channelized Flood current shifted toward the east from Livingston toward Billings. In the broad Yellowstone River Valley, this current cut two large, gravel-capped pediments on the south side of the Crazy Mountains (Figure 27). Pediments and planation surfaces were carved throughout the broad Yellowstone River Valley into southeast Montana. Some have exotic quartzite cobbles and boulders on top. None of the uniformitarian theories explain the pediments associated with the Shields River Valley, but the receding Flood does so quite well.

The Upper Clark Fork Valley near Deer Lodge, Montana

The Upper Clark Fork Valley begins near Butte, Montana, runs west about 20 km toward Anaconda, shifts north for about 50 km, and then turns northwest toward Gold Creek and Missoula (Figure 28 and 29). Just like the upper Shields River Valley, there are no pediments in the southern valley, where flow would have been slow; instead, it is a flat valley with a low nascent pediment on the southeast side (Figure 30 arrow). The pattern of pediments further north has a distinctive pattern, probably shaped as the Floodwater shallowed. The low pediment in Figure 30 increases to about 200 m above the river (Figure 16) and then disappears northeast of Deer Lodge at an escarpment (Figure 31 and 32).

There is no pediment on the southwest side of the Upper Clark Fork Valley (Figure 30, left, also lower left of valley in Figure 28), but moving north, a low

Figure 30. Panorama of the southern part of the Upper Clark Fork Valley with a low pediment (arrow) starting on the right (view north).

Figure 31. View northeast of Deer Lodge with the pediment on the east side of the Upper Clark Fork Valley ending at a scarp (arrow), probably because the strongest flow swung toward the northeast after passing Deer Lodge (see Figure 29).

pediment appears halfway down the valley and gradually rises to ~200 m above the river just west of Deer Lodge. This extensive pediment (Figures 28, 32, and 33) covers about 150 km^2. It is capped by sub-rounded to rounded coarse gravel (Figure 34). The western part of this pediment is capped by glacial debris. Then the pediment ends as the valley turns northwest (Figures 28 and 32). There are small pediments northwest of Garrison Junction, but none between there and the Pacific Ocean.

This pattern can be explained by a slower Flood current near the continental divide that accelerated north, where it carved pediments, first on the east side and then on the west. No east-west valleys impeded the current. The pattern north of Deer Lodge suggests a shallow, strong current that first swung northeast as the valley widened, and then shifted northwest (Figure 29). The wide swing of the current probably formed the scarp

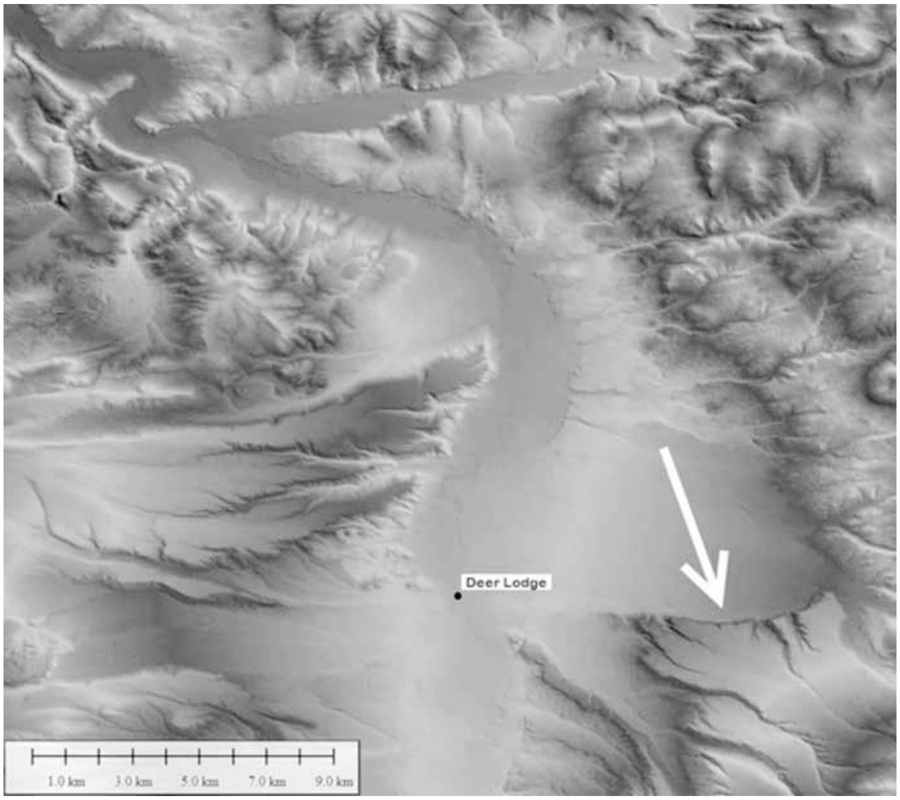

Figure 32. Location of pediment scarp in Figure 31 (imagery courtesy of ESRI).

Figure 33. The extensive pediment on the west side of the Upper Clark Fork Valley west of Deer Lodge (view southwest from about 5 km west of Deer Lodge).

Figure 34. On top of the extensive pediment on the west side of the Upper Clark Fork Valley west of Deer Lodge (view west from about 5 km west of Deer Lodge).

at the end of the east-side pediment (Figures 31 and 32) and then eroded the northern end of the west-side pediment.

The absence of pediments northwest of Garrison Junction suggests active faulting in the Lewis and Clark fault zone. Although the valley narrows, the expected rapid currents were likely disrupted by faulting, forming eddies and turbulent flow with slower currents. Some of the strata is tilted vertical. Such slow flows would be erosive but not ideal for pediments, which require steadier, rapid flow down a long fetch without obstacles.

The Beaverhead and Jefferson River Valleys, Montana

The Beaverhead River flows north near Dillon, Montana, into the Ruby River at Twin Bridges, where they become the Jefferson River (Figure 36). The river valley is about 100 km long; it reaches about 30 km wide near Dillon before narrowing to 10 km near Twin Bridges, but widens again near Whitehall, where three currents converged. It then passes through the Jefferson Canyon water gap (see Part III), home of the Lewis and Clark Caverns.

There are no significant pediments south of Dillon, but they are common down valley (Figure 36). The flow clearly accelerated down valley. North of Twin Bridges, where the Ruby River Valley converges with Beaverhead Valley, the flow swung west, creating a large pediment (~160 km^2) west of the Tobacco Root Mountains (Figures 2 to 4). It ends at the northeast end of the Jefferson River Valley, but another appears on the opposite side, showing the transition of the main current from one side of the valley to the other.

Figure 35. View northeast of the edge of the pediment showing the coarse gravel cap.

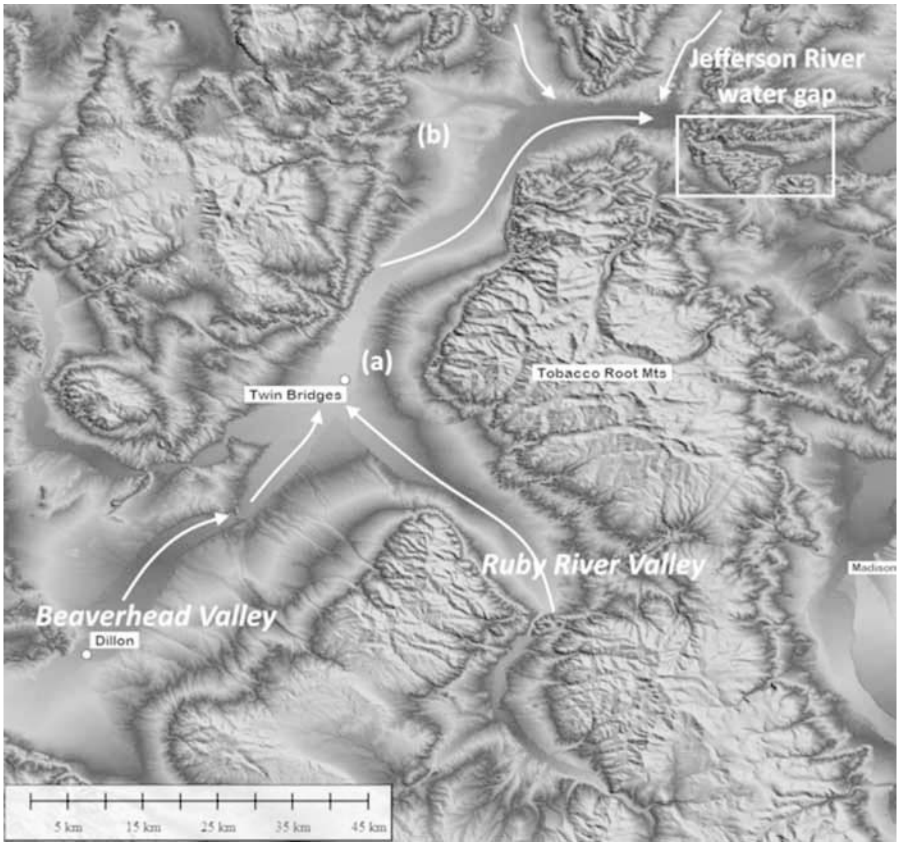

Figure 36. Flood flow down the Beaverhead and Jefferson River Valley, Montana. (a) shows pediment created to the west of the Tobacco Root Mountains (Figures 2 to 4), when flow down Ruby River Valley converged with Beaverhead Valley and then swung to the west. (b) shows pediment appearing on northwest side of valley as pediment on east side disappears. Note three converging currents at the western end of the Jefferson River water gap (see Part III) (imagery courtesy of ESRI)

Conclusions

Pediments are landforms that are best explained as products of the ephemeral final Floodwater currents flowing down newly forming valleys. These currents were powerful enough to erode pediments, sometimes into the hard rock of the mountains, as well as erode valley fill. As the velocity slowed, the very coarse bedload that had cut into both hard rock and valley fill was deposited atop the newly-created pediments as the gravel caps. Rapid current fluctuations explain the erosion of multiple levels of pediments and the swing from one side of a valley to another. No uniformitarian theory has yet been able to match this elegant explanation, and it appears that uniformitarian blinders will not allow a breakthrough in this area until that false assumption is laid to rest.

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.

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