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Genesis Flood Drainage through Southwest Montana:

Part I: Mountain and Valley Erosion and Deposition

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Abstract

During the recessive stage of the Genesis Flood, differential vertical tectonics exposed the mountains and continents. Initially, Floodwaters flowed off the continents in sheets, but the sheets narrowed to channels, and more land was exposed. The rushing waters strongly eroded the continents and left their signature on the surface. These processes can be seen in southwest Montana, an area composed of mountain ranges and adjacent "flat-bottomed" valleys. As the western Rockies first rose, sheets of water flowing over them deposited large breccia fans in southwest Montana, east of the Beartooth Mountains, and east of the Bighorn Mountains in north-central Wyoming. Continuing uplift and erosion destroyed most of these fans. Mountaintops were exposed to varying levels of erosion during uplift. Up to several thousand meters of sediment was washed down into adjacent valleys and basins or transported out of the area. The energy of these events is seen in the erosion and transport of coarse quartzite gravel across the region. When the Floodwater became more channelized, strong down-valley currents eroded approximately 1,000 meters of the recently deposited valley fill, moving it toward the oceans.

Introduction

Creation scientists have proposed several scientific models of the Genesis Flood (Bardwell, 2011), such as Baumgardner's catastrophic plate-tectonics model, Brown's hydroplate model, and Oard's impact/vertical-tectonics model. But regardless of the proposed mechanism of the Flood, these models generally agree that developing deep ocean basins caused the Floodwater to drain off the continents, corresponding to Walker's (1994) recessive stage. Walker's model is similar to other types of floods, such as flash floods (Oard, 2008, 2013), in which there are two main stages: (1) the flooding stage, when the water rises to a

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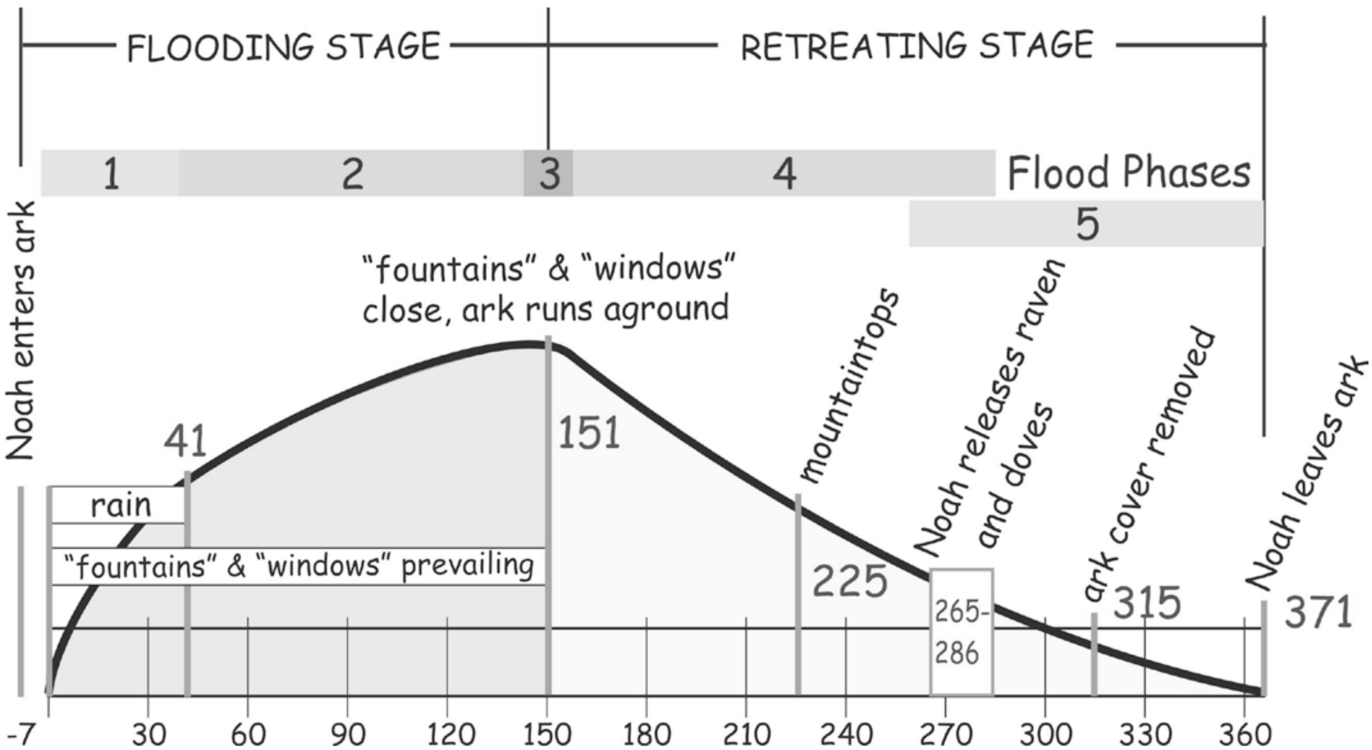

Figure 1. Graph of relative sea level for the two stages and five phases in Walker's model (drawn by John Reed).

peak, and (2) the recessive stage, when the water drains (Figure 1).

Walker's recessive stage began after the Flood peaked, and is divided into two phases, the abative or sheet-flow phase and the dispersive or channelized-flow phase. Early in the sheet-flow phase, the Floodwater flowed in broad sheets, perhaps 1,000 km wide and 3 km deep (Figure 2). As the Floodwater drained, more mountains and plateaus were exposed, forcing a narrowing of the sheets into channels (Figure 3), and eventually into post-Flood rivers and streams. The channelized-flow phase was the final event of the Flood, and saw the Floodwaters completely drained from the continents.

This series will focus on evidence for this two-stage drainage in southwest Montana. This region is uniquely suited for this investigation; its topography is composed of numerous high mountain ranges and generally narrow, "flat-bottomed" valleys. These mountain ranges would have forced the receding waters through these valleys, and both should exhibit features of Flood flow. Part I will describe Floodwater erosion and deposition during the transition from sheet to channelized flow. Part II will focus on pediments and planation surfaces formed in the valleys during erosion, and Part III will explore water and wind gaps carved during this time. In all of this, the superior explanatory power of the Flood model will be shown.

Significant relative uplift between the continents and oceans and mountains and valleys (Psalm 104:8) occurred during the recessive stage. It is not known whether the actual motion was that of the continents rising or the ocean basins sinking, or a combination, but rising still-submarine mountains on the continents were the initial targets of erosion, and many are worn down to granite and gneiss of the upper continental crust. The Rocky Mountains experienced this early massive erosional event. Much of the eroded sediment was deposited in adjacent valleys or transported to the Gulf Coastal Plain. Most of the uplift in southwest Montana seems to have occurred during the sheet-flow phase, as shown by the lack of differential vertical tectonics between the mountains and the valleys during the massive erosion and formation of pediments (see Part II).

The Geomorphology of Southwest Montana

Southwest Montana is composed of uplifted mountains with valleys par-

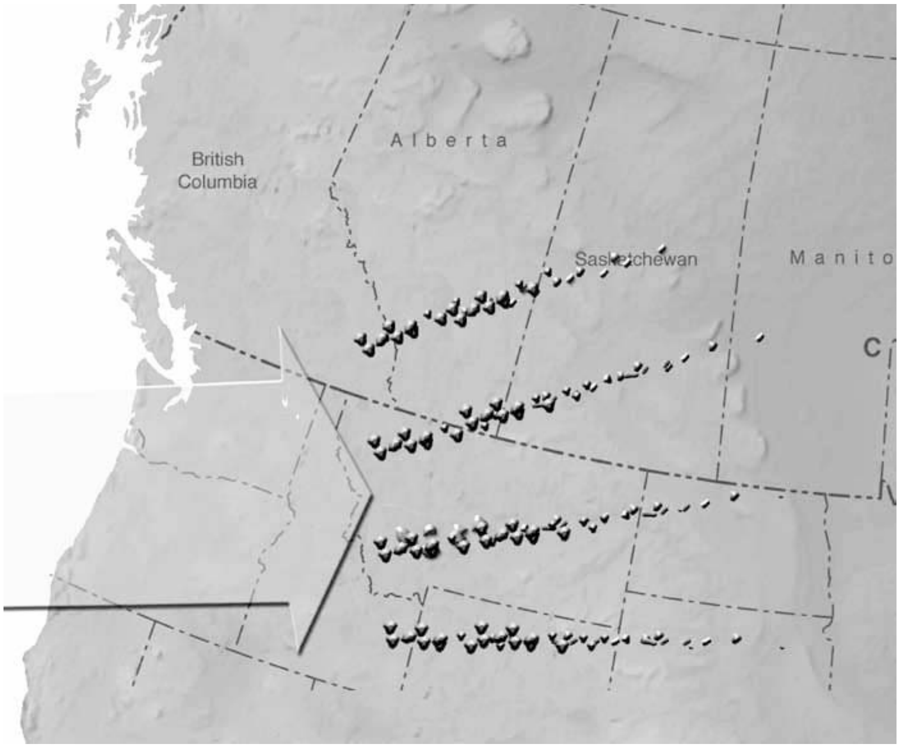

Figure 2. Sheet flow eroded layers of quartzite from the western Rocky Mountains, rounded them, and spread them far to the east (drawn by Bryan Miller and modified by Mrs. Melanie Richard).

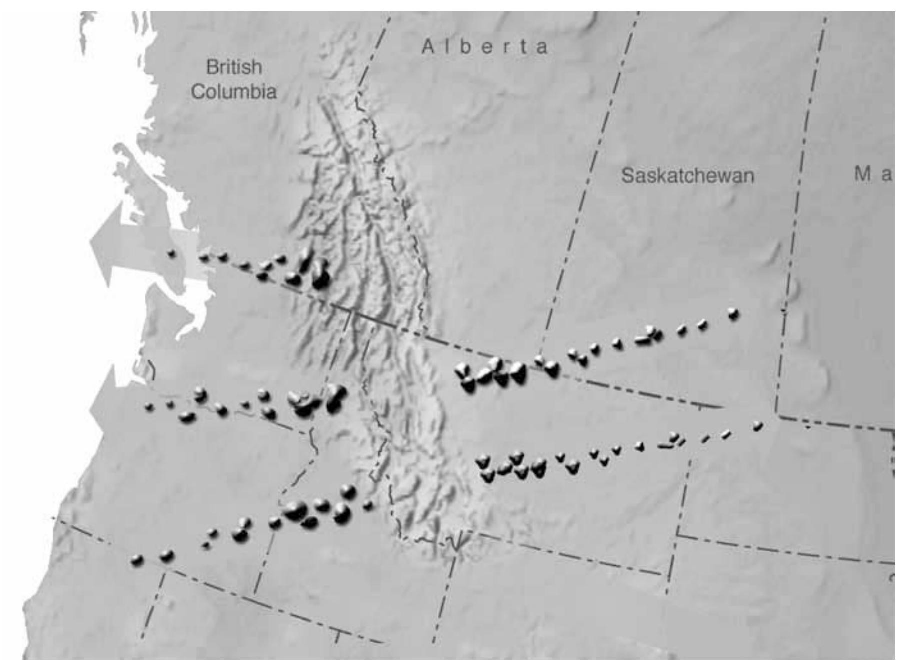

Figure 3. As the Rocky Mountains are exposed, the Floodwater flow is split into east flowing and west flowing branches that become more channelized with time (drawn by Bryan Miller).

tially filled with sediments and volcanic debris, *valley fill* (Figure 4). The large (50 km across) Gallatin Valley is more like a basin. The geomorphology of southwest Montana is similar to that in Wyoming (Oard, 2017). Early geologists thought the flat valleys and basins of southwest Montana represented the bottoms of ancient lakes; so, the sedimentary rocks were first called the Bozeman Lake Beds (Perry, 1962). Then they discovered that much of the valley fill is conglomerate, so the fill is now considered mostly "fluvial" with only minor "lake" sediments. Pediments and water and wind gaps are common in southwest Montana.

The Great Unconformity

Very early in the Flood, the uppermost crust of granite and gneiss was eroded, forming a large planation surface called the Great Unconformity (Oard, 2014, 2017), best known from its exposure near the bottom of Grand Canyon. It is seen at many locations over much of the western United States and is often visible at the tops of many of the northern Rocky Mountains, such as the Wind River Range of northwest Wyoming (Figure 5). It is uncertain whether the Great Unconformity represents a single extensive planation surface over the western United States or a series of smaller surfaces. The Great Unconformity divides the Precambrian upper crustal rocks from Paleozoic sedimentary rocks (Marshak et al., 2017).

The Great Unconformity on the Precambrian Belt Supergroup

In the northern Rocky Mountains, the Great Unconformity also eroded the Precambrian sedimentary rocks of the Belt Supergroup (Figure 6), as it did the sedimentary rocks of the Precambrian Grand Canyon Supergroup. The Belt Supergroup was deposited in a large, deep basin that once extended from east

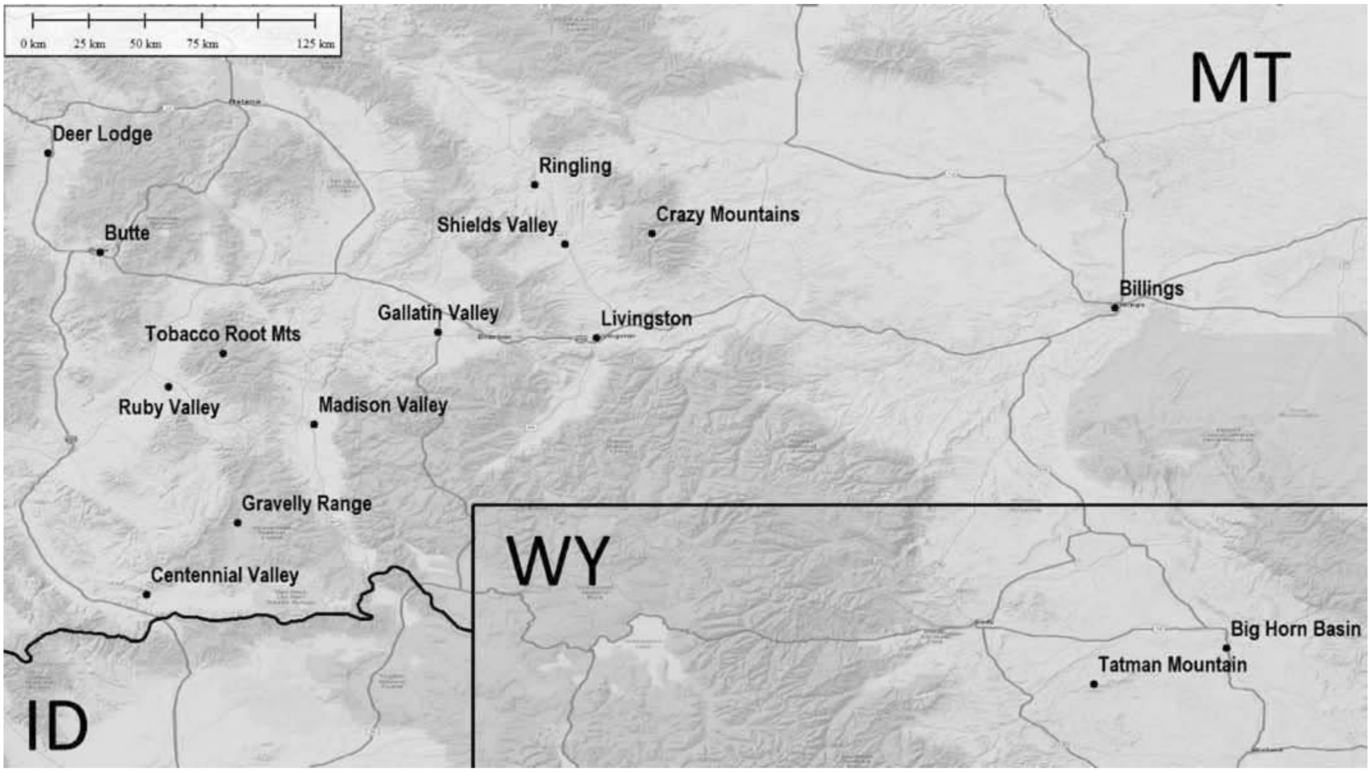

Figure 4. Location map of southwest Montana and vicinity showing mountains (dark) and low areas (light) (imagery courtesy of ESRI).

Figure 5. The flat-topped granitic mountains of the Wind River Mountains, central Wyoming (view east from northern Green River Basin), show the Great Unconformity (arrows).

of Helena, Montana, to Spokane, Washington. The supergroup rock sequence consists of over 20 km of predominantly fine-grained sand or coarse silt. Because of the numerous ripple marks and other features found in the supergroup, geologists believe that the sediments were deposited in shallow water over tens of millions of years. Their model would require slow subsidence to match the sedimentation rate for the entire 20 km basin fill, which has since been uplifted into mountains.

Some believe that the Belt Supergroup formed before the Flood, but I believe it formed very early in the Flood, as sedimentation occurred in deep basins or rifts. This is suggested by the absence of physical erosion between the Belt Supergroup and the Cambrian Flathead Sandstone in many locations, indicating continuous sedimentation (Figure 7). Such contacts between strata have been called *flat gaps*, which are observed in all "ages" of strata all over the world (Roth, 2009). Despite the physical evidence, geologists believe that one billion years of uniformitarian time is missing between the Belt Supergroup and the Flathead Sandstone. The lack of erosion between strata and the huge areal extent of some strata defies the uniformitarian age and paleoenvironmental interpretations of the rocks. This is powerful evidence of the reality of Noah's Flood (Oard and Reed, 2017). The flat gap between the Precambrian and Cambrian sedimentary rocks suggests that all or most Precambrian sedimentary rocks are very early Flood rocks deposited mostly in basins and rifts.

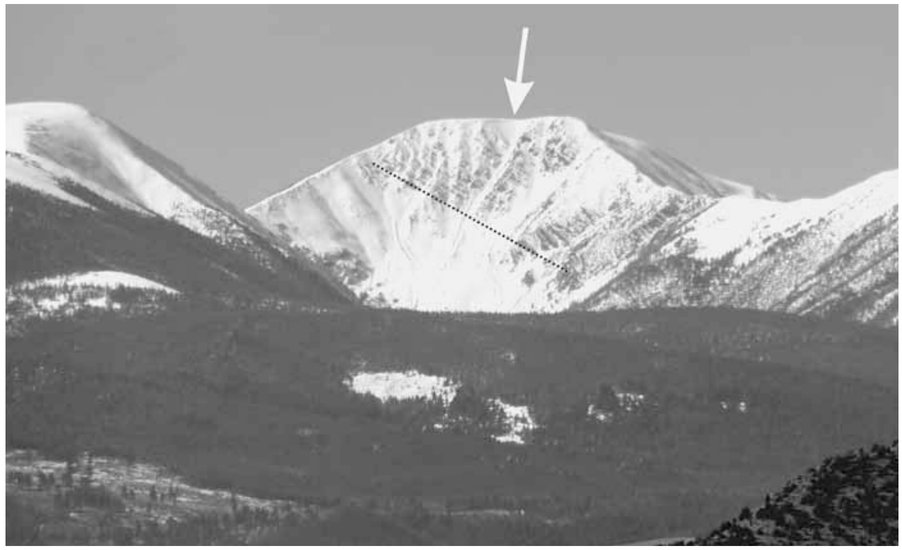

Figure 6. The Great Unconformity (arrow) atop of the Belt Supergroup rocks at the top of the Highland Mountains south of Butte (view southwest). The snow pattern (and dashed line) shows the strata at the top of the mountain dipping about 30° down to the right (northwest).

Figure 7. Peter Klevberg's hand (lower left) shows conformal contact between Middle Cambrian Flathead Sandstone and the Lahood Formation of the Belt Supergroup in the Bridger Mountains, northeast of Bozeman, Montana. Contact represents about one billion years of missing uniformitarian time, yet shows no evidence of erosion.

Deposition onto the Great Unconformity

The Great Unconformity formed early in the Flood, likely by extreme turbulence and fast currents associated with the initial marine incursion. As the water rose during the flooding stage, about 2,000 m of Paleozoic, Mesozoic, and

Figure 8. Lahood Formation breccia with one rock 2 meters in long dimension (circle and arrow) from near Cardwell, Montana, within the Jefferson Canyon water gap.

Figure 9. Beartooth Butte containing marine fossils is located 490 m above Beartooth Lake (foreground), south-central Montana and north-central Wyoming.

early Cenozoic sedimentary rocks were deposited atop the Great Unconformity in Montana and Wyoming. This thickness is estimated from locations showing little erosion. In the Bridger Mountains, northeast of Bozeman, more than 2,000 m of Paleozoic, Mesozoic, and early Cenozoic rocks overlie the Lahood Formation of the Belt Supergroup (Figure 7), which is well over 3,000 m thick at this location. The Lahood Formation is usually recognized by its breccia, the rocks of which can be up to 2 m in diameter at other locations (Figure 8). The Lahood Formation near the top of the Bridger Mountains appears conformable with the overlying Flathead Sandstone (Figure 7); both are tilted down to the east at about 70° and consist of sandstone with

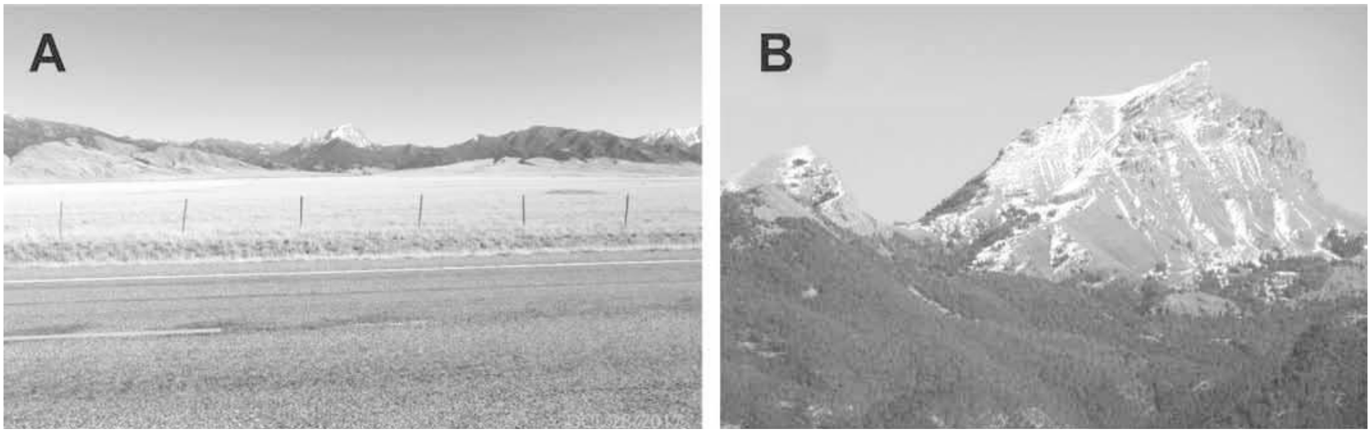

Figure 10. A: Sphinx Mountain in the central Madison Range, southwest Montana, is an isolated erosional remnant composed of about 1,000 m of limestone breccia (view east). B: Close-up of the Sphinx showing layered and slightly deformed breccia.

quartz pebbles. The absence of erosion at the contact suggests that the billion years never existed.

Erosional remnants of the Paleozoic and Mesozoic sedimentary rocks are found atop the Great Unconformity at the tops of some mountain ranges, such as the 425-m Beartooth Butte located on top of the Beartooth Mountains of south-central Montana and north-central Wyoming (Figure 9). These sedimentary rocks, like those of the Belt Supergroup, formed over large areas with little or no erosion between layers. Based on the lack of deformation and the fine-grained sediments, the great depth of these Paleozoic and Mesozoic strata indicates deposition in a generally calm period early in the Flood, which Oard and Reed (2017) have named the Great Deposition. This likely occurred *after* the unleashing of the highly catastrophic Flood mechanism (perhaps after Day 40).

Evidence of Significant Erosion from the Mountains

Sedimentary rocks originally deposited on the granitic upper crust or Belt Supergroup not only rose with the mountains, but also sank with the valleys. The massive erosion of the mountains during the sheet-flow phase (and possibly even before in the late flooding stage) deposited 5,000 m or more of additional, generally flat-lying, Cenozoic sedimentary and volcanic rocks in the valleys and basins in both Wyoming and southwest Montana. This Cenozoic valley fill is up to 4,880 m deep in the Big Hole Valley of extreme southwest Montana (Fields et al., 1985).

A breccia fan over parts of southwest Montana

The sheet currents over the incipient, rising western Rocky Mountains flowed from west to east, as evidenced by an inferred large limestone breccia fan, likely formed from eroded Paleozoic and Mesozoic rocks. Fragments of this fan are found today as tall erosional remnants (Oard, 2008, 2013) making up some of the high mountains in the region. One

Figure 11. The Red Conglomerate Peaks on the southwest Montana/Idaho border, also composed of thick limestone breccia.

Figure 12. Another erosional remnant of limestone breccia, 400-m high, about 5 km from the southeast flank of the Beartooth Mountains (view south from the road to Clarks Fork Canyon). The breccia fan is tilted east about 25°. Large white rocks (foreground and below hill) are glacial granite boulders from the Ice Age.

Figure 13. Three-meter long, sub-rounded granitic boulder from outcrop of large granitic boulders spread just east of the Bighorn Mountains and eroded into erosional remnants (the late Dr. Harold Coffin for scale).

of these peaks is *The Sphinx*, composed of 1,000 m of breccia and standing well above the surrounding mountains on top of the Madison Range (Coffin, 2009) (Figure 10). Similar erosional remnants form isolated high mountains, such as the Red Conglomerate Peaks along the Montana-Idaho border (Figure 11). Other remnants of this fan are exposed at the edge of the valleys and probably exist beneath younger valley fill. Breccia probably once covered the area between these isolated peaks. The areal extent of this breccia fan is unknown but must have covered much of the southern portion of southwest Montana, given the thickness of its remains. The fan would have soon been broken up by ongoing differential vertical tectonics and eroded by powerful currents. The author estimates that approximately 95% of this immense breccia fan was eroded.

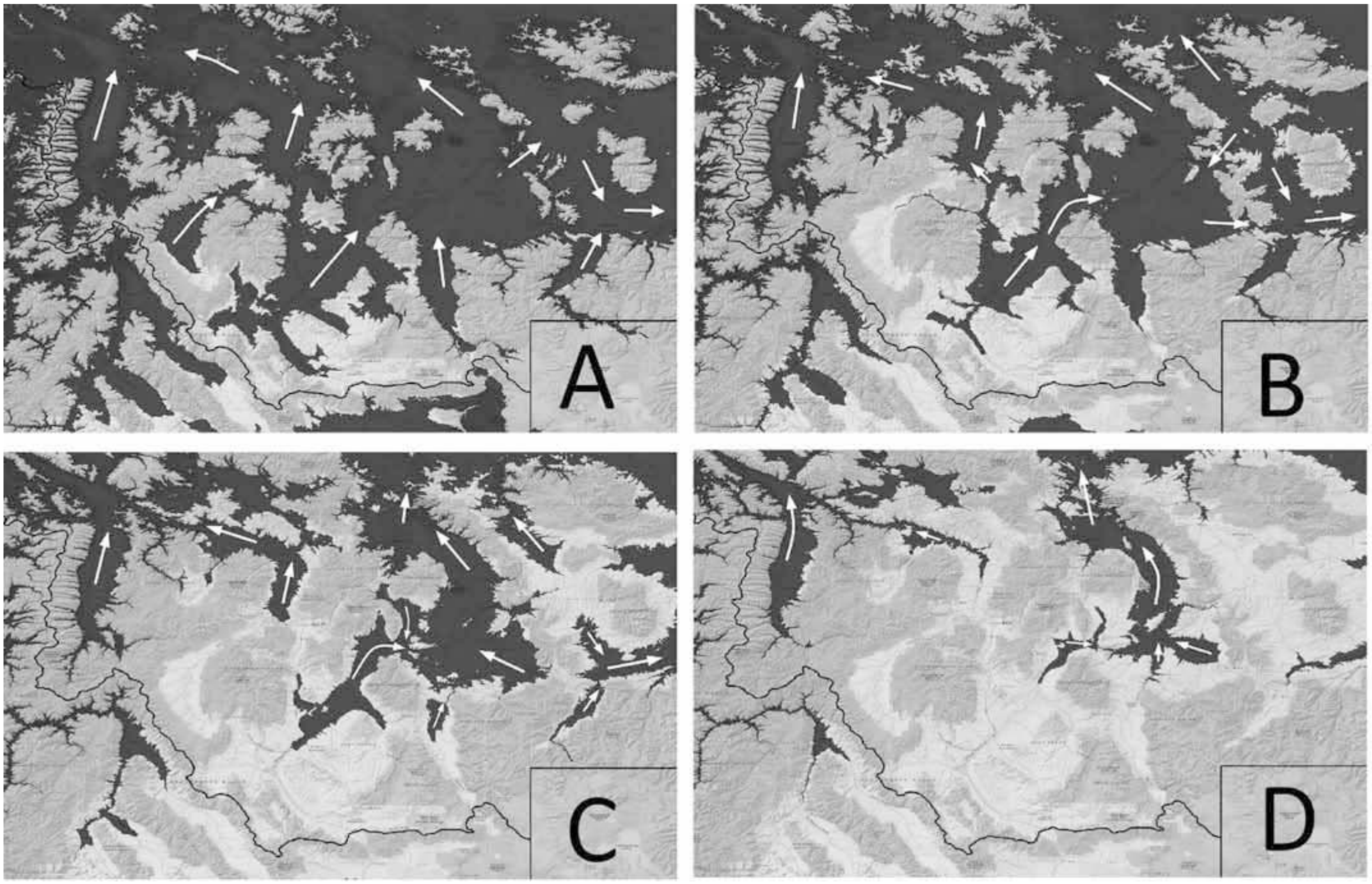

Figure 14. Floodwater drainage in southwest Montana with approximate water levels: A = 2,000 m above sea level (asl); B = 1,800 m asl; C = 1,600 m asl; and D = 1,400 m asl (courtesy of ESRI).

A breccia fan east of the Beartooth Mountains

Another breccia fan, consisting mostly of limestone cobbles and boulders, reached over 1,000 m in thickness and extended about 5 km east from the Beartooth Mountains. This breccia was eroded from the top of the Beartooth Mountains during uplift, which is probably why the fan remnants tilt about 25° down to the east. This fan was almost totally eroded later in the Flood by north-flowing, down-valley currents in the Bighorn Basin. Today, we find only a few erosional remnants (Figure 12).

Thick accumulation of granitic boulders east of the Bighorn Mountains

A third fan is located east of the Bighorn Mountains in Wyoming, but this fan consists mainly of very large, partially rounded granite and gneiss boulders (Figure 13). These boulders are generally sub-rounded and can be over 6 m long.

The Mountains Become Exposed

As the mountains became exposed, runoff transformed to mainly down-valley flow (Figure 14). It is likely the western Rockies were the first land in this region to be exposed and represented a temporary "continental divide" early in Flood runoff. This is based on geological and geomorphological evidence, including the transport of billions of rounded quartzite rocks, ranging in size from gravel to boulders, across the area now occupied by the eastern Rockies and the plains (Oard et al., 2005).

This uplift would have eventually split the sheet flow into currents flowing both east and west, the western current flowing into the deepening Pacific

Figure 15. Thick outcrop of bedded, in situ quartzite along Morgan Creek Road, about 7 km from Highway 93, about 60 km southwest of Salmon, Idaho and 15 km north of Challis, Idaho.

Ocean basin (Figure 3) (Oard, 2013). Sheet flow from west to east transformed into channelized flow through the valleys.

The Spread of Rounded Quartzite Rocks

Following deposition of the limestone breccia fans during the early sheet-flow phase, quartzite rocks were then eroded from the uplifting western Belt Supergroup in Idaho and extreme western Montana and were spread far to the east. In the Centennial Valley, the limestone breccia of the valley walls is overlain by the quartzite rocks, showing that the quartzite was transported *later* than the breccia. It is interesting that there does not appear to be mixtures of limestone and quartzite cobbles and boulders. The quartzite rocks commonly have percussion marks on them (see Figure 18), which are semicircular cracks caused by impacts during transport (Klevberg and Oard, 1998; Oard, 2013). Could it be that the limestone totally pulverized during quartzite rock transport? The billions, if not trillions, of these well-rounded quartzite rocks spread east, well out onto the plains (Oard et al., 2005), which indicates the rapid uplift of thousands of meters of the western Rocky Mountains. Quartzite cobble and boulders were also carried west, to the Pacific Ocean, nearly 600 km away. These rounded quartzite rocks are widespread on the high terrain of eastern Washington and Oregon and through the Columbia River Valley (Oard et al., 2006).

The original *in-situ* layered quartzite (Figure 15) source was broken up, rounded, and transported eastward and northeastward as far as central Saskatchewan and southwest Manitoba—up to 1,200 km (Oard et al., 2005)! These gravels cover much of the High Plains, though many were reworked by the Laurentide Ice Sheet. Quartzite clasts were transported southeast into Wyoming (Oard et al, 2005) and occasionally accumulated in paleovalleys. In two locations they reach thousands of meters in thickness. One lies west of Spencer, Idaho, along Interstate 15 near the Montana-Idaho border. The other is east and northeast of Jackson Hole, Wyoming, with quartzite conglomerate forming some of the mountains northeast of Jackson and in southeast Yellowstone Park.

Quartzite rocks reworked

An indication of the original scale of these transportation processes is seen in the presence of pressure-solution marks on many clasts (Figure 16). These formed when the rocks were deeply buried in rifts thousands of meters deep, and the rock-on-rock pressure contacts generated local recrystallization marks. Subsequent uplift of these areas resulted in erosion or reworking of the quartzite rocks, spreading them east, where they are commonly found, even at the top of the Teton Mountains (Figure 16), indicating that the sharp Teton Mountains rose late in the Flood.

Quartzite rocks on top of mountain ranges

Well-rounded quartzite rocks are found atop at least four mountain ranges: (1) the northern Tetons of northwest Wyoming (Figure 17), (2), the Gravelly Mountains of southwest Montana (Figure 18), (3) the Wallowa Mountains of northeast Oregon (Figure 19), and (4) the Blue Mountains of central Oregon (Figure 20). This widespread distribution suggests the quartzite cobbles and boulders were first carried and deposited by sheet currents. As the mountains uplifted, they carried some of the quartzite detritus up to higher elevations.

Valley Fill Erosion

As the sheet flow decreased (Figure 14), channelized flow developed in the valleys. The top of the valley fill was much thicker than today and probably mostly unconsolidated at the beginning of the channelized-flow phase. Strong down-valley currents would have easily eroded through the soft valley fill and into the hard rock below. This erosion produced nearly flat surfaces at the bottoms of these valleys, with numerous pediments formed at the edge of the mountains and one planation surface in the southwestern portion of the broad Gallatin Valley.

Figure 16. Pressure-solution marks on a quartzite from the top of Red Mountain, Teton Mountains, Wyoming.

Figure 17. Quartzite cobbles and boulders from the top of the generally flat-topped Red Mountain, over 3,000 m above sea level in the northern Teton Mountains of northwest Wyoming. Split cobbles are probably due to freeze-thaw weathering along preexisting fractures. The cobbles were among angular rocks from the local limestone. (Brent Carter for scale.)

Figure 18. Well-rounded quartzite boulder about 0.6 m in diameter in long dimension with numerous percussion marks from on top of the Gravelly Mountains, southwest Montana.

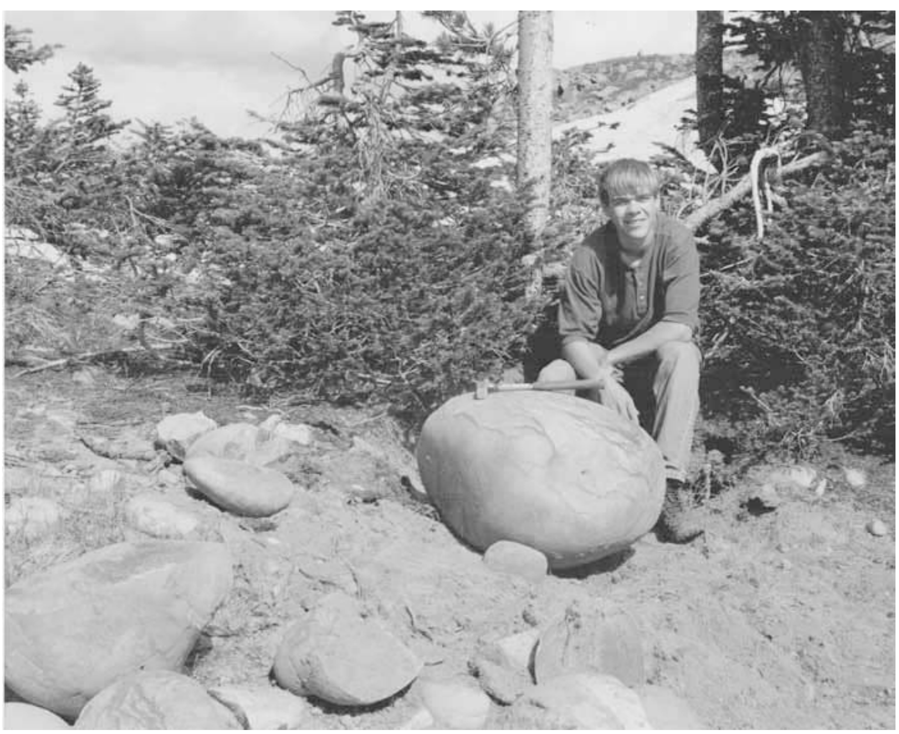

Figure 19. Polished quartzite boulder weighing about 200 kg from just southeast of Lookout Mountain, 2,500 meters above sea level, Wallowa Mountains of northeast Oregon (photograph by Paul Kollas with my youngest son, Nathan, as scale).

Uniformitarians recognize the extensive erosion but cannot explain the numerous *mysterious* pediments:

> Parts of the Sixmile Creek Formation [Late Cenozoic] as well as older lithologic units, exposed along the flanks of the basins, have been efficiently removed by a period of erosion, that spans most, if not all, of Blancan (Pliocene) time. It produced extensive pediments surfaces that can be observed throughout the region. … the pediments are remarkable by their size, indiscriminate cutting of Tertiary and older rock units (including granite), degree of preservation, and geographic extent. (Fields et al., 1985, p. 19)

It is difficult to estimate the total amount of erosion that took place in these valleys, but a minimum can be estimated from the height of erosional remnants and the elevations of pediment surfaces near the mountains. Since the tops of erosional remnants are consolidated or partially consolidated, there were probably hundreds of meters of sediment once above these rocks since cementation occurs below a fair depth of overburden.

In the Bighorn Basin of north-central Wyoming, about 1,000 m of valley-fill sediments were eroded by fast, north-flowing, down-basin currents. This is estimated from the Tatman Mountain planation surface (Figure 21), which lies about 700 m above the eastern Bighorn Basin. The presence of lignite (low rank) coal near the top of Tatman Mountain suggests that hundreds of meters of additional sediment and sedimentary rocks were eroded from Tatman Mountain, an erosional remnant of a once-larger planation surface (Oard, 2018). Later erosion created the topography we observe today. Therefore, it appears that around 1,000 m of sediment was eroded from the valleys of southwest Montana.

Valley-fill erosion likely was rapid. The velocity of channelized currents would have been controlled by the increasing gradient caused by uplift. Potential energy near the continental divide would have resulted in high flow velocities down the valleys of southwest Montana.

Erosional Features of Southwest Montana

During the channelized-flow phase, these strong down-valley currents pulverized and eroded the top of the valley fill. An indication of the power and scale of these currents is seen by the absence of eroded debris in the valleys of southwest Montana, excepting "slackwater areas" (Part III). This debris was instead deposited in the Texas Gulf Coast and the Gulf of Mexico. Erosional debris west of the continental divide was likely deposited on the continental margin off Washington and Oregon or as part of the coastal mountains. During this strong erosion, numerous pediments and water and wind gaps were cut in southwest Montana (see Parts II and III).

At the onset of the Ice Age (Oard, 2004), many local mountain ranges became glaciated. Yellowstone Park was covered by an ice cap up to 900 m deep in the valleys (Licciardi and Pierce, 2008). Outwash from glaciation carpeted the Madison and Paradise valleys. Extensive outwash terraces in the Madison Valley (Figure 22) look like pediments, but the top of the outwash is generally horizontal, while pediments slope gently toward the valley center.

Figure 20. Quartzite gravel, several meters thick, from on top of Gold Hill, Blue Mountains of central Oregon (John Hergenrather for scale).

Conclusion

At the peak of the Flood, the area that is now southwest Montana was covered by nearly 2,000 m of flat-lying Paleozoic, Mesozoic, and early Cenozoic strata, resting on the Great Unconformity cut into granite and gneiss crust, or the Belt Supergroup. At the beginning of the recessive stage, land was uplifted and ocean basins and valleys sank. As mountains were exposed, sheet flow transitioned into channelized flow, and a transient continental divide in the western Rocky Mountains split the currents flowing both east and west. As the western Rocky Mountains began to rise, sheet flow eroded the area and deposited large breccia fans in southwest Montana, east of the Beartooth Mountains and east of the Bighorn Mountains. The continued uplift of the Belt Supergroup was so great that deeply buried metamorphic rocks were uplifted, eroded, and transported far to the east as coarse quartzite gravels. The power and velocity of these late Flood currents are seen in the rounding of those resistant quartzite rocks, ubiquitous percussion marks, and their transport into central Saskatchewan, southwest Manitoba, and north-central North Dakota. Quartzite rocks deposited on still-rising mountains were carried to higher elevations. During channelized flow, current energy remained high, and although erosion became increasingly confined to the valleys of southwest Montana, it was powerful enough to remove up to 1,000 m of the previously deposited valley fill and produce pediments and water and wind gaps. All of these features make sense in this Flood framework but are extremely difficult for uniformitarian scientists to explain. We will explore the landforms created by the late-Flood dynamics in Parts II and III.

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Figure 21a. Tatman Mountain, western Bighorn Basin, an isolated erosional remnant about 300 m above the surrounding land, capped by mostly rounded volcanic and quartzite rocks (photo courtesy of Tim Thorton, Jackson Hole Bible College).

Figure 21b. Well-rounded quartzite rock from the top of Tatman Mountain showing abundant percussion marks (photo courtesy of Tim Thorton, Jackson Hole Bible College).

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Figure 22. Multiple outwash terraces in Madison Valley from deglaciation in Yellowstone Park (view south).

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