Relating the Lava Creek Ash to the post-Flood boundary

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Since we cannot rely on relative uniformitarian dates, I have developed thirty-two criteria to help determine the location of the Flood/post-Flood boundary for any specific area. However, the timing of two rock features (the Yellowstone supereruptions and the mammal fossils of the Rocky Mountains and High Plains) within the biblical timeframe is difficult to determine. The last eruption of the Yellowstone supervolcano produced the Lava Creek Ash layer, which lies within a pediment in the Wind River Basin in the US. This fortuitous discovery places the Flood/post-Flood boundary in the mid-Pleistocene in this area. Tas Walker's Biblical Geological Model places the Yellowstone eruptions during the Flood. The ash and its geological context also give a Flood date for the mammal fossils found in the walls of valleys and canyons of the southern High Plains. Since some Ice Age and recent mammals are found in these Flood rocks, it is imperative the geological context be examined to determine the Flood/post-Flood boundary.

The location of the Flood/post-Flood boundary in the sedimentary rocks and the placing of various rocks, fossils, and events within the biblical timeframe are contentious issues. Assuming the geological column for sake of discussion (the geological column is a subject that needs much discussion, but is beyond the scope of this article), there are four possible general locations for the post-Flood boundary on a global scale: (1) the Precambrian, (2) the late Paleozoic, (3) the K/T, and (4) the late Cenozoic. However, the Precambrian and late Paleozoic boundary locations largely adopted by those who support 'recolonization' has numerous problems,[1,2] and so the main debate is between the K/T Boundary Model and the Late Cenozoic Boundary Model. (I acknowledge that these two locations are general since some creation scientists favour the early Cenozoic or even variable locations within the Cenozoic.)

After once supporting the K/T Boundary Model, my study of geology and the Ice Age for the past 40 years has convinced me the boundary is in the Late Cenozoic, loosely defined as the Miocene, Pliocene, and Pleistocene. I have developed 32 criteria, varying from strong to weak, to back up the Late Cenozoic location, assuming the geological column (table 1).[2] The 'timeframe' is so broad with respect to the geological column because we cannot trust the geological column and timescale for the late Cenozoic, dated either by radioisotope methods[3] or by fossils, to determine biblical earth history. The uniformitarian dates are too variable. Because there are exceptions to each of the criteria listed in table 1, it is necessary to use multiple criteria. Each area needs to be examined on its own merits, and this is time consuming. Using the criteria of table 1, I have discovered that the Flood/post-Flood boundary is commonly in the early to mid-Pleistocene.

One of the most powerful evidences for the Late Cenozoic location of the Flood/post-Flood boundary is the amount of erosion that took place on the continents during the Recessive Stage of the Flood. It can be calculated that many areas experienced hundreds to thousands of metres of erosion after deposition of thick strata.[4,5] This astonishing amount of water erosion especially includes high-elevation areas and fits very well within the Recessive Stage of the Flood (figure 1), when the continents rose up out of the floodwater (Psalm 104:6–9).[6] Therefore, the high-altitude strata that include the Rocky Mountains and High Plains of the western US are very likely from the Flood.

The vast continental erosion that took place during the Recessive Stage of the Flood means that the strata left on the high areas of the western US must be from the Inundatory Stage of the Flood. Furthermore, the strata eroded from the continents during the Recessive Stage of the Flood must have mostly been deposited during the early Flood. The eroded strata from the continents are called the 'Erodozoic',[7] which is depicted in figure 2. Therefore sedimentation during the Flood was highly non-linear; there was much greater sedimentation during the early Inundatory Stage of the Flood on the continents with sedimentation during the Recessive Stage mainly along the continental margin.

Therefore, the location of the Flood/post-Flood boundary should be relatively straightforward in the western US. However, heavy precipitation associated with the Ice Age occurred right after the Flood, which would have caused greater erosion and deposition immediately post-Flood than observed today. Moreover, mammals migrated from the 'mountains of Ararat' into the western US. So the location of the Flood/post-Flood boundary may be difficult to locate in near-surface sediments or sedimentary rocks.

Two difficult observations

Two events or observations in the western US are difficult to place either within or after the Flood. One of these events is the gigantic eruption, or eruptions, of the Yellowstone supervolcano. Did these eruptions take place during the Flood, after the Flood, or both?

The second observation is the mammal fossils found in both the Tertiary and Pleistocene strata in the Rocky Mountains and High Plains region. The Tertiary part of the Cenozoic lies between 65 to 2.6 Ma within the geological timescale, while the Pleistocene is from 2.6 Ma to about 11,000 years ago. The sometimes similar mammals in the Tertiary and Pleistocene have led Dr Marcus Ross to conclude the Tertiary is post-Flood, at least in the western US.[8,9] I admit mammal fossils are difficult to interpret within biblical earth history.[10] However, it is best to gather as much information as possible before attempting a solution to the problems, especially with difficult-to-interpret features such as the Yellowstone supereruptions and the mammal fossils of the Rocky Mountains and High Plains. As Sherlock Holmes says to Dr Watson: "It is a capital mistake to theorize before you have all the evidence. It biases the judgment."[11]

The Rocky Mountains and High Plains of the western US

The Rocky Mountains of the western United States consist of about a hundred mountain ranges separated by broad valleys or basins. The mountains are predominantly orientated north–south, following the trend of the Rocky Mountains as a whole. They consist of a wide variety of rocks. The Rocky Mountain valleys have been filled with hundreds to thousands of metres of sediment, which is now mostly sedimentary rock, called valley or basin fill. The fill commonly consists of conglomerate, sandstone, shale, and various types of volcanic debris. The thickest sedimentary rocks are located in the rather small Hanna Basin of south-central Wyoming, about 2,100 m above sea level. It contains a basin fill depth of about 11,500 m; 7,000 m is dated as upper Cretaceous, 4,000 m as early Cenozoic (Paleocene), and 500 m is considered late Cenozoic.[12] With respect to the two rock features mentioned above, it is significant that the huge erosion of the top of the valley fill fits well with the erosion during the Recessive Stage of the Flood.[4]

There are numerous dinosaur and mammal fossils in the basins of the Rocky Mountains and on the High Plains.

Table 1. Summary of evidences for a late Cenozoic Flood/post-Flood boundary rated as either strong, moderate, or weak, depending on my subjective evaluations of their strengths.

Evidences		Strength
1.	Huge volume of Cenozoic sedimentary rocks	strong
2.	Deposition of widespread or thick Cenozoic precipiates	strong
3.	Tremendous Cenozoic continental margin rocks	strong
4.	Thick, pure Cenozoic coal seams	strong
5.	Cenozoic amber	strong
6.	Lack of mammals buried in the Flood but millions afterwards	strong
7.	Huge Cenozoic vertical tectonics	strong
8.	Huge Cenozoic erosion of the continents	strong
9.	Widespread Cenozoic planation surfaces	strong
10.	Long-distance, transported of hard rocks dur ing the Cenozoic	strong
11.	Cenozoic deep valleys	strong
12.	Cenozoic water and wind gaps	strong
13.	Cenozoic mid and high latitude warm-climate fossils	strong
14.	Cenozoic volcanic winter	strong
15.	Cenozoic accelerated radiometric decay	strong
16.	Cenozoic Middle East geology	strong
17.	Oil and natural gas formed during the Cenozoic	strong
18.	Thin, widespread Cenozoic sedimentary layers	moderate
19.	Consolidated Cenozoic sedimentary rocks	moderate
20.	Formation of Cenozoic carbonates	moderate
21.	Cenozoic mineralized fossils	moderate
22.	Large, pure microorganism layers during the Cenozoic	moderate
23.	Cenozoic fossil order and massive, numerous extinctions	moderate
24.	Tremendous horizontal plate movement Cenozoic	moderate
25.	Cenozoic ophiolites	moderate
26.	Cenozoic ultrahigh-pressure minerals	moderate
27.	Erosional escarpments formed during the Cenozoic	moderate
28.	Cenozoic pediments	moderate
29.	Cenozoic submarine canyons	moderate
30.	Cenozoic phosphorites and high phosphate sedimentary rocks	weak
31.	Cenozoic metamorphic core complexes	weak
32.	*Cenozoic meteorite or comet impacts*	weak

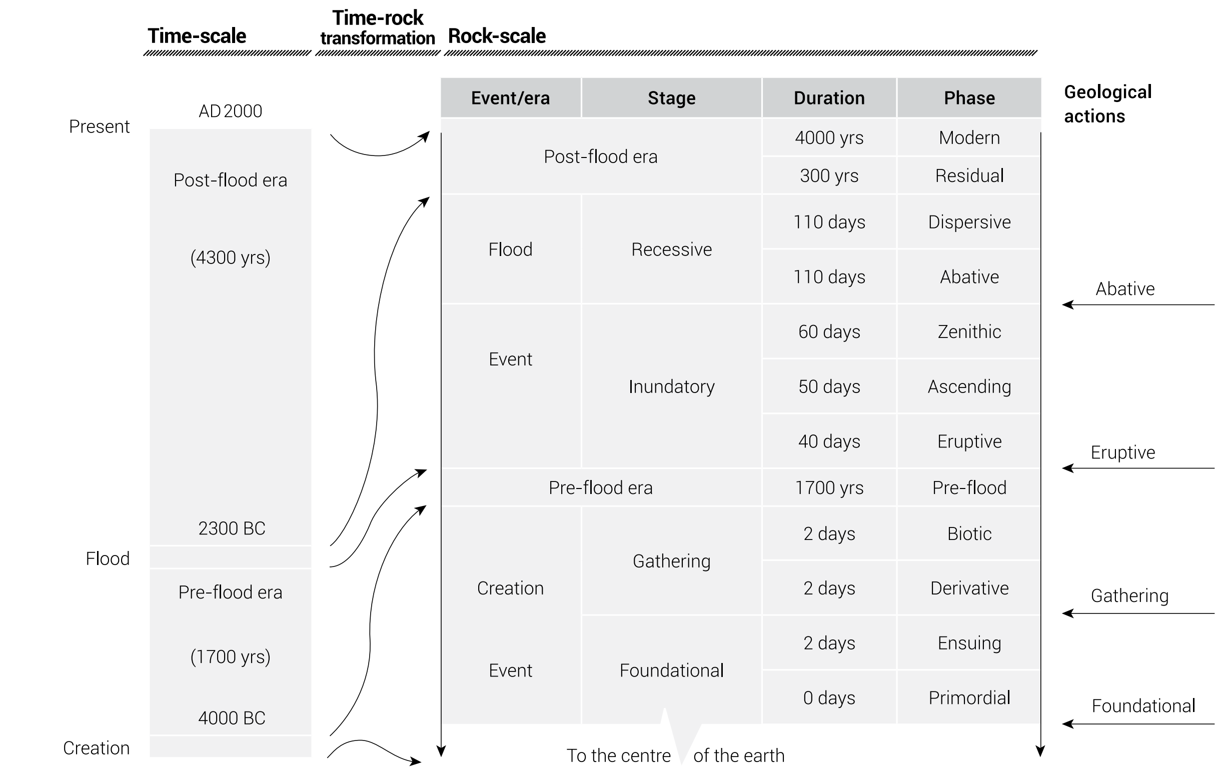


Figure 1. Tas Walker's biblical geological model for biblical earth history (courtesy of Tas Walker, biblicalgeology.net/).

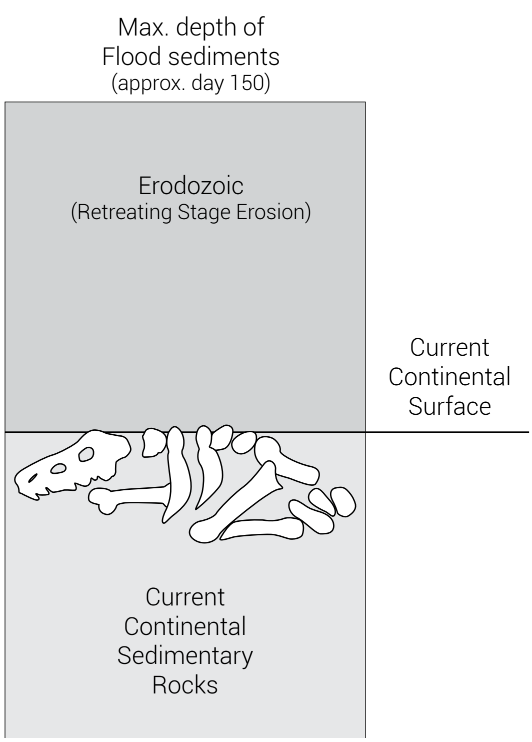


Figure 2. A simple block diagram showing the current continental sedimentary rocks with the volume of sediments eroded after Day 150, the 'Erodozoic', during the Recessive Stage of the Flood (illustrated by Mrs Melanie Richard).

The dinosaur fossils include tracks, eggs, and scavenged bonebeds, which provided evidences for Briefly Exposed Diluvial Sediments (BEDS)[13] in this area. It is possible that BEDs may explain some of the more exotic mammal observations in the Rocky Mountains and the High Plains, but this is beyond the scope of this paper.

The Yellowstone supervolcano

There are several large volcanic areas within the Rocky Mountains. One is the supereruption in what is now Yellowstone National Park, in northwest Wyoming and small areas in Montana and Idaho.[14] A supervolcano is a volcanic eruption with an ejecta volume greater than 1,000 km^3—about a thousand times normal eruptions. The Yellowstone supervolcano is believed to consist of three generally overlapping calderas from three supereruptions. They are mostly obscured by lava from several smaller subsequent eruptions. But the caldera around Island Park, Idaho, is still discernible (figure 3). The timing of these eruptions within the uniformitarian/evolutionary timescale is based on fission track dating of cemented volcanic ash called tuff. These tuffs and ages are

1. the Huckleberry Ridge tuff, dated at 2.1 Ma ago
2. the Mesa Falls tuff, dated at 1.3 Ma ago, and
3. the Lava Creek tuff, dated at 0.65 Ma ago.[15]

These three eruptions were much larger than the largest recorded eruption in history, the 1815 eruption of Mount Tambora on Sumatra. Mount Tambora caused the 'year without a summer' in 1816 in the northeast US and Europe.[16] Since the Yellowstone supereruptions were much larger, they would reach well up into the stratosphere and spread volcanic aerosols (very small particles) across the earth, causing dramatic global cooling and greatly stressing Earth's biology. Ash from these three eruptions spread over much of the western and central United States and is even claimed to have spread offshore, where it is found in deep-sea cores.[17]

It was once thought that there was one supereruption with the ash called the Pearlette Ash, named after a post office in Meade County, Kansas, US. Mammal locations in Meade County are dated with respect to the Pearlette Ash and other ashes. However, it was subsequently discovered that ash in Meade County had variable fission tracks, which suggested three separate eruptions instead of just one. This find was reinforced by K-Ar dates from sources in Yellowstone National Park and vicinity.[18]

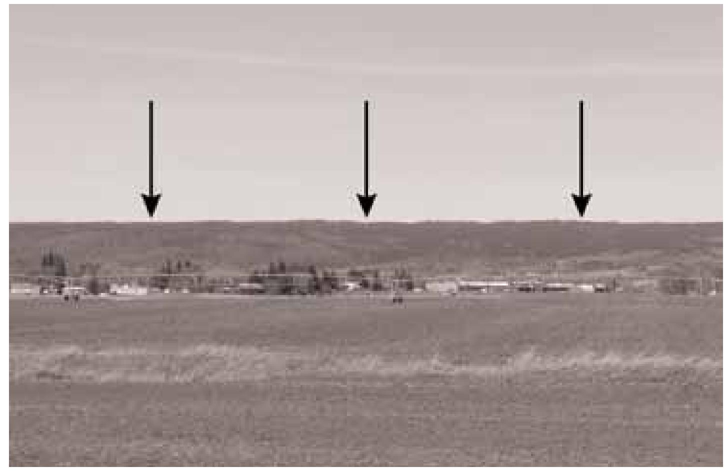


Figure 3. The southern edge of the Yellowstone caldera that formed the Mesa Falls tuff (view north from near Ashfork, Idaho, US).

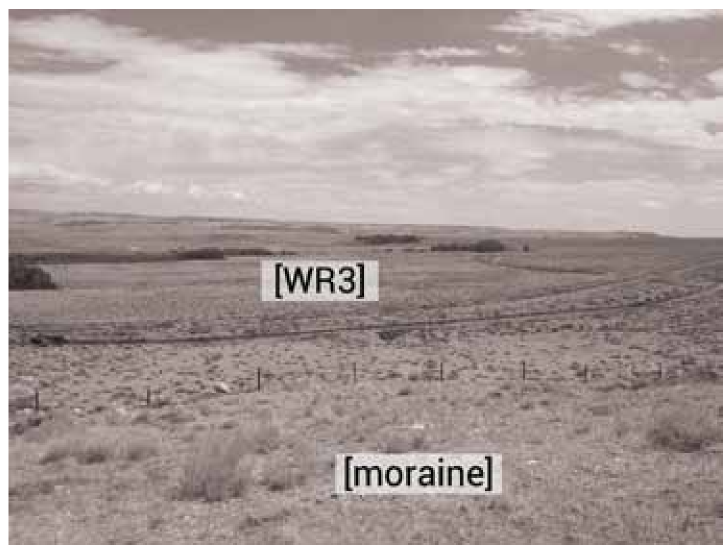


Figure 4. Outwash terrace WR3 with an irrigation ditch on it, as viewed from its associated moraine (foreground) in the Upper Wind River Basin, Wyoming, US.

The Wind River terraces

There are claimed to be a series of fifteen terraces along the Upper Wind River that uniformitarian scientists attempt to relate to numerous glacial/interglacial cycles, under the problematic assumption of the astronomical theory of ice ages.[19] Only four terraces are widespread enough to be significant: WR1, WR3, WR7, and WR9 (WR stands for 'Wind River').[20] The terraces are numbered upward with altitude from the Wind River. It is clear that WR1 and WR3 (figure 4) are related to outwash from glaciation of the Wind River Mountains. However, WR7, which is claimed to be related to the 'Sacagewa glaciation', is not associated with the claimed Sacagewa moraine (figure 5), which has a geomorphology similar to the other moraines in the area.[20] In fact, the moraines are all young-looking, with generally sharp crests, providing strong evidence for only one glaciation with nested moraines.

WR7 is actually an isolated pediment[21] remnant (figure 6) that is about 140 m above the river. WR9 is a planation surface remnant and is mainly located around Riverton, Wyoming, at about 190 m above the river in the middle of the valley. The Riverton airport is built on WR9.

Pediments formed during the Flood

Pediments are numerous and found at the base of mountains all over the world. They are large flat or nearly flat surfaces often bevelled into granite. In the Rocky Mountains, pediments are usually bevelled into sedimentary rock of the valley or basin fills. Pediments are usually associated with a lag of rounded rocks, indicating pediments were carved by water (figures 7 and 8). Pediments can be quite large; some well over 500 km^2 in area. They are mysterious features for the uniformitarian paradigm because they are not forming today but are in the process of being destroyed by erosion.[22]

All uniformitarian hypotheses on the origin of pediments have serious problems. For one, they depend

Figure 5. The Sacagawea Ridge lateral moraine east of Dinwoody Lakes in the upper Wind River Basin.

Figure 6. The WR7 pediment (view south toward the foothills of the Wind River Mountains).

Figure 7. Pediment in the Ruby River Valley along the western slope of the Gravelly Range of southwest Montana, US. 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 at a low angle.

on their formation by streams issuing from the adjacent mountains. However, several researchers have found exotic rocks on pediments that do not outcrop in the nearby mountains but came from up valley and, in some cases, very far away. They also have rounded rocks from the adjacent mountains or ridges on pediments.

The evidence strongly suggests that the pediments formed late in the Flood, during the high-speed channelized phase,[23–25] which is criterion 28 of table 1. The draining floodwaters eroded the valley fill and formed pediments, as well as planation surfaces. The channelized floodwaters not only transported rocks from far up-flow but also from the sides of the mountains. This accounts for both the local and exotic rocks found on pediments. Continued erosion after the formation of the pediment often wore away part of the pediment, leaving pediment remnants. Sometimes a second or third pediment was carved at lower altitudes.

Lava Creek Ash found in the WR7 pediment remnant

The Lava Creek Ash from the last eruption of the Yellowstone supervolcano was found between the eroded bedrock and the gravel cap of pediment remnant WR7 (figures 9 and 10). The cited literature indicates the Lava Creek Ash is also found on other pediment remnants in the upper Wind River Basin. This means that the ash was laid down during the formation of the pediment, which indicates that it was laid down late in the Flood, during the erosion of the Wind River Basin during the formation of pediments.

Therefore, the last eruption of the Yellowstone supervolcano can be placed within the Dispersive Phase of the Recessive Stage of the Flood (figure 1).[23,25] Moreover, this places all of the major eruptions *during* the Flood! This deduction is reinforced by the ash from the first Yellowstone supereruption found within Signal Mountain in northern Jackson Hole Valley. The ash dips to the west at 11° (figure 11).[26] Therefore, the Huckleberry Ridge tuff was in the process of being laid down while Jackson Hole was tectonically sinking and collecting sediments. Jackson Hole is a half graben in which valley sinking took place mainly along one side of the valley. The main sinking occurred close to the Teton Mountains, likely while the mountains were rising at the Teton Fault, reminiscent of Psalm 104:8 during Flood runoff. In the western part of Jackson Hole Valley, large quantities of valley fill sediments were deposited on top of the ash. This would likely place the Huckleberry Ridge ash in the Abative (or Sheet-flow) Phase of the Recessive Stage of the Flood. The Abative Phase is the time when the sediments were likely still accumulating in the Rocky Mountain valleys and basins, since the Dispersive Phase was likely an erosional phase in the valleys and basins.

The Flood/Post-Flood boundary is in the Mid Pleistocene in the Wind River Basin

The ash is dated at about 650,000 years old, which is mid-Pleistocene, using the uniformitarian/evolutionary timescale. Since the ash was laid down in the Flood, the Flood/post-Flood boundary would be even higher. The late Pleistocene is post-Flood and associated with the Ice Age as well as other post-Flood processes in non-glaciated areas. The obvious conclusion is the Flood/post-Flood boundary in the Wind River basin is late within the mid-Pleistocene in this area.

Flood/post-Flood boundary is in the Mid Pleistocene Southern High Plains

Since Yellowstone ashes are found across the western and central United States, they are used to date mammal fossils at some locations, especially the southern High Plains. Where the Yellowstone ashes can be identified, the fossils below the ash would be from the Flood and those above could be either Flood or post-Flood or both. This assumes the ashes can be matched by major, trace, and rare-earth elements to the eruptions of Yellowstone. This is a good assumption close to Yellowstone, but somewhat problematic far away, mainly because tuffs from different volcanoes can be similar and the same volcano can produce ash of different signatures.[27]

The Yellowstone ash is claimed to be present in patches near the top of the High Plains of southwest Kansas.[28,29] The ash can be viewed in erosional cuts in the High Plains. It is described as being near the top of the Meade Formation, as in Cudahy volcanic ash pit (figures 12 and 13) about 12 km north of Meade, Kansas (see figure 14 for location). This ash is considered the Lava Creek Ash.[30] (Claude Hibbard correlated the mammals to the lower portion of the four ice age scheme farther northeast, although there is no physical connection of the area to the Ice Age. However, the four ice age scheme is obsolete and has been superseded by about 50 ice ages that repeat at regular intervals according to the astronomical theory of the ice ages and based on deep-sea cores.[31])

Numerous mammals are found below the Lava Creek Ash and called the Cudahy local fauna. The Borchers local fauna, about 13 km south of Meade, is found within and slightly above the Yellowstone Ash in the walls of the valley (figure 15). The Meade Formation lies above the Ogallala Formation. Both make up the *walls* of the valleys cut into the High Plains, showing the strata of the top of

Figure 8. Coarse gravel veneer capping the pediment shown in figure 7. Note that the rocks are rounded to subrounded. Most of them are exotic quartzite with the closest outcrops in central Idaho, US.

Figure 9. Lava Creek B ash layer from the last Yellowstone supereruption on top of bedrock in WR7 (Hans and Lisa Reinhardt for scale).

Figure 10. Close up of Lava Creek B Ash in the pediment of figure 9.

Figure 11. Signal Mountain with the Huckleberry Ridge tuff dipping toward the west.

Figure 12. Lava Creek Ash from the last Yellowstone supereruption in Cudahy ash pit, about 12 km north of Meade, Kansas, US.

Figure 13. Close up of the volcanic ash in Cudahy ash pit.

the High Plains in this area extends tens to hundreds of km in all directions, suggesting a Flood context according to criterion 18 in table 1. The Meade Formation contains a wide variety of mammals, which would also place the burial of these mammals during the Flood.

In north central Texas, at Gilliland, the Yellowstone Ash is claimed to be above mammal fossils.[32] They too would be from the Flood. This conclusion is reinforced by the finding of climate-sensitive large tortoises and alligators that require a frost-free climate, which does not occur in the present climate and certainly did not occur during the post-Flood Ice Age, if these mammal fossils were post-Flood.

Joe Taylor from the Mount Blanco Fossil Museum in Crosbyton, northwest Texas, showed me the stratigraphic relationship of the abundant mammals he has found in Blanco Canyon along the east edge of the Llano Estacado, about 50 km east of Lubbock, Texas. Figure 16 shows Blanco Canyon and the flat planation surface of the Llano Estacado that covers much of southeast New Mexico and northwest Texas (figure 14). Although there were volcanic ashes present in the sediments and sedimentary rocks, I don't know if any of them are from any of the Yellowstone supereruptions. Nevertheless, the context was similar to that observed in southwest Kansas; the mammal fossils were found within the walls of the canyon in dissected areas of the southern High Plains. Therefore, the mammal fossils found in the walls of Blanco Canyon are from the Flood.

Figure 17 shows a schematic of the Flood context of the mammals found within dissected valleys in the southern High Plains. In figure 17a, thick sediments are deposited on the southern High Plains during sheet deposition, either late in the Inundatory Stage or early in the Recessive Stage. Then sheet erosion removes the top layers of sediments and sedimentary rocks forming a planation surface during the Abative Phase of the Recessive Stage of which the Llano Estacada is one prominent planation surface (figure 17b). It is not certain whether the Ogallala Formation consisting of long transported Rocky Mountain rocks and sand and the Blancan beds above were deposited as a lag during planation or were part of the original strata, but figure 17b places the strata at the end of the sheet erosion.

Then sheet erosion transformed into channelized erosion during the Dispersive Phase and carved valleys and canyons, of which Blanco Canyon is one (figure 17c). Figure 17d is a close up of the Blanco Canyon and shows the Flood has ended and post-Flood slumping and erosion has reworked the wall sedimentary rocks, probably due to the much higher rainfall of the post-Flood Ice Age. The Ogallala Formation and the Blancan beds are part of the walls of the eroded valleys and extend hundreds of kilometrers toward the west, north, and south and lie below the surface of the southern High Plains. Sometimes, different formation names are given to this stratum at various locations.

Mammals found within the walls would be from the Flood while mammals discovered in the reworked valley sediments would predominantly be from the post-Flood period. It is possible that some of the mammals in reworked bottom material could be from the Flood if they are within an intact slump block. It is also possible to rework valley wall fossils into the valley bottom, but this situation should be rare.

Based on southwest Kansas and Blancan Canyon, as well as personal communication from Joe Taylor, mammals are abundant in many other valleys and canyons. If extrapolated in the subsurface, there must be millions of buried mammals. This many mammals would be hard to explain in the post-Flood period by mammals rounding the Bering Land Bridge or arriving on log mats,[33] multiplying into the millions, and being buried in sheet deposits within the strata of the southern High Plains. Based on the dates of the Blancan beds, it looks as though the Flood/post-Flood boundary is in the mid-Pleistocene in northwest and north central Texas, as well as in southwest Kansas.

The biblical 'orchard of life'

Some of the Cenozoic fossils found within Flood beds of Blanco Canyon include stegomastodon, *equus scotti*, various three-toed horses, glyptodon, land tortoises, giant hyena, giant camel, lama, badger, rabbit, birds, peccaries, mammoths, saber-toothed cats, giant sloth, crocodiles, four-tusked proboscidians, prairie dogs, giant ass, rodents, a dog-like animal, and antelope (Joe Taylor, personal communication). Many of these animals are extinct but some are found in post-Flood Ice Age debris and a few even live today.

The finding of sometimes similar animals in both Flood and post-Flood sediments may seem perplexing at first glance. An examination of the biblical orchard of life explains how this could happen (figure 18). In figure 18, we begin with a created kind, let us say the elephant kind, with much variability at the time of creation with diversification expressed during the pre-Flood period. The Flood is considered a great bottleneck where two of each kind of air-breathing land animal were taken on the Ark. This would cause a loss of genetic diversity within each kind. Presumably, there would be a fairly large amount of genetic variability within the kinds on the Ark, although less than that of the pre-Flood world. After the Flood, a male and female of each kind would multiply and spread across the earth. They would diversify after the Flood (speciation) but with less genetic material than before the Flood. The

Figure 14. Map of the southern High Plains of the US, showing the location of Llano Estacado planation surface and the three mammal localities discussed in the text (drawn by Melanie Richard)..

Figure 15. The general location of the Borchers local fauna in the walls of the valley, about 13 km south of Meade, Kansas, US.

Figure 16. Blanco Canyon in the foreground with the flatness of the Llano Estacado in the background near Crosbyton, Texas, US.

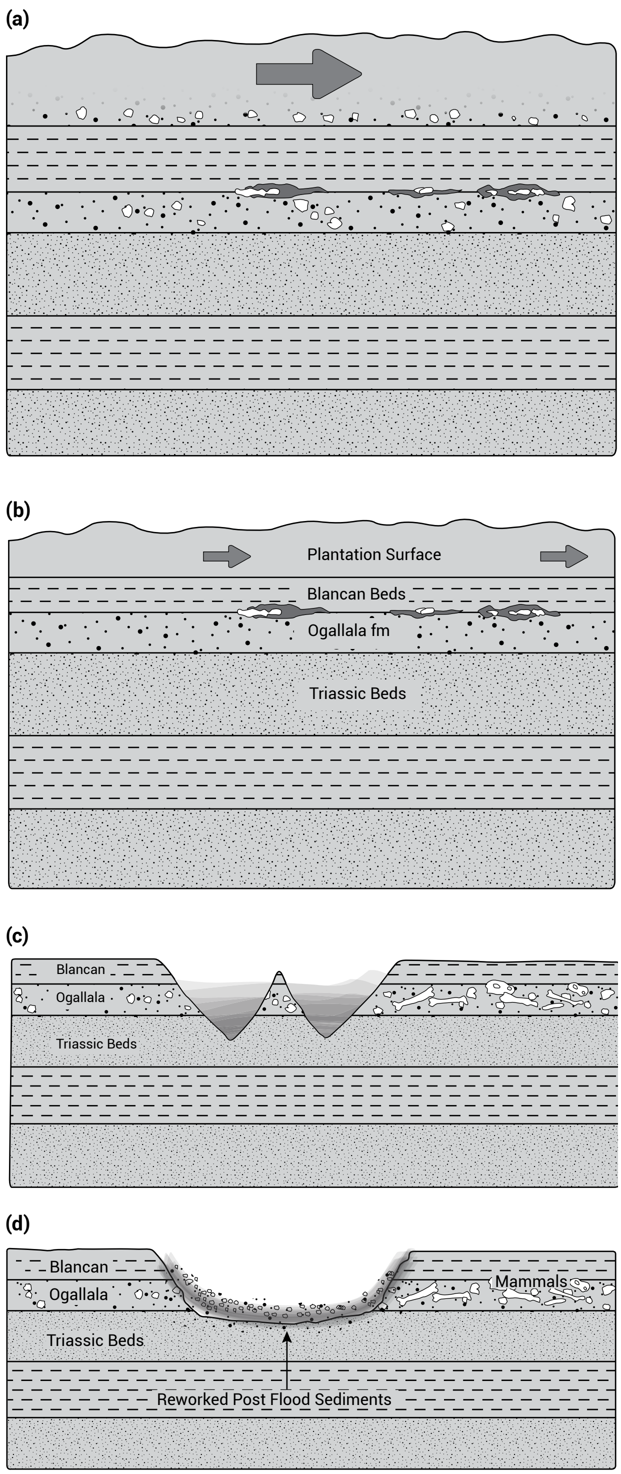
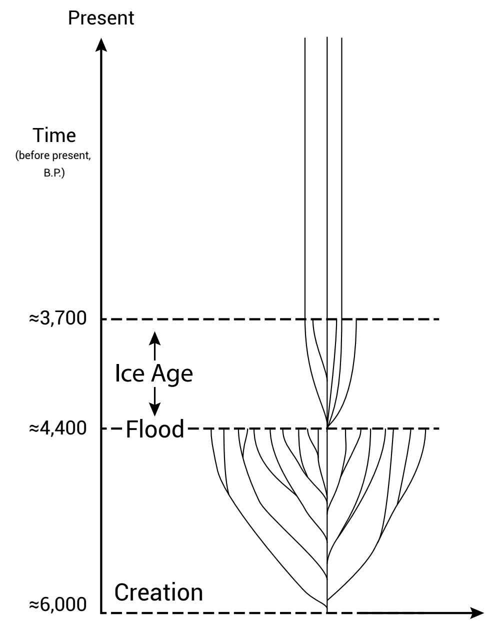


Figure 17. Schematic of deposition through sheet and channelized erosion during the Flood, showing the context of mammals in Blanco Canyon: a. deposition of sediments on the southern High Plains of the USA b. sheet erosion (Abative Phase) of the top layers forming a planation surface (the Llano Estacado) c. channelized erosion during the Dispersive Phase of the Flood d. close up of Blanco Canyon today, showing valley walls with Flood mammals and reworked sediments in the valley bottom that contain mostly post-Flood animals (drawn by Melanie Richard).



Figures 18. The creation orchard of life for one kind, such as the horse kind or the elephant kind (drawn by Melanie Richard).

mass extinction at the end of the Ice Age once again culled some of the variety within each kind.

Therefore, we would expect to see a far greater variety of mammals in Flood sediments compared to post-Flood sediments. This appears to be the case before and after the mid-Pleistocene in southwest Kansas and Blanco Canyon. Moreover, the animals of the Ice Age and post-Flood period should have representatives from *before* the Flood buried in Flood deposits. We would expect to find mammoths, mastodons, horses, antelope, etc. buried during the Flood, and the same varieties diversifying and spreading from the 'mountains of Ararat' buried after the Flood. So, it should be expected that we would find Ice Age and present-day mammals buried in Flood sediments, and that mammals cannot be used as creation science 'index fossils' for either the Flood or post-Flood period. It is the geological context that needs to be analyzed for each area in order to distinguish the Flood/post-Flood boundary.

Discussion

The eruptions of the Yellowstone supervolcano were found to be from the late Flood period based on the finding of ash from the last eruption within a pediment of the Upper Wind River Basin of northwest Wyoming. Moreover, the ash and geological context was used to place the mammal fossils of southwest Kansas and northwest Texas as being from the Flood.

There are many other fossil locations in the western and central US, and these should be examined and placed within the Flood or afterwards (this applies worldwide as well). This can be done with the aid of table 1. Once it is determined that a particular fossil location is from the Flood, we can go on to estimate in which stage and/or phase of the Flood they were buried, using criteria developed in Walker's Biblical Geological Model.

References

1. Reed, J.K., Kulikovsky, A.S. and Oard, M.J., Can recolonization explain the rock record? *Creation Research Society Quarterly* **46**(1):27–39, 2009.
2. Oard, M.J., *The Flood/Post-Flood Boundary is in the Late Cenozoic with Very Little Post-Flood Catastrophism*, michael.oards.net/ (in press).
3. Oard, M.J., Can the relative timing of radioisotope dates be applied to biblical geology? *J. Creation* **27**(2):125–132, 2013.
4. Oard, M.J., Surficial continental erosion places the Flood/post-Flood boundary in the late Cenozoic, *J. Creation* **27**(2):110–118, 2013.
5. Oard, M.J., Massive erosion of continents demonstrates Flood runoff, *Creation* **35**(3):44–47, 2013.
6. Walker, T., A biblical geological model; in: Walsh, R.E. (Ed.), *The Third International Conference on Creationism*, technical symposium sessions, Creation Science Fellowship, Pittsburgh, PA, pp. 581–592, 1994.
7. Holt, R.D., Evidence for a Late Cainozoic Flood/post-Flood boundary, *J. Creation* **10**(1):128–167, 1996.
8. Ross, M.R., Evaluating potential post-Flood boundaries with biostratigraphy—the Pliocene/Pleistocene boundary, *J. Creation* **26**(2):82–87, 2012.
9. Ross, M.R., The Flood/post-Flood boundary, *J. Creation* **27**(2):43–44, 2013.
10. Oard, M.J., The Flood/post-Flood boundary, Michael Oard replies, *J. Creation* **27**(2):44–45, 2013.
11. Doyle, A.C., Sherlock Holmes says to Watson in *A Study in Scarlet* from *The Complete Sherlock Holmes*, Signature Edition Authorized by the Conan Doyle Estate, Ltd, 2012.
12. Grimaldi, D.A., Lillegraven, J.A., Wampler, T.W., Bookwalter, D. and Shedrinsky, A., Amber from upper Cretaceous through Paleocene strata of the Hanna Basin, Wyoming, with evidence for source and taphonomy of fossil resins, *Rocky Mountain Geology* **35**(2), p. 165, 2000.
13. Oard, M.J., *Dinosaur Challenges and Mysteries: How the Genesis Flood Makes Sense of Dinosaur Evidence Including Tracks, Nests, Eggs, and Scavenged Bones*, Creation Book Publishers, Powder Springs, GA, 2011.
14. Hergenrather, J., Vail, T., Oard, M., and Bokovoy, D., *Your Guide to Yellowstone and Grand Teton National Parks: A Different Perspective*, Master Books, Green Forest, AR, 2012.
15. Good, J.M and Pierce, K.L., *Interpreting the Landscape: Recent and Ongoing Geology of Grand Teton & Yellowstone National Parks*, Grand Teton Natural History Association, Moose, WY, 2002.
16. Jacoby, G.C., Ivanciu, I.S. and Ulan, L.D., A 263-year record of summer temperature for northern Quebec reconstructed from tree-ring data and evidence of a major climatic shift in the early 1800's, *Palaeogeography, Palaeoclimatology, Palaeoecology* **64**:69–78, 1988.
17. Sarna-Wojcicki, A.M., Morrison, S.D., Meyer, C.E. and Hillhouse, J.W., Correlation of upper Cenozoic tephra layers between sediments of the western United States and eastern Pacific Ocean and comparison with biostratigraphic and magnetostratigraphic age data, *GSA Bulletin* **98**:207–223, 1987.
18. Naeser, C.W., Izett, G.A. and Wilcox, R.E., Zircon fission-track ages of Pearlette family ash beds in Meade County, Kansas, *Geology* **1**:187–189, 1973.
19. Oard, M.J., Ice ages: the mystery solved? Part I: the inadequacy of the uniformitarian ice ages, *Creation Research Society Quarterly* **21**(2):66–76, 1984; Oard, M.J., Ice ages: the mystery solved? Part II: the manipulation of deep-sea cores, *Creation Research Society Quarterly* **21**(3):125–137, 1984; Oard, M.J., Ice ages: the mystery solved? Part III: paleomagnetic stratigraphy and data manipulation, *Creation Research Society Quarterly* **21**(3):170–181, 1985.
20. Oard, M.J., Were the Wind River terraces caused by multiple glaciations? Creation Research Society Quarterly (in press).
21. A pediment is a planation surface at the foot of mountains, ridges, or plateaus.
22. Oard, M.J., *Flood by Design: Receding Water Shapes the Earth's Surface*, Master Books, Green Forest, AR, 2008.
23. Oard, M.J., Pediments formed by the Flood—evidence for the Flood/post-Flood boundary in the Late Cenozoic, *J. Creation* **18**(2):15–27, 2004.
24. Oard, M.J. Earth's Surface Shaped by Genesis Flood Runoff, michael.Oards.net/GenesisFloodRunoff.htm, 2013 and in press.
25. Walker, T., A Biblical geological model; in: Walsh, R.E. (Ed.), *Proceedings of the Third International Conference on Creationism*, technical symposium sessions, Creation Science Fellowship, Pittsburgh, PA, pp. 581–592, 1994.
26. Love, J.D., Reed, Jr, J.C. and Pierce, K.L., *Creation of the Teton Landscape: A Geological Chronicle of Jackson Hole & the Teton Range*, Grand Teton Association, Moose, WY, p. 86, 2007.
27. Lowe, D.J., Tephrochronology and its application: a review, *Quaternary Geochronology* **6**:107–153, 2011.
28. Hibbard, C.W., Stratigraphy and vertebrate paleontology of Pleistocene deposits of southwestern Kansas, *GSA Bulletin* **55**:707–754, 1944.
29. Frye, J.C. and Hibbard, C.W., Pliocene and Pleistocene stratigraphy and paleontology of the Meade Basin, southwestern Kansas, *Kansas Geological Survey Bulletin 38,* Part 13, Kansas Geological Survey, University of Kansas, Lawrence, KS, 1944.
30. Bell, C.J. and Repenning, C.A., Observations on dental variation in *Microtus* from the Cudahy Ash Pit fauna, Meade County, Kansas and implications for Irvingtonian microtine rodent biochronology, *J. Vertebrate Paleontology* **19**(4):757–766, 1999.
31. Walker, M. and Lowe, J., Quaternary science 2007: a 50-year retrospective, *J. Geological Society, London* **164**:1,073–1,092, 2007.
32. Hibbard, C.W. and Dalquest, W.W., Fossils from the Seymour Formation of Knox and Baylor Counties, Texas, and their bearing on the Late Kansan climate of that region, *Contributions from the Museum of Paleontology*, the University of Michigan, Ann Arbor, MI, 1967.
33. Oard, M.J. The Genesis Flood and Floating Log Mats: Solving Geological Riddles, Creation Book Publishers ebook, Powder Springs, GA, 2013.

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