Is the K/T the post-Flood boundary?—part 3: volcanism and plate tectonics

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Two evidences commonly presented for the Cretaceous/Tertiary (K/T) boundary being the location of the Flood/post-Flood boundary are: (1) Tertiary volcanism in the northwest United States, and (2) the cooling of ocean basalt while the continents rise. However, a close analysis of these suggests that they raise more questions than they answer and ignore contrary evidence, which supports the idea that the end of the Flood corresponds to the Late Cenozoic.

In part 1,[1] I documented that among creationists there are several major Flood models with variable ideas. For the time being and in face of many geological and geophysical unknowns, such a situation is healthy, according to the principle of multiple working hypotheses.[2] Such differences are no more apparent than in the different ideas on the location of the Flood/post-Flood boundary and the extent of post-Flood catastrophism. This boundary is an important boundary and much research should be expended to locate it, assuming the geological column for sake of discussion.

I have developed eleven criteria with which to determine the boundary[3] and I have about two dozen more to add—all saying the same thing: that the boundary is in the late Cenozoic. These criteria are based on an assortment of field studies, literature research, and geological deductions. Of the three main boundary positions within the geological column, the Carboniferous boundary in the recolonization model[4] has been analyzed and found to have many problems.[5] The K/T boundary hypothesis, which states that the Flood/post-Flood boundary is at, or a little above, the Cretaceous/Tertiary boundary in the geological column, is much more popular than the Carboniferous boundary hypothesis.

How well is the K/T boundary model supported? Six main evidences are used to support the hypothesis and these are listed in table 1. In part 1, I analyzed the first main evidence used to justify this hypothesis, a change from global/continental to regional/local sedimentation, and showed that it has many problems as a boundary-defining criterion. In part 2,[6] I analyzed the next three evidences related to tertiary fossils and paleoclimatology, and found that K/T boundary advocates accepted dubious uniformitarian assumptions in their interpretation of the evidence, even though they had rightly discarded them for "older" Flood strata. In this final part, I will analyze the last two evidences sometimes claimed as support for the K/T boundary hypothesis: (1) Tertiary volcanism in the northwest United States; and (2) the cooling of ocean basalt while the continents rise.

Table 1. Evidence used to support the K/T boundary proposal.

1.	Change from worldwide/continental to local/regional sedimentation
2.	The Tertiary cooling trend
3.	Tertiary mammals of the western United States
4.	Tertiary bird and mammal tracks and the Devils corkscrews
5.	Tertiary volcanism in the northwest United States
6.	The cooling of ocean basalt while the continents rise

Tertiary volcanic deposits northwestern United States

The fifth major evidence argued by the K/T boundary advocates is the presence of Tertiary volcanic deposits in the northwestern United States. These deposits represent a variety of formations, types of volcanism, and uniformitarian ages. They are generally dated from Eocene to Pliocene (early to late Tertiary). These include volcanic formations from the John Day Country of north-central Oregon (figure 1) and the more extensive and younger Columbia River Basalts (CRB) (figure 2). The relative ages are apparent because the basalts overlie the John Day Country volcanic debris in north-central Oregon. Were the CRB formed during or after the Flood? If the CRB are Flood units, then the older formations are also from the Flood.

The CRB consist of over 100 individual lava flows that moved rapidly westward from fissures in southeast Washington, north-central, and northeast Oregon (figure 3). They flowed through the Columbia River Gorge, all the way to the Pacific Ocean, indicating that the Cascade Mountains were elevated at the time. The basalt flows cover an area of about 164,000 km^2,[7,8] with an estimated volume of 175,000 km^3, an average thickness of over 1,000 m, and a maximum of 3,500 m in the Pasco Basin of south-central Washington—the central part of the flows. The basalt is dated as "Miocene" or the beginning of the late Tertiary.

For many years, Austin has argued that the Tertiary is post-Flood.[9] He concluded when he was young that the Eocene to Pliocene John Day County sedimentary and volcanic rocks of northeastern Oregon were post-Flood; thus the Columbia River Basalt would also be post-Flood by superposition.[10] He cited a number of features that point to a post-Flood emplacement, but the primary evidence was that of subaerial volcanics.

Figure 1. The Clarno Formation with vertical and horizontal horsetail (*equisetum*) fossils (arrows) at the Clarno Nut Bed of the John Day Country of north-central Oregon, USA.

Figure 2. The Columbia River Basalts at Palouse Falls, southeast Washington, USA.

Figure 3. Dike from which the Columbia River Basalts erupted, west of Cottonwood Creek, John Day Country, north-central Oregon, USA.

At one time I agreed,[11] convinced by Austin's research. But being from Washington State, I was able to examine much of the geology first hand. That revealed overwhelming, obvious evidence that the CRB were deposited during the Flood.[12]

Figure 4. Pillow lava from the Columbia River Basalts, Washington, USA. The yellow material between the pillows (arrow) is palagonite, which forms when hot lava moves slowly into water and shatters.

Figure 5. Rattlesnake Formation welded tuff, north of Dayville, north-central Oregon, USA.

Austin's reasons for a post-Flood emplacement are equivocal; he argued that basalts in the area had to be post-Flood because they exhibit subaerial features, such as columnar joints, widespread flow, and a lack of pillow structures.[10] But none of these are conclusively diagnostic of a subaerial environment. Pillows, as observed when lava is emplaced on the sea floor, can be absent if the extrusion is rapid.[13] And pillow lava is common in the CRB, especially at the edges of flows where the lava slowed (figure 4).[14]

Austin also argued that volcanic material in the region was emplaced after the Flood because of the presence of welded tuff, or ignimbrite, such as the most recent formation, the Rattlesnake Ignimbrite (figure 5). However, welded tuff can form underwater if the magma flow is large and rapidly extruded.[15–17] Other features of the Rattlesnake Ignimbrite in eastern Oregon, such as its scale and deeply eroded surface, indicates that it was laid down late in the Sheet Flow Phase of the Flood.[18]

Table 2 summarizes the field evidence that convinced me the CRB and associated deposits were not post-Flood.

Table 2. Evidence for Flood emplacement of Miocene Columbia River Basalts.

1.	Quartzite gravel overlying basalt at numerous locations
2.	Nearly pure diatomite bed locally between lava flows
3.	Massive Thorp gravel stratigraphically above the CRB
4.	Rounded, eroded basalt anticlines
5.	Tropical and subtropical trees within and between lava flows
6.	Water gaps of Yakima River through basalt anticlines

The first evidence comes from well-rounded quartzite cobbles and boulders spread over this region—1,000 to 1,300 km east and about 650 km west of their source in the western Rocky Mountains.[19–22] These clasts are found on top of the CRB, and even on top of mountains, such as the Wallowa and Blue Mountains of Oregon (figure 6). They occur on all of the lava ridges in the southwest Columbia River Basin, including the first tall lava ridge, the Horse Heaven Hills, to altitudes over 1,200 m above the Columbia River. The cobbles and boulders were deposited by moving water, and the extent and altitude of the deposits indicates deposition during the Retreating Stage of the Flood. Since they cover the CRB, and until a better explanation of their occurrence can be found, it stands to reason that the CRB were emplaced by the Flood.

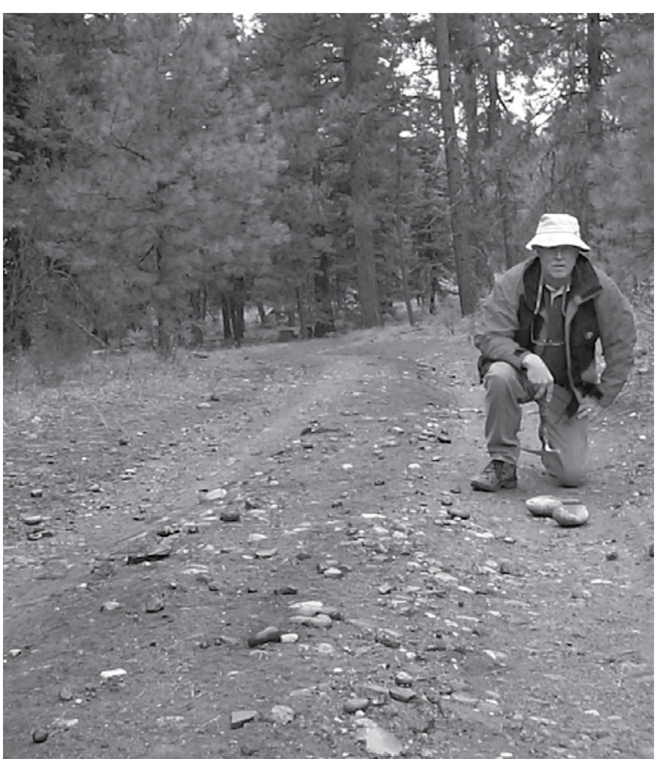

Figure 6. Quartzite cobbles from on top of Gold Hill in the Blue Mountains of central Oregon, USA (John Hergenrather provides the scale).

Photo by Ray Strom

Figure 7. A 6-m layer of pure diatomite (arrow) between two basalt flows of the Columbia River Basalts near George, Washington, USA.

Figure 8. The Thorp Gravel in a 75-m-high terrace in the western Kittitas Valley about 15 km west of Ellensburg, Washington, USA. The gravel consists entirely of volcanic cobbles and boulders shed from the Cascade Mountains to the west.

Another compelling evidence is the presence of a white diatomite layer locally sandwiched between black basalt flows. It can be seen south of Quincy and east of Ellensburg, Washington, where its 6-m thickness is mined (figure 7). Being nearly pure, with little clay or other impurities, makes it not only commercial, but also strongly suggests that it could not have formed over a number of years in a post-Flood lake.

The massive, layered Thorp Gravel consists of cobbles and boulders, and lies atop the CRB in the Yakima-Ellensburg area of central Washington. The gravel is widespread west of Ellensburg, forming terraces about 75 m high (figure 8). There is no evidence that it was deposited by the Ice Age; it consists of well-rounded volcanic rocks. This Pliocene deposit[23–25] indicates a massive current flowing east from the Cascade Mountains. The volume and extent of the water needed to deposit this gravel is consistent with the Retreating Stage of the Flood, as the Cascades diverted west-flowing currents back to the east before they found the exit to the Pacific Ocean through the Columbia River Gorge.

Figure 9. The south limb of the eroded anticline of the Rattlesnake Hills, southeast of Yakima, Washington, USA. The dip of the Columbia River Basalts and interbeds is shown by the smooth slope on the south side of the hogbacks (arrow). Extrapolating the dip of the hogbacks up to the axis of the anticline (left) shows that about 300 m of basalt and interbedded sediments were eroded from the top of the anticline.

Figure 10. Union water gap (right arrow) on the Yakima River, just south of Yakima, Washington, USA, between Antanum Ridge to the west (right) and the Rattlesnake Hills to the east (left) of the water gap (view southeast). Antanum Ridge/Rattlesnake Hills is a basalt anticline of the Columbia River Basalts. Konnowac Pass (left arrow) is a wind gap through the Rattlesnake Hills.

Massive water currents also are indicated by eroded basalt anticlines in the southwest CRB. The Rattlesnake Hills shows evidence that more than 300 m of rock was beveled off its top (figure 9). Rounded quartzite cobbles and boulders, transported from western Montana or Idaho are found overlying this erosional surface, again more consistent with the retreating Floodwater than with any post-Flood process.

Tropical plants and trees are found within and between the CRB flows. Over 200 species have been found just at Ginkgo Petrified Forest State Park at Vantage, Washington. The trees are from an impressive range of climate zones—tropical jungles to the northern plains of Canada and Alaska.[26,27] Tropical trees include teak, breadfruit, cinnamon, and gum. These would not be expected in this region in an early post-Flood climate. With a rapid onset of the Ice Age, temperatures would have been too low. A warm Pacific Ocean might have warmed the area if the Cascades were not in place, but since the CRB was blocked by the Cascades, that does not appear to be an option. Petrified logs abound at Ginkgo Petrified Forest State Park, many of them vertical or at an acute angle to the lava flows.

Finally, there are at least six water gaps on the Yakima River between Ellensburg and the lower Yakima Valley, where the Yakima River cuts CRB anticlines. Near Ellensburg in the Kittitas Valley, the river should have continued eastward over a low pass, when the valley sediments were thicker, and then down to the Columbia River. Instead, it took an unexpected southerly turn and incised at least six anticlines. The last one is Union Gap, just south of Yakima, between Antanum Ridge, to the west, and the Rattlesnake Hills, to the east (figure 10). Again the river did the unexpected, avoiding the lower Konnowac Pass (a wind gap at 380 m elevation) about 6 km east in the Rattlesnake Hills, in order to incise the 500–600-m high anticline and form Union Gap. The best explanation is that these water gaps were cut during the Retreating Stage of the Flood, before the rivers were established.[28]

Cooling ocean basalt and rising continents

Proponents of catastrophic plate tectonics (CPT) state that the ocean basins were resurfaced with basalt during the middle to late Flood (Mesozoic and Cenozoic). As the basalt cooled, the story goes, it contracted, causing the ocean basins to sink, the sea level to drop, and the continents to rise. Wise *et al.* stated:

> "After the global effects of the Flood ended, the earth continued to experience several hundred years of residual catastrophism. … A cooling lithosphere is likely to have produced a pattern of decreasing incidence … and intensity of volcanism … the large changes in crustal thicknesses produced during the Flood left the earth in isostatic disequilibrium. Isostatic readjustments with their associated intense mountain uplift, earthquake, and volcanic activity would have occurred for hundreds of years after the global effects of the Flood ended … Because of the frequency and intensity of residual catastrophism after the Flood, post-Flood sedimentary processes were predominantly rapid. The local nature of such catastrophism, on the other hand, restricted sedimentation to local areas, explaining the basinal nature of most Cenozoic sedimentation."[29]

It is ironic that this early version of CPT advocated a K/T Flood boundary. However, Dr Baumgardner has since stated his belief that the end of the Flood was in the late Cenozoic:

"On the issue of when the Flood catastrophe ended relative to the geology we observe today, I personally correlate the end of the year of the Flood with the later Cenozoic. I side with Oard on this question."[30]

There are several problems with rapid post-Flood isostatic adjustments. Submarine cooling of the basalt sufficient to induce major tectonic subsidence would probably take much longer. Second, the average basalt thickness (Layer 2A) is 0.5 km.[31] The sheeted dikes of Layer 2B are about 1.5 km thick. How much contraction would occur from the cooling of 2 km of basalt? I would think only a little. Third, what mechanism would cause the continents to rise as the ocean basalt cooled? Only the relative drop in sea level caused by the subsiding ocean floor could account for any perceived change in base level. Fourth, geomorphology indicates that *rapid currents* moving off the continents created many of the surficial landforms on top of the continents.[28] The supposed isostatic change after the Flood would produce weak, local corrections to changing base level, and thus slow currents—not the energy needed to erode many thousands of meters of sedimentary rocks, create planation surfaces, cut water and wind gaps, etc.

A generally invisible landform created by Flood runoff is the continental shelf/slope, a large sedimentary deposit that is ubiquitous on continental margins as well as those of large islands. The similarity of the continental profiles suggests that *the Flood ended at about the same time* all over the world, because only the energy and volume of the Flood could have deposited these massive features. This corresponds to the biblical account, which indicates that the Flood was over at the time of the Noahic Covenant. Thus, we would not expect continued direct effects for many years. Nor does the implied energy needed for the volume of the shelf/slope system[28] suggest slow drainage by isostatic cooling of the ocean floor. The consistent 130-m depth of the shelf edge along all of the continents but Antarctica (pushed down isostatically because of the ice sheet) implies the end of significant vertical tectonic motions at the end of the Flood, and also supports the simultaneous global termination of the Flood. Thus, large-scale tectonism, needed for post-Flood catastrophes, does not seem reasonable. That does not rule out minor changes along the edges of continents—these are clear from marine terraces. However, the issue at hand is one of scale, and the scale of energy needed to create the Cenozoic section after the Flood does not seem possible. Finally, a slow relative recession of sea level over hundreds of years would seem to produce a number of smaller shelves/slopes; not one large one.

Isostatic changes would have been too rapid for cooling basalt to produce anyway, since Noah observed rapidly falling sea level after Day 150. A global change in the relative elevations of the continents and sea floor was needed, consistent with the account describing the final 221 days of the Flood, not the centuries after.

All of these problems are summarized in table 3.

Table 3. Problems with the cooling of a resurfaced basaltic ocean floor explaining observed data.

1. Basalt cooling time likely more than tens of thousands of years
2. The oceanic basalt layer not thick enough to cause significant ocean bottom sinking
3. Need to find a mechanism for the continents to rise after the Flood
4. Slow water currents running off the continent due to slow ocean-floor cooling hard pressed to explain geomorphology
5. Noah observed a rapid fall of water

Conclusion

At one time, the K/T boundary was considered a logical place for the post-Flood boundary. Six lines of evidence have been suggested to support that position, four of which have been analyzed in parts 1 and 2, and shown to create more problems than they solve. The remaining two lines of evidence have been analyzed in this paper. Attributing Tertiary volcanism in the northwest United States to the post-Flood ignores other interpretations of the data, and also ignores the evidence of large-scale erosion in the area that is too extensive to account for within the post-Flood period. Post-Flood isostatic changes, which supposedly produced most of the Tertiary sediments, do not have enough energy to create the features we see. This examination strongly suggests that the end of the Flood is better placed well above the K/T boundary. Advocates of the K/T boundary model should re-evaluate their evidence and seriously consider the abundant evidence that the boundary is late in the Cenozoic, assuming the geological column for sake of discussion.

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CRSQ—Creation Research Society Quarterly

JofC—Journal of Creation, formerly TJ and *Creation Ex Nihilo Technical Journal*

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