Chapter 31

Flood Runoff Formed the Continental Margin

The structure and composition of the continental margin is very difficult for a uniformitarian scientist to explain. Yet, it can be easily be seen as the deposition from Flood runoff which happened as the continents rose and the ocean basins sank.

The Continental Margin—A Mysterious Geomorphic Feature

Although few uniformitarian scientists address this issue, the continental shelf and slope are mysterious geomorphological features within the uniformitarian paradigm. Natural process would favor a gradual descent to the ocean depths. There really should be no continental shelf or slope (see dashed line on Figure 30.4). King described the problem:

> There arises, however, the question as to what marine agency was responsible for the leveling of the shelf in early Cenozoic time, a leveling that was preserved, with minor modification, until the offshore canyon cutting of Quaternary time? Briefly *the shelf is too wide, and towards the outer edge too deep*, to have been controlled by normal wind-generated waves of the ocean surface (emphasis mine).[1]

The nearly flat continental shelves are too wide and the continental slope too steep for present processes to explain. This defies the uniformitarian principle upon which most of geological interpretation is based. Even before King pointed out the continental margin represents an unusual profile, Hedberg had stated "…there is considerable controversy as to the origin in detail of continental slopes. It seems evident that there is no unique answer."[2]

At the time King wrote these words, many scientists believed the submarine canyons that were cut into the continental shelves and slopes were young features that formed when the sea level was lower, during the "Quaternary" Ice Age. However, researchers now realize submarine canyons had to have taken much more time to erode than their paradigm earlier allowed (see Volume III on submarine canyons).

Why Is the Margin Mysterious?

Why would natural processes not form a profile like the continental margin? Winds generate most ocean currents. The sinking of dense water at high latitudes is only a minor factor, although it is widely believed to be a major factor by many scientists.[3] Because of the prevailing winds, ocean currents are commonly *parallel* to the coast, such as the Gulf Stream off the East Coast of the United States.[4]

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[1] King, L.C., 1983. *Wandering Continents and Spreading Sea Floors on an Expanding Earth*, John Wiley and Sons, New York, NY, p. 199.

[2] Hedberg, H.D., 1970. Continental margins from viewpoint of the petroleum geologist. *AAPG Bulletin* 54(1):11.

[3] Wunsch, C., 2006. An oceanographer charts the ebb and flow of opinion on ocean currents. *Nature* 439:513.

[4] Kennett, J., 1982. *Marine Geology*, Prentice-Hall, Englewood Cliffs, NJ, p. 241.

Sediments today reach the oceans from rivers and form deltas. The deltas are like miniature continental margins in that the deposition progresses seaward with a slow seaward-deepening slope, reaching a sudden drop off. (In fact, a delta has a similar surface profile as a continental shelf, slope, and rise, but of limited areal extent.) At the same time as the delta sediments are being deposited seaward and commonly sloughing down the slope into the deep sea, shore-parallel currents spread some of the sediment along the continental margin. Hurricanes and storms further move the sediment parallel to the coast. At the same time, sediments tend to slide and spread down toward the deep, abyssal plains by slumping and other mass movements. Mass movement is ubiquitous along the continental margins today and should have been common throughout the formation of the continental margin, assuming the margins formed over millions of years. So, if we accept it took millions of years, the coastal processes should form a more gradual seabed profile from the shore to the deep sea, as shown by the dashed line in Figure 30.4.

King believed tidal currents leveled the shelf sediment.[5] But, there are many variables involved in determining the profile of the continental shelf and slope.[6] The question remains what caused the unique bottom profile of the continental shelf and slope?

Continental Margins Mostly Formed before Submarine Canyons

King believed the submarine canyons were cut *after* the margin sediments were deposited. He believed the margin sediments were deposited *first* as a sheet around all of the continents and large islands. Later, submarine canyons were cut as channels perpendicular to the coast. Seismic images show that *buried* submarine canyons are rare within the sedimentary rocks of the continental shelf and slope. Submarine canyons seem to have formed after most of the continental margin sediments were already deposited.[6,7,8] The buried canyons seen in seismic images are usually shallow and associated with submarine canyons that exist today.[9]

If the continental shelf and slope formed slowly over millions of years, according to the uniformitarian assumption, there should be numerous deep submarine canyons perpendicular to the coast within the sedimentary rocks. The reason for this is because at present there are numerous submarine canyons on the present continental slopes, and if the present is the key to the past, abundant canyons should also be seen within the sedimentary rocks themselves. Therefore, the continental margin and the canyons were not formed over millions of years by present processes and submarine canyons are younger than the continental margins.

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[5] King, L.C., 1983. *Wandering Continents and Spreading Sea Floors on an Expanding Earth*, John Wiley and Sons, New York, NY.

[6] Fulthorpe, C.S. and J.A. Austin, Jr., 1998. Anatomy of rapid margin progradation: three-dimensional geometries of Miocene clinoforms, New Jersey Margin. *AAPG Bulletin* 82:251–273.

[7] Fulthorpe, C.S., J.A. Austin, Jr., and G.S. Mountain, 2000. Morphology and distribution of Miocene slope incisions off New Jersey: are they diagnostic of sequence boundaries? *GSA Bulletin* 112:817–828.

[8] Steckler, M.S., G.S. Mountain, K.G. Miller, and N. Christie-Blick, 1999. Reconstruction of Tertiary progradation and clinoform development on the New Jersey passive margin by 2-D backstripping. *Marine Geology* 154:399–420.

[9] Fulthorpe, C.S., J.A. Austin, Jr., and G.S. Mountain, 1999. Buried fluvial channels off New Jersey: did sea-level lowstands expose the entire shelf during the Miocene? *Geology* 27:203–206

The Genesis Flood Formed the Continental Margin

Since continental shelves and slopes surround all of the continents, sheet deposition during the Flood seems the reasonable way to explain their existence and profile. Sheet deposition would correspond with the first half of the Retreating Stage of the Flood in Walker's model.[10] Sheet deposition from currents moving off the uplifting continents is supported by the seismic profiles of continental shelves where many layers are generally planar over large areas (see Figure 7.3). Strong currents are implied by sheet deposition. Sometimes, the dip of the strata increases *seaward*, forming what are called unconformities and delta-like features. This signifies the depositional current was flowing *offshore* and not parallel to the shoreline as would be expected from wind generated currents. Hedberg states: "Reflection profiling has shown that many slopes in their present form are the result of prograding sedimentation."[2] This prograding wedge of sedimentation is perpendicular to the coast, implying currents moved directly off the continents, not as the typical parallel shore currents we see today.

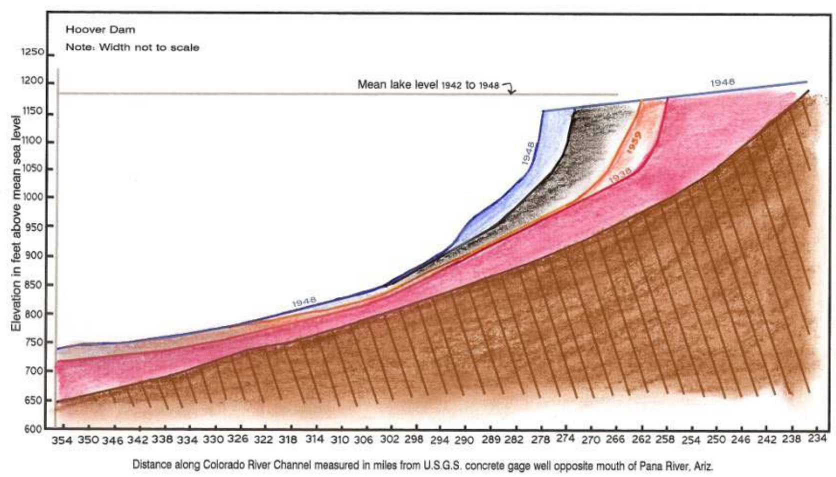

Figure 31.1. The yearly prograding Colorado River delta into Lake Mead in the Lower Granite Gorge as the lake was filling (drawn by Mrs. Melanie Richard).

Continental slopes likely signify the edge of sheet flow deposition. This would be analogous to the edge of a river delta, the top of the delta representing the continental shelf. The delta can serve as an analog for the Flood formation of the continental margin. A case in point would be the recently-formed delta of the Colorado River which meets Lake Mead in the narrow Lower Granite Gorge (Figure 31.1). The delta formed as the lake was filling. There were no along shore currents to spread the sediments since they were deposited in a narrow gorge. The illustration shows the top of the delta is nearly flat with a slight lakeward slope until it reaches a steep drop off. Now, compare the Colorado River delta feature to the edge of the continents and the large islands. This gives an understanding of how the continental shelf and slope would form when wide Flood sheet currents flowed off of the rising continents.

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

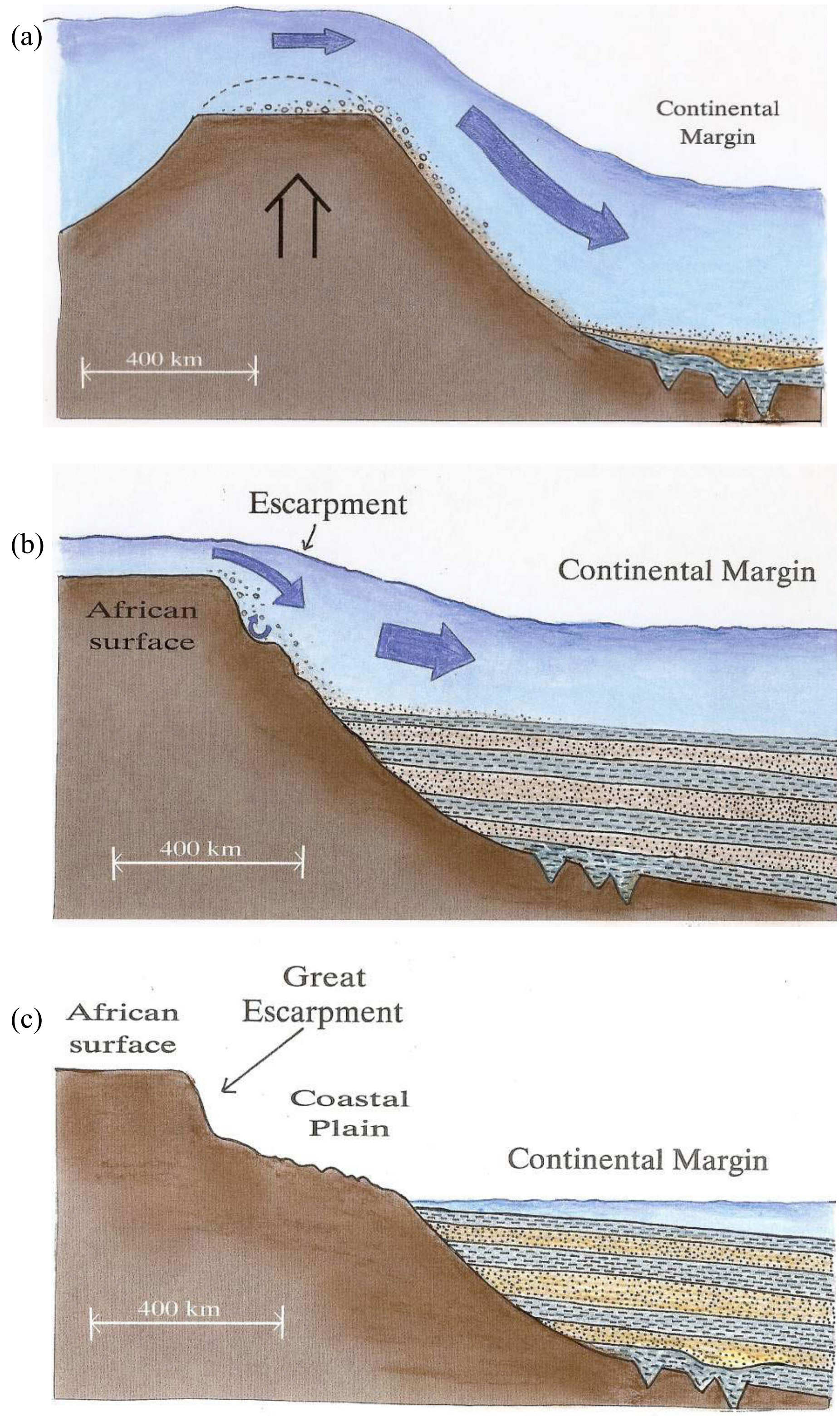

Figure 31.2. Schematic of Flood deposition of the continental margin and the formation of the Great Escarpment of southeast Africa (drawn by Mrs. Melanie Richard).

During the Flood, some sediment would have managed to spread farther than the continental slope and form the continental rise and the generally flat bottom of the abyssal plains (sediment pools above rough igneous rocks in the abyssal plains). It would have been mainly fine-grained sediment like clay that would have mostly filled up the bottom of the deep ocean basins. Sedimentation of fine particles would likely have continued after the Flood due to wind deposition.[11]

But once in a while, a downslope flow of debris, usually called a turbidity current, would travel long distances and transport sand past the continental rise to the abyssal plain, explaining layers of sand often found on the abyssal plain. This type sedimentation continues today during landsliding off the continental slope. Turbidity currents can be initiated by submarine landslides, and can continue moving on a nearly flat slope. Figure 31.2 is a schematic of the Flood formation of the continental margin.

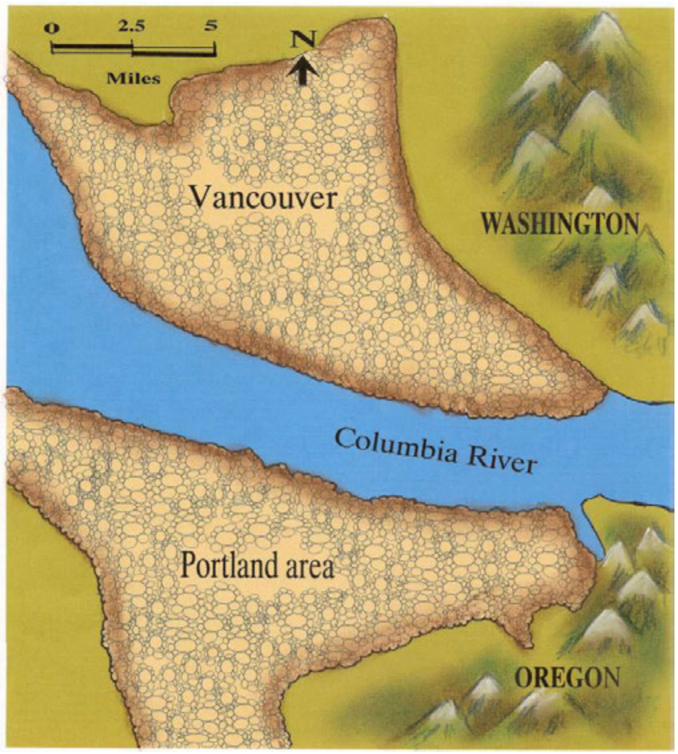

Figure 31.3. The Portland delta, a thick gravel bar deposited by the Lake Missoula flood as the floodwater exited the Columbia Gorge and spread out horizontally (drawn by Mrs. Melanie Richard). The last phase of the flood was the more channelized erosion that eroded the channel of the Columbia River.

A Lake Missoula Flood Analog

A good analog for the rapid Flood deposition along the continental margin is also provided by the Lake Missoula flood.[12,13] As the Lake Missoula floodwater rushed through the Columbia Gorge between Washington and Oregon at more than 80 mph

[11] Froede Jr., C.R., 2003. Dust storms from the sub-Saharan African continent: implications for plant and insect dispersion in the post-Flood world. *Creation Research Society Quarterly 39* (4):237–244.

[12] Bretz, J.H., 1928. Bars of channeled scabland. *GSA Bulletin* 39:697–700.

[13] Oard, M.J., 2004. *The Missoula Flood Controversy and the Genesis Flood*, Creation Research Society Monograph No. 13, Chino Valley, AZ, pp. 25–26.

(130 kph), the velocity slowed as it came to the wide mouth of the gorge in the Portland, Oregon, and Vancouver, Washington, area. The waning current spread out and deposited a giant sand and gravel bar, called the Portland Delta, over 350 feet (110 m) thick, covering an area greater than 200 mi^2 (500 km^2). Later, this delta was dissected where the Columbia and Willamette Rivers now flow, probably as the Lake Missoula flood subsided and the currents coming from the Columbia gorge and the Willamette Valley became more channelized and eroded two channels into the delta (Figure 31.3). The deposition of the Portland Delta mimics the formation of the continental margin with submarine canyons forming after *deposition*. The situation on the continental margin would be a bit different in that the sediments were laid down as the currents slowed upon hitting deeper water along the sinking continental margin.

Determining that the continental margin was formed during the Sheet Flow Phase of the Retreating Stage of the Flood helps time other events. Spencer and Oard were able to place the buried Chesapeake Bay Impact Crater (located on the upper continental shelf) to a time about midway in the Sheet Flow Phase of the Genesis Flood.[14] This placement was based on data showing the meteorite punched a crater in the lower half of the shelf sediments of southern Chesapeake Bay. If the Sheet Flow Phase lasted about 100 days within the Retreating Stage's 221 days, then the impact would have occurred at approximately Day 200 of the Flood.

Flood Ended Everywhere by Day 371

Some creationists have thought that although the Flood ended for Noah and his family, it continued on other continents, perhaps for hundreds of years. This presupposes the description of the Flood was entirely from Noah's perspective not that of an omniscient God. However, the wording of the Flood record appears to be from God's point of view. There is evidence from the field of geomorphology that can support this assumption.

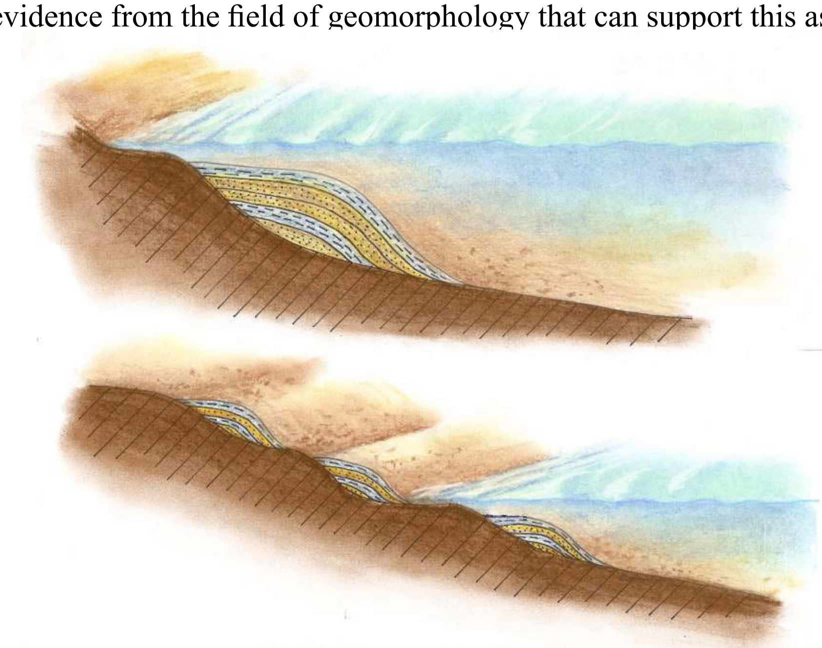

Figure 31.4. Comparison of the continental shelf and slope today (top) with multiple continental shelves that likely would have formed if the Flood did not end for many years in some areas (bottom).

[14] Spencer, W.R. and M.J. Oard, 2004. The Chesapeake Bay impact and Noah's Flood, *Creation Research Society Quarterly* 41 (3):206–215.

As we have previously stated, the continental margins were formed during Flood runoff from currents moving at *high* speeds at times perpendicular to the continents. The result was the bathtub ring continuation of the continental shelf and slope. The top of the continental slope is at a *consistent depth* off all continents, except Antarctic for reasons mentioned earlier. It seems that if the Flood were raging many more years on some continents and not others, this shelf break would not be at a similar depth of 425 feet (130 m) everywhere, instead it would be at variable depths (Figure 31.4).

Based on the geomorphology of the continental margin, it appears the Flood ended everywhere by Day 371. It did not stop in one part of the world and continue in other parts. It did not form numerous "continental margins" with variable depths for the shelf breaks.

The similar depth implies the energy of the Flood gave out at about the same time everywhere on earth. Otherwise, a consistent depth of the edge of the continental shelf could not form once the currents diminished because it takes too much hydrological energy to form the present profile. Once the water stopped flowing at high speeds off the continents there would be less energy available. Hypothetically, if one continent continued to rise slowly, say for a few hundred years after the Flood, only weak currents would flow off the continents, forming small continental margin sediments (Figure 31.4). However, parallel shore deposition should have become more likely and a chaos of small delta-like features would be found along the continental margin.

Considering the data, large-scale differential vertical motion between the continents and oceans quit about the same time late in the Flood. When it says in Genesis 8:13-14 that the Floodwater dried up from the Earth, it would mean from *all* of the continents on the Earth, not just where the Ark landed or a few continents and not the others.

Of course, there would be minor, but local, uplift and subsidence of coastal areas due to residual tectonics after the Flood. Such minor tectonics continues to this day in the form of earthquakes, slow plate movements, and faulting. The effects of post-Flood tectonics can be seen in raised beaches on shorelines along some coasts today, as those along the northern California and southern Oregon coast (Figure 31.5). So, the sea level at any one coastal area may be different from the average based on post-Flood tectonics. Such tectonic episodes, likely caused by earthquakes, were not that significant, only in the range of a few hundred feet maximum vertical change.

Consequently, the present distribution of continents and oceans, the topography of the continents, and the bathymetry of the ocean were generally fixed at Day 371. But, the sea level likely was higher than today, as discussed below in the in-depth section. Since the Ice Age started immediately after the Flood with accumulation of snow in favorable areas,[15,16] the sea would fall rapidly.

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15 Oard, M.J., 1990. *An Ice Age Caused by the Genesis Flood*, Institute for Creation Research, El Cajon, CA.

16 Oard, M. J., 2004a. *Frozen In Time: The Woolly Mammoth, the Ice Age, and the Bible*, Master Books, Green Forest, AR.

Figure 31.5. Likely raised wave-cut terrace northern Oregon coast.

Sea Level Higher at the End of the Flood Than Today (in-depth section)

During the Retreating Stage, the continents moved from being flooded to essentially the topography and geography we see today. I use the word "essentially" because there are a number of variables that would cause the geography, topography, and sea level to be slightly different than today.

The first variable is the Greenland and Antarctic Ice Sheets did not exist at the end of the Flood, so the water in those ice sheets would still be in the ocean on Day 371. This would add about 220 feet (68 m) of water to the oceans.[17] The added water would push down the ocean bottom, a phenomenon called isostatic compression, the second variable affecting the sea level. It is believed that isostatic compression would push the continental crust down about 1/3 of the added mass, but because ocean crust and upper mantle are denser, the percentage of isostatic sinking is considered to be only about 8.3% of the depth of the added water.[18] Subtracting 8.3% of the estimated rise from the missing ice sheets, the sea level would be about 202 feet (62 m) higher than it is today.

Isostatic compression is a reality observed on the continents, as shown by previously glaciated areas, such as Scandinavia and Hudson Bay, and the sinking of the Antarctic continental shelf because of the Antarctic Ice Sheet. The rebounding of the land after the

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[17] Oard, M.J., 2005. *The Frozen Record: Examining the Ice Core History of the Greenland and Antarctic Ice Sheets*, Institute for Creation Research, Dallas, TX, p. 5.

[18] Conrad, C.P. and B.H. Hager, 1997. Spatial variations in the rate of sea level rise caused by the present-day melting of glaciers and ice sheets. *Geophysical Research Letters* 24(12):1,503–1,506.

ice load has melted has been observed, such as the relative lowering of sea level in the Baltic Sea. After Lake Bonneville (about 800 feet (245 m) deeper and eight times the size of Great Salt Lake) shrank, the shorelines around Lake Bonneville were bowed up in the deepest part of the lake about 230 feet (70 m).[19]

The third variable is the temperature of the oceans was much warmer than today immediately after the Flood, and the warmer the water, the larger its volume, adding to the higher sea level. Based on the estimated change in ocean heat content, sea surface temperature, and sea level rise between 1961 and 2003,[20] an average ocean temperature of 86°F (30°C) immediately after the Flood would result in about a 13 foot (4 m) rise in sea level. This is not a significant change in sea level. So, sea level would be 215 feet (66 m) higher based on the above three variables.

A fourth variable affecting sea level is that Flood sediments and sedimentary rocks would contain extra water within their pores, between sediment grains, since they were deposited in water. Much of this water would have been expelled during sediment compression due to rapid deposition during the Flood. However, it would be expected the top layers would contain more water than today and gradually leak into the ocean. Taking into account this variable, the sea level would be lower at first, right after the Flood, but rise thereafter. The magnitude of this effect is difficult to estimate.

Table 31.1 lists the variables that would determine sea level at the very end of the Flood. At this point, it is difficult to estimate what the sea level would be immediately after the Flood, mostly because of the fourth variable. Nonetheless, it is likely the sea level was higher than it is today.

Variable	Effect on Sea Level Compared to Today
No Greenland and Antarctic Ice Sheets	Much higher
Isostatic depression caused by more water	Slightly lower
A warmer ocean	Slightly higher
Water remaining in top sedimentary rocks	Lower

Table 31.1. Four variables that cause a different sea level right after the Flood than today.

19 King, P.B., 1965. Tectonics of Quaternary time in middle North America. In, Wright, Jr., H.E. and D.B. Frey (editors), *The Quaternary of the United States*, Princeton University Press, Princeton, New Jersey, pp. 831–870.

20 Domingues, C.M., J.A. Church, N.J. White, P.J. Gleckler, S.E. Wijffels, P.M. Barker, and J.R. Dunn, 2008. Improved estimates of upper-ocean warming and multi-decadal sea-level rise. *Nature* 453:1,090–1,093.