Chapter 28

Submarine Canyons Point towards a Late Cenozoic Boundary

The last geomorphological feature to be discussed is submarine canyons which are canyons carved perpendicular to the coast. Submarine canyons are not deep-sea trenches, like the Mariana Trench, the deepest spot in the ocean. Trenches generally run *parallel* to the shoreline or a string of islands that form an arc, appropriately called an island arc. Trenches are fault-controlled structures, caused by down warping ocean crust.[1] Submarine canyons structures formed by erosion that crosses the continental margin sedimentary and igneous rocks.

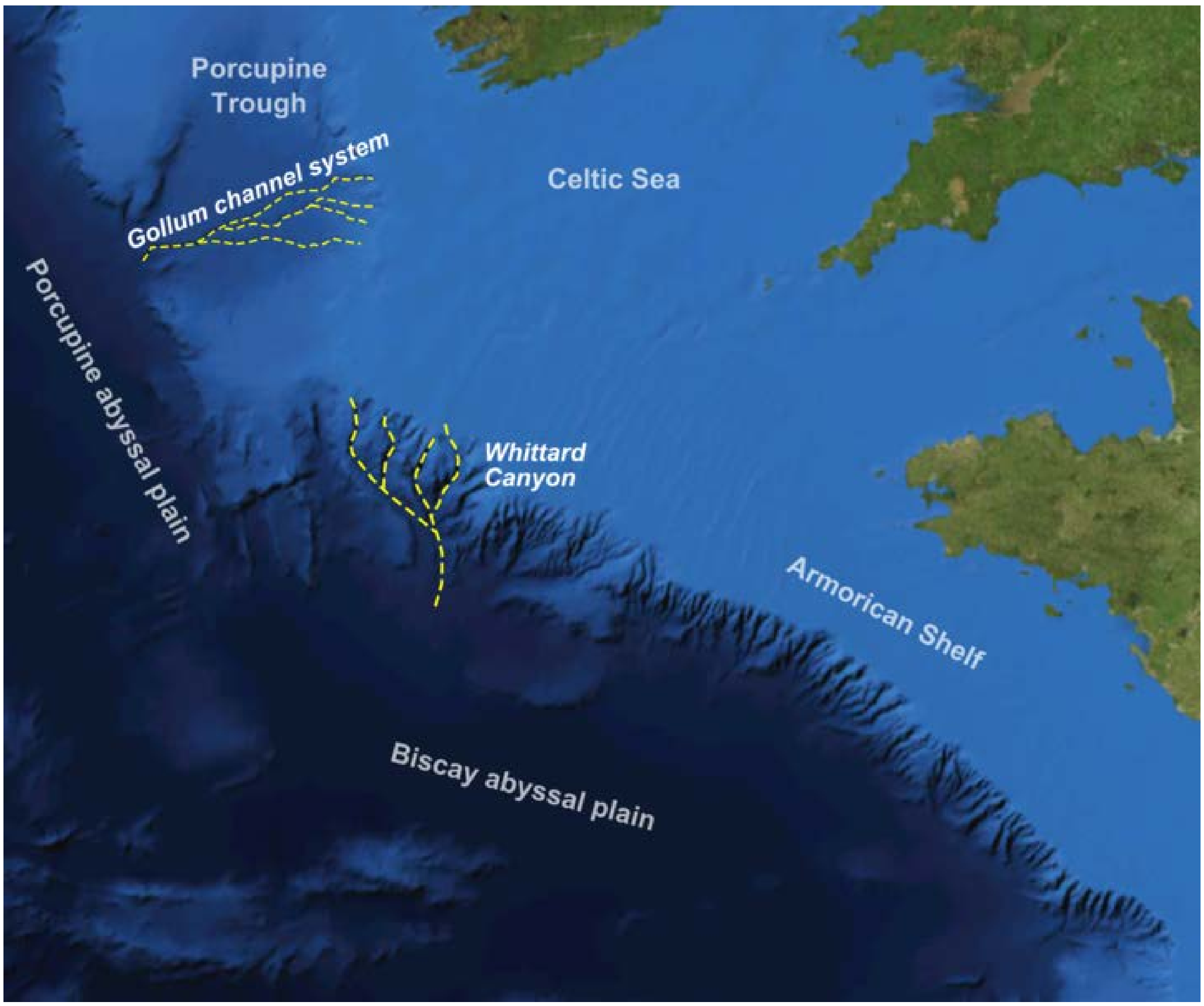


Figure 28.1. Submarine Canyons off southwest England, Ireland, and northwest France (Wikipedia). Notice the numerous canyons on the continual slope with only the Gollum channel system penetrating the shallow continental shelf.

[1] Oard, M.J., 2000. Subduction unlikely—Plate tectonics improbable. In, Reed, J.K. (editor), *Plate Tectonics: A Different View*, Creation Research Society Monograph No. 10, Creation Research Society, Chino Valley, AZ, pp. 93-145.

Characteristics of Submarine Canyons

There are two main types of submarine canyons and a rare third type that is caused by faulting.[2] The vast majority of submarine canyons eroded down the continental slope (Figure 28.1). The average slope canyon heads is in water at depths commonly over 700 feet (215 m).[3] These canyons never eroded headward from the sea into the continental shelf toward land.[4] As a result, they are generally shallow and straight.[5,6] There are thousands of this type of canyon, easily carved by downslope rock and sediment sliding down the continental slope.

A second type of submarine canyon is carved into the continental shelf (Gollum channel system in Figure 28.1), sometimes clear to near the shore. They are unique in that they are much deeper and longer that the first type, and these are of interest to us. Shelf indenting submarine canyons start at a water depths ranging from a few feet (about a meter) to more than 1,000 feet (300 m). Their average depth of the start of the canyon is 350 feet (107 m), near the edge of the continental shelf. Capbreton Canyon off northern Spain is a good example. It begins at 100 feet (30 m) deep, 820 feet (250 m) from the shore.[7] The Scripps and La Jolla Canyons off La Jolla, California also begin very close to the beach; so close, in fact, that the Scripps Institute of Oceanography pier extends to near the head of Scripps Canyon. If the head of this canyon grows shoreward, the pier would crash down into the canyon. The southern head of Monterey Canyon starts just off the pier at Moss Landing in 60 feet (18 m) of water.[8]

Submarine canyons are generally V-shaped, indicating youth. They are commonly associated with rivers but there are many exceptions, which indicate that the relationship is more complicated. At one time most geologists believed rivers carved the canyons when the sea level was low during the supposed ice ages. This idea has been mostly abandoned, especially since scientists now date the canyons as older than the ice ages.

The average length of a submarine canyon is 30 miles (50 km). These include the very short canyons off the Hawaiian Islands which are less than 10 miles (16 km) long, and include the long canyons along the Bering Sea slope. The longest submarine canyon is the Bering Canyon. The total length is 310 miles (495 km), including a 60 mile (95 km) long fan valley. So this submarine canyon is even longer than Grand Canyon.[9,10] If a submarine canyon's fan valley

---

[2] Lastras, G. et al., 2011. Understanding sediment dynamics of two large submarine valleys from seafloor data: Blanes andLa Fonera canyons, northwestern Mediterranean Sea. *Marine Geology* 280:21.

[3] Harris, P.T. and T. Whiteway, 2011. Global distribution of large submarine canyons: geomorphic differences between active and passive continental margins. *Marine Geology* 285:76.

[4] Popescu, I., G. Lericolais, N. Panin, A. Normand, C. Dinu, and E. Le Drezen, 2004. The Danube submarine canyon (Black Sea): morphology and sedimentary processes. *Marine Geology* 206:249-250.

[5] Pratson, L.F., W.B.F. Ryan, G S. Mountain, and D.C. Twichell, 1994. Submarine canyon initiation by downslope-eroding sediment flows: evidence in late Cenozoic strata on the New Jersey continental slope. *GSA Bulletin* 106:395-412.

[6] Pratson, L.F. and B.J. Coakley, 1996. A model for the headward erosion of submarine canyons induced by downslope-eroding sediment flows. *GSA Bulletin* 108:225-234.

[7] Mulder, T. *et al*., 2004. Understanding continent-ocean sediment transfer. *EOS, Transactions, American Geophysical Union* 85 (27):257, 261-262.

[8] Shepard, F.P. and R.F. Dill, 1966. *Submarine Canyons and Other Sea Valleys*, Rand McNally & Company, Chicago, IL, p. 81.

[9] Carlson, P.R. and H.A. Karl, 1984. Discovery of two new large submarine canyons in the Bering Sea. *Marine Geology* 56:159-179.

were included in the statistics, submarine canyons would measure significantly longer. For example the Congo Canyon would change from 120 miles (190 km) long to 500 miles (800 km).

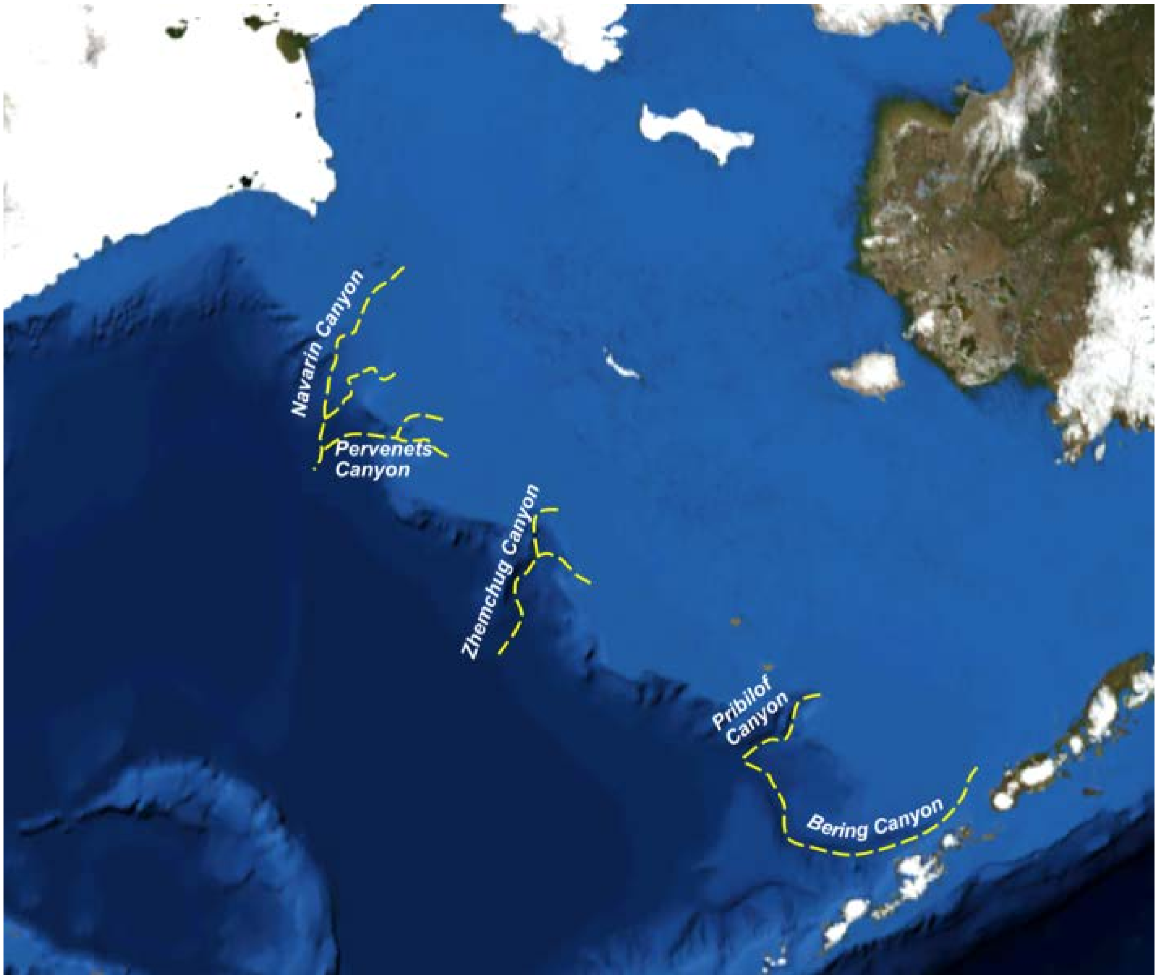


Figure 28.2. Five of the seven canyons on the edge of the very wide Bering Sea continental shelf, including the location of the very long Bering submarine canyon (Wikipedia).

The average maximum height of submarine canyon walls is about 3,000 feet (915 m). This is higher than average land canyons. A submarine canyon's height varies down the canyon, and it is hardly ever the same height on opposite sides. Many are as deep, or deeper, than Grand Canyon. The Capbreton Submarine Canyon along the northern margin of Spain in the Bay of Biscay has a maximum wall height of 9,840 feet (3,000 m), the highest in the world excluding the Bahama canyons,[11] which technically are not submarine canyons. Zhemchug Canyon along the Bering Sea slope is a close second at 8,530 feet (2,600 m) high.[10]

The largest submarine canyons in the world by volume are found on the outer continental

---

[10] Karl, H.A., P.R. Carlson, and J.V. Gardner, 1996. Aleutian basin of the Bering Sea: styles of sedimentation and canyon development. In, Gardner, J.V., M.E. Field, and D.C. Twichell (editors), *Geology of the United States' Seafloor—The View from GLORIA*, Cambridge University Press, New York, NY, p. 305-332.

[11] Mulder, T. *et al*., 2004. Understanding continent-ocean sediment transfer. *EOS, Transactions, American Geophysical Union* 85 (27):257, 261-262.

shelf of the Bering Sea about 375 miles (600 km) from land (Figure 28.2).[10,12,13] There are seven large canyons in all. The volume of sediment removal is ten times any submarine canyon incised into the margin of the lower 48 states. Zhemchug Canyon holds the world record volume of eroded sedimentary rock at 1,415 mi^3 (5,800 km^3), significantly more than Grand Canyon.

The majority of canyons meander and a significant number are gently curved. A few show cut-offs or meander loops—similar to rivers.[14] Two canyons surveyed by Shepard and Dill have right-angled bends.[8] The majority of the surveyed canyons have tributary canyons that converge into the main canyon at an acute angle (less than 90 degrees), similar to land canyons. This similarity can enlighten our understanding about how the Flood could have shaped land canyons. Most submarine canyons are cut into sedimentary rock, but a significant number are cut into igneous rock, mainly granite, indicating forceful channelized erosion.

Uniformitarian Difficulties

Uniformitarian scientists' understanding of the origin of submarine canyons is better than any other geomorphological feature discussed so far. Even so their two main hypotheses have difficulties. The first proposes a type of mass flow, a downslope flow of debris, on the continental slope cut the canyons. The main difficulty with this hypothesis is it focuses on numerous mass flows taking place at *one* location so a huge canyon erodes and not many small canyons as would happen if sediments were deposited widely along the continental shelf. Since continental slope canyons are so abundant, it is logical than some of the (hundreds) of mass flow canyons should have eroded headward into the continental shelf that is, from the sea into the shelf.[15] If the large shelf indenting submarine canyons, some of which start almost at the beach, were formed from multiple mass flows, there would be little or no relationship to rivers or valleys on land, but there is, although the relationship is unknown.

The second hypothesis associates the origin of submarine canyons with the collapse of sediments at the *shelf edge*, sometimes related to low stands of sea level.[16,17] The collapse would generate a mass flow and could erode a small submarine canyon starting at the shelf edge that could grow shoreward and deepen with time. This is plausible, except submarine canyons are now believed to have begun *well before* ice age low stands. There is the additional problem of how continental erosional debris became concentrated at *one* location along the shelf edge. Carving a canyon would require many or frequent mass flows in a large region, over a long period of time, in one location. This is highly unlikely.

---

[12] Carlson, P.R. and H.A. Karl, 1984. Discovery of two new large submarine canyons in the Bering Sea. *Marine Geology* 56:159-179.

[13] Carlson, P.R. and H.A. Karl, 1988. Development of large submarine canyons in the Bering Sea, indicated by morphologic, seismic, and sedimentologic characteristics. *GSA Bulletin* 100:1,594-1,615.

[14] Krastel, S., T.J.J. Hanebuth, A.A. Antobreh, R. Henrich, C. Holz, M. Kölling, H.D. Schulz, K Wien, and R.B. Wynn, 2004. Cap Timiris Canyon: a newly discovered channel system offshore of Mauritania. *EOS* 85 (42):417, 423.

[15] Pratson, L.F., W.B.F. Ryan, G S. Mountain, and D.C. Twichell, 1994. Submarine canyon initiation by downslope-eroding sediment flows: evidence in late Cenozoic strata on the New Jersey continental slope. *GSA Bulletin* 106:411.

[16] Pratson *et al.*, Ref. 5, pp. 395–412.

[17] O'Leary, D.W., 1996. The timing and spatial relations of submarine canyon erosion and mass movement on the New England continental slope and rise. In, Gardner, J.V., M.E. Field, and D.C. Twichell (editors), *Geology of the United States' Seafloor: The View from GLORIA*, Cambridge University Press, New York, NY, p. 47.

Submarine Canyons Also Difficult to Form from Post-Flood Catastrophism

Since submarine canyons are commonly believed to have formed in the Cenozoic, they are assumed to be post-Flood features by those who think the Flood/post-Flood boundary is at the Cretaceous/Tertiary (K/T) or lower in the geological column. As a result, they require a post-Flood mechanism to explain the origin of submarine canyons. Submarine canyons are only a bit less difficult than uniformitarian hypotheses because of the hypothetical larger mass of catastrophically deposited sediments. The timing of submarine canyons, however, must wait until the top half the continental shelf is deposited, since about half the shelf sediments are dated Cenozoic by uniformitarian scientists. Post-Flood catastrophists still have the problem of *focusing the sediments in one location* along the edge of continental shelf, especially since many canyons are not associated with rivers that would normally spread the sediments seaward.

Submarine Canyons Formed Late in the Flood

The uniformitarian idea of mass flow, I believe, is generally correct, but they are missing an essential point. What would cause thick sediments to amass in one location near the edge of the continental shelf? Only a late Flood runoff could provide the needed sediment (Figure 28.3).

From the geomorphology of the continental margin, deep submarine canyons had to be formed very late in the Flood.[18] This would be *after* the majority of the continental shelf sediments were laid down and much of it consolidated into sedimentary rock. This information fits well within Tas Walker's model for the Retreating Stage of the Flood (see Chapter 4).[19] First, sheet erosion of the continents resulted in sheet deposition along the continental margins (Figure 28.3a). Second, the channelized erosion resulted in submarine canyons and the deposition of submarine fans (Figure 28.3b-e).

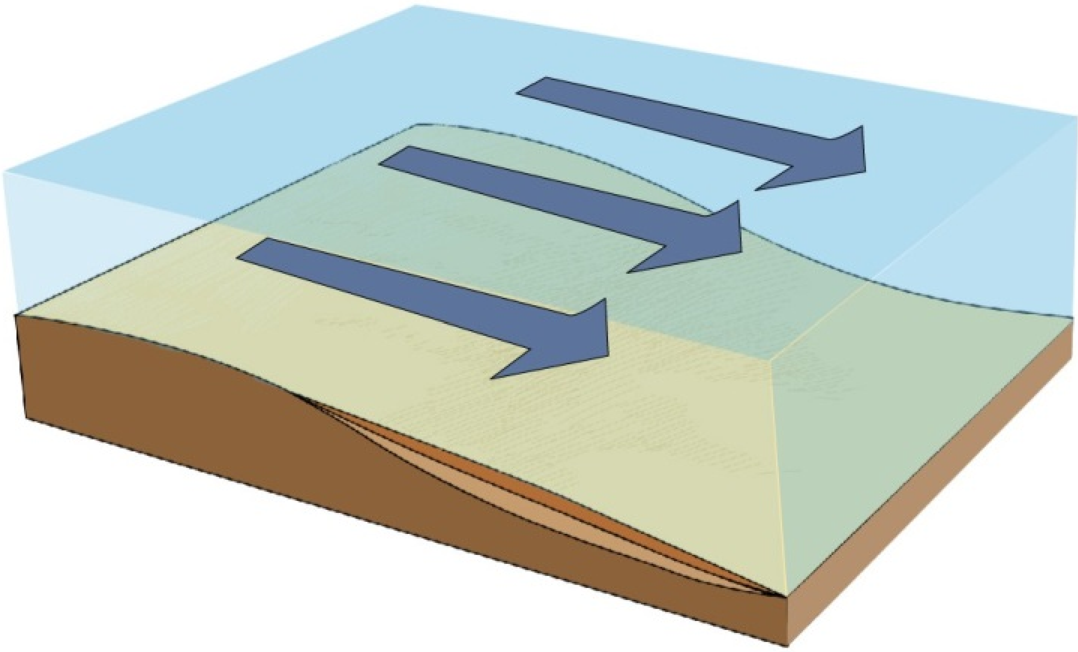
As the continents rose during the Retreating Stage of the Flood, the mountains and plateaus became exposed. The Floodwater then became channelized, eventually flowing to the continental margin. The channelized flow accelerated in some areas (Figure 28.3b-d) as an enormous flow of water was forced through narrower spaces, like forcing the same amount of water from a wide pipe into a narrow pipe (Figure 28.4). The rapid rise of continents and sinking of the ocean floor would further accelerate the currents. When the energetic channeled, currents reached the present coastlines, they sped across the newly-deposited continental shelf sediments, decelerating as the current reached deep marine conditions.[20] This provides an outline for the rapid formation of submarine canyons.

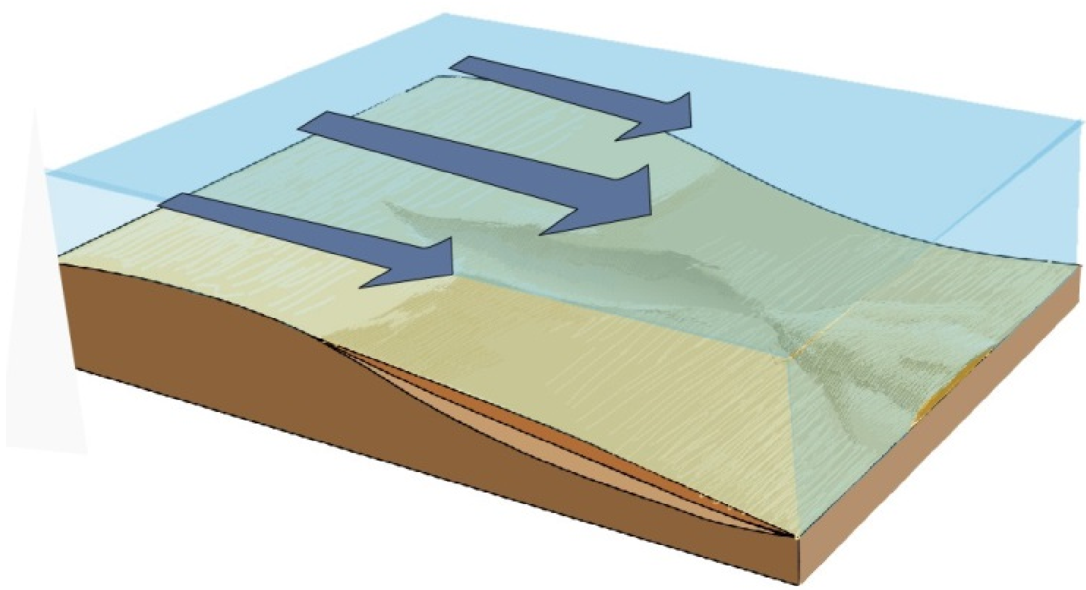
---

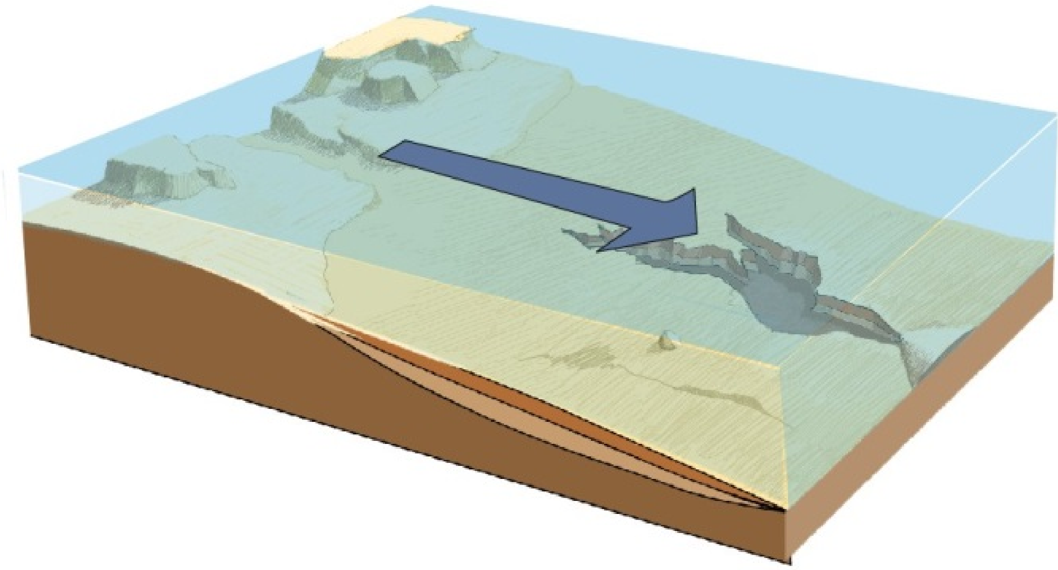
[18] Oard, M.J., 2001. Vertical tectonics and the drainage of Floodwater: a model for the middle and late diluvian period—Part II. *Creation Research Society Quarterly* 38(2):87-89.

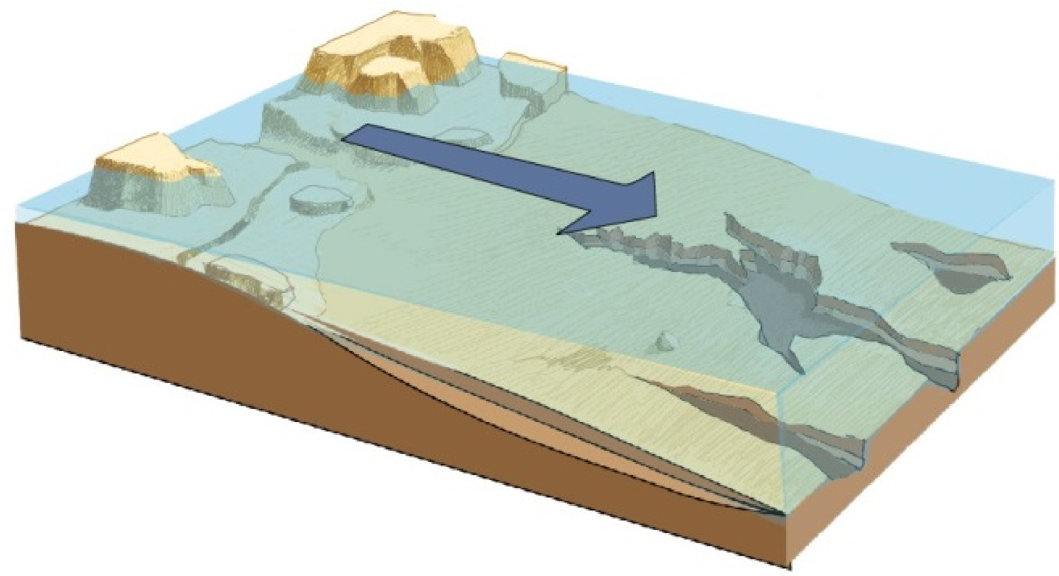
[19] Walker, T., 1994. A Biblical geological model. In, Walsh, R.E. (editor), *Proceedings of the Third International Conference on Creationism*, technical symposium sessions, Creation Science Fellowship, Pittsburgh, PA, pp. 581-592.

[20] Barnette, D.W. and J.R. Baumgardner, 1994. Patterns of ocean circulation over the continents during Noah's Flood. In, Walsh, R.E. (editor), *Proceedings of The Third International Conference on Creationism*, Technical Symposium Sessions, Creation Science Fellowship, Pittsburgh, PA, pp. 77-86.









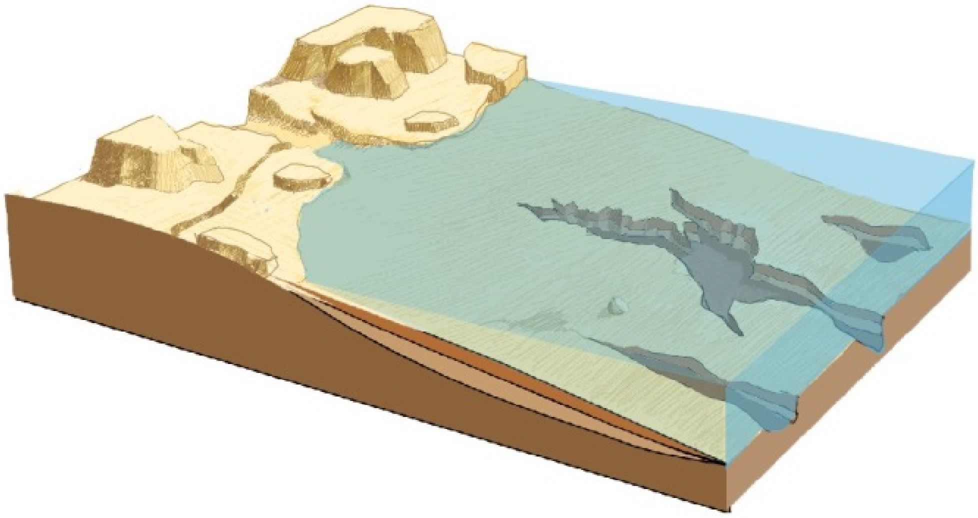


Figure 28.3. Postulate origin of submarine canyons during the Channelized Phase of the Flood after the continental margin sediments were first deposited as a sheet along the edge of the continents (drawn by Peter Klevberg and modified by Bryan Miller).
a) Deposition on the continental shelf and slope during the Sheet Flow Phase of the Flood.
b) Sheet flow transforms into channelized flow carrying debris to the shelf edge that starts to descend the continental slope forming a small canyon.
c) More and more land becomes exposed with valley deepening on land, as channelized currents continue to focus sediments at the edge of the shelf at the same location causing the submarine canyon to grow deeper and deeper.
d) The submarine canyon erosion continues while small canyons form on the continental slope by mass flow.
e) The Flood has ended. Note that submarine canyon reflects the topography on the land. Other submarine canyons would form by slumping and sliding on the oversteepened continental slope either at the end of the Flood or in post-Flood time.

I think the key component in this hypothesis is that channelized currents would be carrying huge amounts of sediment and deposit their load where the currents slowed. This would happen mainly on the outer continental shelf and the upper continental slope. The rapid accumulation of masses of sediment would be unstable and tend to cause mass flows down the continental slope. Rapid canyon cutting ensues, with further delivery of sediments to the *same* location which would funnel them down the canyon, continuing the deepening process.

In the formation of submarine canyons, it is not the river that is significant, but instead, the valley or canyon that reaches the coastline (Figure 28.3c,d). On land, rivers commonly take advantage of a depression left by channelized erosion. Evolutionary geomorphologist, Lester King, stated that submarine canyons commonly are reflections of the topography of the adjacent land: “In this way coastal hinterlands and shelf areas show remarkable geomorphic homologies [similarities] throughout a long history.”[21] So, it is the valley onshore that is significant and not the river.

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

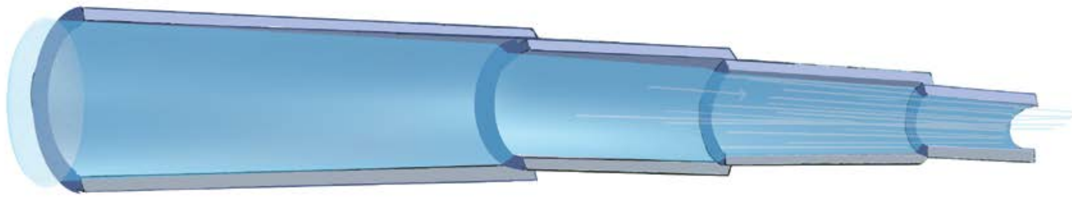


Figure 28.4. The same volume of water moving from a wide pipe into a narrow pipe has to accelerate.