Chapter 71

Submarine Canyons' Relationship to River Valleys

Many submarine canyons appear to be extensions of rivers (Figure 71.1) so scientists once assumed they were drowned river valleys,[1] also implying low sea level at some recent time in the past. The idea that rivers cut the canyons had to be abandoned when better mapping showed submarine canyons not only indent the shallow continental shelf adjacent to rivers, but continue across the slope, and down into the deep sea (see Chapter 70). It is unlikely a normal river would carve a deep chasm that reaches as far as the abyssal depths, so scientists have abandoned belief that rivers cut the submarine canyons when the sea level was low.[2] However, a few scientists still hold submarine canyons were cut when the sea level was lower and the continental shelf was exposed during glacial intervals in the Pleistocene.[3,4]

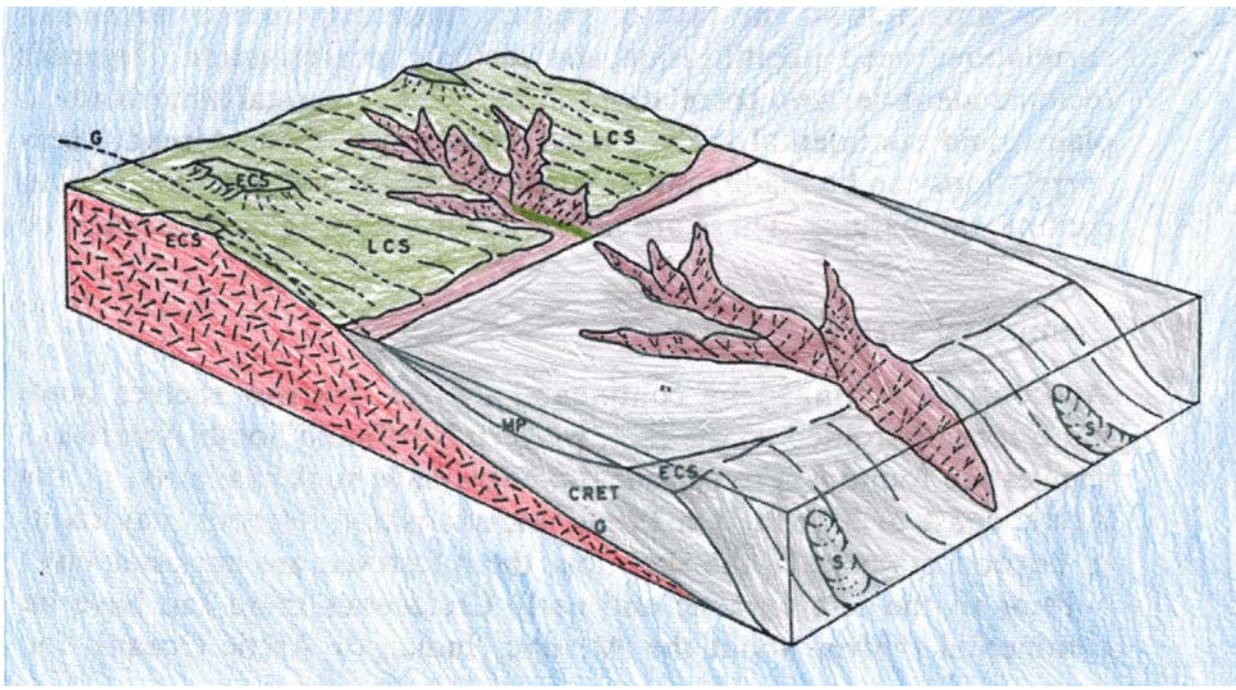

Figure 71.1. Submarine canyons are commonly seaward from rivers (from King, 1983, p. 1999).

[1] Shepard, F.P. and R.F. Dill, 1966. *Submarine Canyons and Other Sea Valleys,* Rand McNally & Company, Chicago, IL, p. 2.

[2] Walker, H.J. and J.M. Coleman, 1987. Atlantic and Gulf coastal province, In, Graf, W.L. (editor), *Geomorphic Systems of North America*, Geological Society of America Centennial Special Volume 2, Boulder, CO, pp. 51-110.

[3] 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.

[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* 206:249-265.

What is the Similarity to Rivers?

Nonetheless, most submarine canyons are found seaward of rivers, and many features of the canyons are similar to rivers. Submarine canyons have tributaries, meanders, meander loops, and horseshoe-shaped meander cutoffs.[5,6,7] So, there must be some relationship. Shepard and Dill compared submarine canyons to river valleys:

> The submarine canyons are remarkably similar in general character to land canyons cut into slopes of comparable steepness. They have courses that are approximately as winding as land canyons cut in similar slopes. Most of them have comparable V-shaped transverse profiles and a similar dendritic type of entering tributaries. Furthermore, the submarine canyons occur preponderantly outside the mouths of land valleys.[8]

Moreover, the channels on the submarine fan are also similar to rivers.[9,10] Could the features of both the river valleys and the submarine canyons and channels have been cut by underwater erosion that took place during the Channelized Flow Phase of the Flood (see Chapter 74)?

Contrary Observations

Submarine canyons are not always extensions of rivers.[11,12,13] Twidale and Campbell state:

> Many canyons cutting into the continental slope and shelf south of the [Australian] continent, however, are not obviously related to any existing river, although they may have been linked with rivers that no longer exist.[14]

Some submarine canyons do not even extend from land, like those at the eastern end of Bass Strait between southeast Australia and Tasmania.[14] Some extend from arid regions, as in southern Baja California and northern Chile and[15,16,17] the Cap Timiris Canyon is in the Atlantic Ocean offshore the Sahara Desert![6]

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[5] Mitchell, N.C., 2004. Form of submarine erosion from confluences in Atlantic USA continental slope canyons. *American Journal of Science* 304:590-611.

[6] 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

[7] Perkins, S., 2005. Hidden canyons: vast seabed chasms carved by riverlike processes. *Science News* 167:9-11.

[8] Shepard and Dill, Ref. 1, p. 231.

[9] Clark, J.D., Kenyon, N.H., and Pickering, K.T., 1992. Quantitative analysis of the geometry of submarine channels: implications for the classification of submarine fans. *Geology* 20:633–636.

[10] Konsoer, K., Zinger, J., and Parker, G., 2013. Bankfull hydraulic geometry of submarine channels created by turbidity currents: relations between bankfull channel characteristics and formative flow discharge. *Journal of Geophysical Research* 118:1–13.

[11] Nagel, D.K., H.T. Mullins, and H.G. Greene, 1986. Ascension Submarine Canyon, California—evolution of a multi-head canyon system along a strike-slip continental margin. *Marine Geology* 73:285-310.

[12] Waters, T., 1995. The other Grand Canyon. *Earth* 4 (6):45-51.

[13] Scanlon, K.M. and D.G. Masson, 1996. Sedimentary processes in a tectonically active region: Puerto Rico north insular slope. In, Gardner, J.V., M.E. Field, and D.C. Twichell, *Geology of the United States' Seafloor: The View from GLORIA*, Cambridge University Press, New York, NY, pp. 123-134.

[14] Twidale, C.R. and E.M. Campbell, 2005. *Australian Landforms: Understanding a Low, Flat, Arid and Old Landscape*, Rosenberg Publishing Pty and Ltd, New South Wales, Australia, p. 269.

[15] Shepard and Dill, Ref. 1, pp. 101-130.

[16] Hagen, R.A., D.D. Begersen, R. Moberly, and W.T. Coulbourn, 1994. Morphology of a large meandering submarine canyon system on the Peru-Chile forearc. *Marine Geology* 119:7-38.

[17] Hagen, R.A., H. Vergara, and D.F. Naar, 1996. Morphology of San Antonio submarine canyon on the central Chile forearc. *Marine Geology* 129:197-205.

Interestingly, the submarine canyon size is not related to the size of the river.[18] Monterey Canyon, is an extension of Elkhorn Slough and transports little water. It is important to keep in mind, rivers decelerate when they flow into the ocean and so rapidly become non erosive.

The long profile of both rivers and submarine canyons is not continuous between land and submarine canyons either on the surface or in the subsurface. In the vast majority of cases there is no deep canyon at the river mouth or on the upper continental slope.

Submarine canyons have an average slope of 120 ft/mi (58 m/km). A new study discovered that submarine channels have a width and depth 10 times and a slope about 100 times that of modern rivers.[10] This is much steeper than the slope of rivers and land valleys.

There are even more observations of submarine canyons that are contrary to the river hypothesis. On the Izu-Bonin volcanic arc, southeast of Japan, canyons up to 3,900 to 5,575 feet (1,200 to 1,700 m) deep are incised on a gently sloping sea bottom on a ridge.[19,20] The submarine canyons trend east almost reaching the bottom of the Izu-Bonin Trench. They *start deep on an underwater ridge*. The Izu-Bonin island arc is dotted with volcanic islands, the submarine canyons are around 3,300 ft (1,000 m) deep. It is impossible for them to be extensions of rivers. Furthermore, these canyons traverse across forearc basins, that were subsequently filled with sediment and the canyon was cut *after* filling. This indicates the canyons developed very late in earth history, which fits precisely within the Flood model (see Chapter 74). It has been suggested by others that strong currents may have initiated the development of canyons on gentle slopes just east of the Izu-Bonin ridge.[21]

The continental slope off the eastern United States exhibits a number of canyons and tributaries. Only a few extend onto the continental shelf (see Figure 70.1).[22] Sonar surveys along the coast have shown that most of the canyons and gullies *initiate* at the mid and lower continental slope with no link to the shelf or discharging rivers.[5,23]

Submarine Canyons Now Older Than the Ice Age

As we noted earlier, submarine canyons were once thought to have formed during the Pleistocene, when the sea level stands were low. Uniformitarian scientists now believe many canyons, instead of being 1 or 2 million years old, the age of their ice age model, are early and mid Cenozoic, around 60 million years old. Some of them have been dated into the Cretaceous period, around 100 million years ago.[24] Although older dates provide more time for development, they also effectively disconnect the origin of these canyons from the Ice Age and low sea level.[5] Their conclusion that the submarine canyons were cut before the Ice Age strongly indicates to Flood geologists that they are related to Flood runoff and not to the post-Flood Ice Age.

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[18] Normark, W.R. and P.R. Carlson, 2003. Giant submarine canyons: is size any clue to their importance in the rock record? In, Chan, M.A. and A.W. Archer (editors), *Extreme Depositional Environments: Mega End Members in Geologic Time*, Geological Society of America Special Paper 370,Boulder, CO, pp. 175-190.

[19] Taylor, B. and N.C. Smoot, 1984. Morphology of Bonin fore-arc submarine canyons. *Geology* 12:724-727.

[20] Klaus, A. and B. Taylor, 1991. Submarine canyon development in the Izu-Bonin forearc: a SeaMARC II and seismic survey of Aoga Shima Canyon. *Marine Geophysical Researches* 13:131-152.

[21] Taylor and Smoot, Ref. 19, p. 727.

[22] Ryan, W.B.F., 1982. Imaging of submarine landslides with wide-swath sonar. In, Saxov, S. and J.K. Nieuwenhuis (editors), *Marine Slides and Other Mass Movements*, Plenum Press, New York, NY, pp. 175-188.

[23] Mitchell, N.C., 2005. Interpreting long-profiles of canyons in the USA Atlantic continental slope. *Marine Geology* 214:75-99.

[24] Shepard, F.P., 1981. Submarine canyons: multiple causes and long-time persistence. *AAPG Bulletin* 65:1,062-1,077.

There is evidence for actual Ice Age submarine channels, but these channels are shallow and extensive, giving good indication they were cut into the continental shelf when the sea level was lower. The small paleochannels that have been seismically imaged on the upper continental shelf to depths of about 230 feet (70 m) seaward of rivers north of Monterey Bay is a good example of Ice Age channels.[25] They do not connect to any submarine canyon of significant size. They most likely are the effects of a low sea level during a short Ice Age[26,27] and indicate only limited erosion of the exposed continental shelf.

Summary

In summary, the relationship between submarine canyons and rivers is significant, but cannot support the idea of canyons being formed directly by river erosion. Furthermore, there is no direct connection between rivers and nearby submarine canyons either on the surface of the continental shelf or the subsurface. The rivers end abruptly at the shoreline and the canyons start well offshore. The river carving idea has too many contradictory observations.

We are left with the question of how then are submarine canyons and river valleys related to each other. The key lies in realizing the necessity of connecting the submarine canyons, not with rivers, but with valleys, as we will see. Both the river valleys and submarine canyons were cut at the same time by underwater channelized erosion. This will be amplified in Chapter 74. But first, it is helpful to examine the well-studied submarine canyon, the Monterey Submarine Canyon off central California.

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[25] Anima, R.J., S.L. Eittreim, B.D. Edwards, and A.J. Stevenson, 2002. Nearshore morphology and late Quaternary geologic framework of the northern Monterey Bay Marine Sanctuary, California. *Marine Geology* 181:35-54.
[26] Oard, M.J., 1990. *An Ice Age Caused by the Genesis Flood*, Institute for Creation Research, Dallas, TX.
[27] Oard, M.J., 2004. *Frozen In Time: The Woolly Mammoth, the Ice Age, and the Bible*, Master Books, Green Forest, AR.