Appendix 2

The Mystery of Guyot Formation and Sinking

Origin of Guyots Unknown

In 1946, geologist Harry Hess was the first geologist to describe guyots (flat-topped seamount).[1] Since then, the number of guyots has become numerous. Resolution Guyot in the Mid-Pacific Mountains that was studied in the 1990s by the Deep Sea Drilling Project[2] is a typical guyot. Figure A2.1 shows the silhouette.

Figure A2.1. Silhouette of Resolution Guyot in the Mid-Pacific Mountains (drawn by Mrs. Melanie Richard).

Ever since Hess's time, the cause of the flat top has eluded explanation.[3] Winterer and Metzler maintain: "Since Hess first recognized them in 1946, the origin of flat-topped seamounts, or guyots, has remained one of the most persistent problems in marine geology."[4] Since guyots are believed to have been truncated near sea level, there are two suggested subsidence mechanisms used to explain why they are now found well below sea level. But some guyots must have become flat well below sea level.

Not All Guyots Eroded At Sea Level

Many scientists have simply assumed that the flat top of a guyot was eroded at or near sea level.[5,6] 'This has been challenged by a few marine geologists.'[7,8] For instance, a number of guyots near the East Pacific Rise have been attributed to the infilling of calderas by small lava flows well below sea level.[9,10,11,12] "But, these guyots are small

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[1] Hess, H.H., 1946. Drowned ancient islands of the Pacific Basin. *American Journal of Science* 244:772–791.

[2] Sager, W. et al., 1993. Examining guyots in the Mid-Pacific Mountains. *EOS* 74 (17):201, 205–207.

[3] Menard, H.W., 1984. Origin of guyots: *the Beagle to Seabeam. Journal of Geophysical Research 89* (B13):11,117–11,123.

[4] Winterer, E.L. and C.V. Metzler, 1984. Origin and subsidence of guyots in Mid-Pacific Mountains. *Journal of Geophysical Research 89* (B12):9,969.

[5] Wilson, P.A., H.C. Jenkyns, H. Elderfield, and R.L. Larson, 1998. The paradox of drowned carbonate platforms and the origin of Cretaceous Pacific guyots. *Nature* 392:889–894.

[6] Hamilton, E.L., 1956. Sunken Islands of the Mid-Pacific Mountains. *The GSA Memoir 64*, Geological Society of America, Boulder, CO.

[7] Lonsdale, P. and F.N. Spiess, 1979. A pair of young cratered volcanoes on the East Pacific Rise. *Journal of Geology* 87:157–173.

[8] Simkin, T., 1972. Origin of some flat-topped volcanoes and guyots. *GSA Memoir 132*, Geological Society of America, Boulder, CO, pp. 183–193.

[9] Fornari, D.J., W.B.F. Ryan, and P.J. Fox, 1984. The evolution of craters and calderas on young seamounts: insights from Sea Mark I and sea beam sonar surveys of a small seamount group near the axis of the East pacific Rise at ~ 100N. *Journal of Geophysical Research 89* (B13):11,069–11,083.

[10] Clague, D.A., J.G. Moore, and J.R. Reynolds, 2000. Formation of submarine flat-topped volcanic cones in Hawaii. *Bulletin of Volcanology* 62:214–233.

[11] Clague, D.A., J.R. Reynolds, and A.S. Davis, 2000. Near-ridge seamount chains in the northeastern Pacific Ocean. *Journal of Geophysical Research* 105 (B7):16,541–16,561.

[12] Mitchell, N.C., 2001. Transition from circular to stellate forms of submarine volcanoes. *Journal of Geophysical Research* 106 (B2):1,987–2,003.

compared to the tall classical guyots in the western Pacific,"[13,14,15,16] and cannot be used to nullify the argument that most guyots, especially the tall ones, were eroded near sea level.

A guyot can also be formed by the deposition of sediment on an uneven volcanic platform. It has been discovered that many guyots whose top is a large surface area, are flat because they are *capped by thick carbonate rocks*. These deposits are similar to the thick carbonates found on atolls, such as on Eniwetok (also called Enewetak or Anewetak) Atoll in the Marshall Islands. It was considered a typical reefal deposit thousands of feet thick (see Appendix 3 for a discussion of how such carbonates could form in the Flood model). An atoll is a generally circular reef surrounding a central lagoon. Carbonate deposition on a seamount could give the appearance of a guyot by filing in hollows, which would be irrelevant to past sea level. However, the surface below the carbonate of many guyots is also generally flat, indicating the seamount was probably flattened at or near sea level before it sank and later collected the carbonate cap.[17] There are enough guyots *without* carbonate caps reinforcing the belief that tall guyots were truncated at sea level.[4,18,19,20]

In conclusion, some guyots were not sheered at sea level, but they were later topped with a carbonate or lava cap, leaving them generally flat.

Tall Guyots Most Likely Flattened at or Near Sea level

The most reasonable mechanism for the origin of *tall* guyots is that they were flattened at or near sea level. Not only does their flat top indicate they were sheared near sea level, but so do shallow-water fossils found in the carbonate caps on top of some guyots.[2,21] Rounded basalt pebbles and cobbles were dredged up from some guyots suggesting strong

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[13] Searle, R.C., 1983. Submarine central volcanoes on the Nazca Plate—high-resolution sonar observations. *Marine Geology* 53:77–102.

[14] Lonsdale, P., 1983. Laccoliths(?) and small volcanoes on the flank of the East Pacific Rise. *Geology* 11: 706–709.

[15] Batiza, R. and D. Vanko, 1983/1984. Volcanic development of small oceanic central volcanoes on the flanks of the East Pacific Rise inferred from narrow-beam echo-sounder surveys. *Marine Geology* 54:53–90.

[16] Wessel, P., 2001. Global distribution of seamounts inferred from gridded Geosat/ERS-1 altimetry. *Journal of Geophysical Research* 106 (B9):19,431–19,441.

[17] Premoli Silva, I., J. Haggerty, F. Rack et al. (editors), 1993. *Proceedings of the Ocean Drilling Program, Initial Reports 144*, Ocean Drilling
Program, Texas A&M University, College Station, TX.

[18] Carsola, A.J. and R.S. Dietz, 1952. Submarine geology of two flat-topped northeast Pacific seamounts. *American Journal of Science* 250:481–497.

[19] McNutt, M.K., E.L. Winterer, W.W. Sager, J.H. Natland, and G. Ito, 1990. The Darwin rise: a Cretaceous superswell. *Geophysical Research Letters* 17 (8):1,101–1,104.

[20] Hoernle, K., F. Hauff, R. Werner, and N. Mortimer, 2004. New insights into the origin and evolution of the Hikurangi Oceanic Plateau. *EOS* 85 (41):401, 408.

[21] Shipboard Scientific Party, 1993. Introduction and scientific objectives. In, Sager, W.S., E.L. Winterer, J.V. Firth, et al., *Proceedings of the Ocean Drilling Program, Initial Reports 143*, Ocean Drilling Program, Texas A&M University, College Station, TX, pp. 7–12.

currents and/or a beach environment.[22,23,24,25] Edwin Hamilton noted rounded rocks long ago on the Mid-Pacific Mountains and presumed they were rounded in a beach environment.[6] A few scientists have claimed they could have formed by the extrusion of lava into seawater.[26] Extrusion into seawater usually produces generally rounded pillow lavas. These should have been easily distinguished from rocks that are rounded by a beach environment.

Another possible indicator of near sea level shearing of guyots was the discovery of karst-like features on the tops of some.[19,27,28] Karst is: "A type of topography formed on limestone, gypsum, and other soluble rocks, primarily by dissolution. It is characterized by sinkholes, caves, and underground drainage."[29] Karst is assumed to have formed when the guyot rose above sea level;[30] however, there are other processes that can produce karst-like features underwater, such as acidic spring water. The deduction that these features are karst formed by subaerial (above water) limestone dissolution is disputed.[5,31]

A final indicator of sea level shearing is *coal and wood* has been found within the tops of some guyots. [21,25,27] This observation suggests a subaerial environment to uniformitarian scientists. Therefore, the below sea level height of tall guyots is still considered an ancient sea-level indicator within the uniformitarian model.[32,33,34] Table A2.1 lists the uniformitarian indicators for the near sea level origin of guyots.

1.	The flat top indicates truncation at or near sea level
2.	Shallow-water fossils
3.	Rounded rocks on top
4.	Karst-like features
5.	Coal and wood

Table A2.1. Evidence that some guyots formed near sea level.

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[22] Carsola, A.J. and R.S. Dietz, 1952. Submarine geology of two flat-topped northeast Pacific seamounts. *American Journal of Science* 250:481–497.

[23] Simkin, Ref. 8, p. 191.

[24] Menard, H.W., 1984. Origin of guyots: the Beagle to Seabeam. *Journal of Geophysical Research* 89(B13):11,117–11,123.

Shipboard Scientific Party, 1993. Introduction. In, Premoli Silva, I., J. Haggerty, F. Rack et al., *Proceedings of the Ocean Drilling Program, Initial Reports 144*, Ocean Drilling Program, Texas A&M University, College Station, TX, pp. 3–4.

[26] Budinger, T.F., 1967. Cobb Seamount. *Deep-Sea Research* 14:191–201.

[27] Shipboard Scientific Party, 1993. Synthesis of results, Leg 143. In, Sager, W.S., E.L. Winterer, J.V. Firth, *et al.*, *Proceedings of the Ocean Drilling Program, Initial Reports 143*, Ocean Drilling Program, Texas A&M University, College Station, TX, pp. 13–29.

[28] Sager et al., Ref. 2, p. 205.

[29] Neuendorf, K.K.E., J.P. Mehl, Jr., and J.A. Jackson, 2005. *Glossary of Geology*, Fifth edition, American Geological Institute, Alexandria, VA, p. 348.

[30] Winterer, E.L., 1998. Cretaceous karst guyots: new evidence for inheritance of atoll morphology from subaerial erosional terrain. *Geology* 26:59–62.

[31] Jenkyns, H.C. and P.A. Wilson, 1999. Stratigraphy, paleoceanography, and evolution of Cretaceous Pacific guyots: relics from a greenhouse earth. *American Journal of Science* 299:341–392.

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

[33] Smoot, N.C. and R.E. King, 1997. The Darwin Rise demise: the Western Pacific guyot heights trace the trans-Pacific Mendocino fracture zone. *Geomorphology* 18:223–235.

[34] Caplan-Auerbach, J., F. Duennebier, and G. Ito, 2000. Origin of intraplate volcanoes from guyot heights and oceanic paleodepth. *Journal of Geophysical Research* 105 (B2):2,679–2,697.

Why Have Guyots Subsided?

If guyots formed at or near sea level, both uniformitarian and creation scientists need to explain why they are now at an average depth of 5,000 feet (1,525 m) below sea level. For those capped with thick carbonate over a generally flat surface, the subsidence was even greater, since sea level shearing would apply to the surface *below* the carbonate.

Two uniformitarian hypotheses have been presented to explain the sinking of guyots. Both have difficulties. The first is the "death-by-emergence-and-submergence" hypothesis that postulates that guyots are drowned reefs. Regional tectonic and eustatic (sea level) changes cause a temporary emergence of the reef above sea level followed by a rapid relative rise in sea level to drown the reef. The idea of emergence is based on the likely development of karst caves and sinkholes on many guyots.[19] Once sea level rose again, the karst topography retarded further reef building, allowing the original reef to drown.

The second hypothesis is the "death-in-the-tropics" hypothesis. This hypothesis assumes that reefs first formed in the Southern Hemisphere and were submerged as they moved northwest across the equator on the Pacific Plate. The reefs drowned and died forming guyots. This hypothesis assumes that during plate tectonics, reefs or carbonate banks move through a "low-oxygen zone" in the tropics killing the reef builders. The problem with this is the equatorial belt is currently a zone of *high* reef growth. In spite of the aforementioned problems, this hypothesis is favored among uniformitarian scientists.[31,35]

Uniformitarian scientists estimate the planation of a volcanic island down to sea level may take several millions years;[36] however, recent observations indicate planing the top of an exposed seamount can be accomplished in a much shorter time. Falcon Island is an example in case. Falcon Island is in the Tonga Islands. It was generated from a subsurface volcanic eruption and built to nearly 300 feet (90 m) above the sea by the year, 1877. Within thirteen years it was reduced to a shoal near sea level.[37] In another fourteen years, it became a bank 30 to 60 feet (9 to 18 m) below sea level.[38] So, even today's processes can reduce volcanoes to sea level in a short time.

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[35] Schlager, W., 1999. Scaling of sedimentation rates and drowning of reefs and carbonate platforms. *Geology* 27:183–186.

[36] Turner, D.L., R.D. Jarrard, and R.B. Forbes, 1980. Geochronology and origin of the Pratt-Welker seamount chain, Gulf of Alaska: a new pole of rotation for the Pacific plate. *Journal of Geophysical Research* 85 (B11):6,547–6,556.

[37] Hoffmeister, J.E., H.S. Ladd, and H.L. Alling, 1929. Falcon Island. *American Journal of Science* 218: 461–471.

[38] Hamilton, Ref. 6, p. 41.

During the hypothetical slow subsidence of a volcano, a reef growth on top should be 10 to 100 times faster than any postulated sea level rise.[5,35,39,40] According to the uniformitarian view reef growth should keep up with any amount of sea level rise. Drowning and becoming a guyot should never happen. All the same, the drowning of guyots continues to be accepted and remains a uniformitarian puzzle: "Nevertheless, the mechanism responsible for drowning remains poorly constrained"[41]

Problem of the Carbonate Cap Not Being a Drowned Reef

The carbonate cap on guyots as well as atolls has been simply assumed to be a thick reef on a seamount. The reef grew while sea level rose or the seamount sank. But, recent drilling has shown that most, if not all, guyots do not seem to be drowned reefs or atolls.

Furthermore, it has been discovered in the Marshall Islands that carbonate-capped guyots are adjacent to carbonate-capped atolls! Why should the elevations of these features be so different, if former atolls "uniformly" sank thousands of feet to form guyots? There seems to be more to the story than meets the eye and will be explored further in Appendix 3.

Guyot Formation Late in the Flood

If uniformitarian scientists have difficulty explaining guyots, can Flood scientists do any better? There is little doubt more research is required to understand guyots, but what is known about them seems consistent with rapid formation during the Flood.

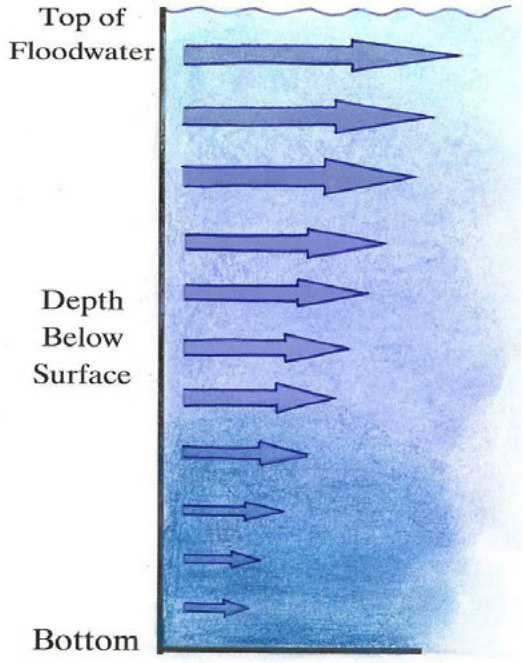

Figure A2.2. Schematic showing decrease in current speed with depth (drawn by Mrs Melanie Richard).

Although observations of Falcon Island indicate it took a dramatically shorter time to plane off the top of a volcano than uniformitarian expectations, this timeframe is still much too long to account for guyots forming during the Flood. The only way to plane them fast enough would be by powerful currents. In the shallower ocean of the Flood, the Coriolis effect would cause strong currents to form.[42] The profile of a current in a river generally looks like that in Figure A2.2 with the fast flow near the surface, decreasing downward.

[39] Winterer, E.L. and C.V. Metzler, 1984. Origin and subsidence of guyots in Mid-Pacific Mountains. *Journal of Geophysical Research* 89 (B12):9,969–9,979.

[40] Schlager, W., 1981. The paradox of drowned reefs and carbonate platforms. *GSA Bulletin* 92:197–211.

[41] Wilson *et al*., Ref. 5, p. 890.

[42] 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.

The decrease is mainly caused by friction with the bottom. It is difficult to know the vertical profile of Flood currents, but most of the time it may resemble the typical stream profile. (During tectonics, the strongest velocity
could be near the bottom of the water, so the Flood the profile would not always be like figure A2.2). If I assume a river profile during guyot formation, fast Flood currents near the top of the water could have quickly truncated the tops of the large seamounts just below the sea surface, much like the formation of planation surfaces, as described in Volume II of this book.

In a Flood model, several of the shallow water indicators used by the uniformitarian scientists would be equivocal. Flood currents, of course, would account for the rounded rocks on top of some guyots. Fast currents would have rounded the rocks as they rushed over the seamounts that were a little below sea level. However, the shallow-water organisms and wood (and later coal upon compression) could have been transported from a distance and could not be used to indicate shallow water. The karst-like features could have formed in deep water by hydrothermal activity during the Flood.[43] Regardless, guyots would still represent a sea level indicator in a Flood model also.

[43] Silvestru, E., 2003. A hydrothermal model of rapid post-Flood karsting. In, Ivey, Jr., R.L. (editor), *Proceedings of the Fifth International Conference on Creationism*, technical symposium sessions, Creation Science Fellowship, Pittsburgh, PA, pp. 233–241.