Appendix 3

How did the Thick Carbonate Cap on Atolls Form?

Surprising Thick Carbonate Cap on Eniwetok Island—A Difficulty

Scientists drilled into the margin of Eniwetok (also called Enewetak or Anewetak) Atoll in the Marshall Islands and discovered a 4,133 to 4,608 feet (1,260 to 1,405 m) thick carbonate cap! [1] Other coral atolls later drilled showed lesser but still significant thicknesses of carbonate rock. Scientists interpreted the thick carbonate on these islands to be a reef deposit. Thick reefal carbonate presumably would take a very long time to accumulate (but see Whitmore's hypothesis below). Needless to say, these thick carbonate deposits have long been considered a powerful argument against the short timescale of Scripture. Anti-creationist Arthur Strahler stated the problem this way:

> Using a rate of 1 cm/yr as the rate of upward growth, assumed continuous and constant, 1,300 m [4,265 feet] of reef rock would require 130,000 years to accumulate … If, as the creation scientists assert, modern reefs were produced in the post-Flood time of 4,300 years, the available time is far too short to account for the Eniwetok carbonate deposit. [2]

Similarly, evangelical Christian Daniel Wonderly considered the thick carbonate on Eniwetok atoll (as well as on Bikini atoll) as a strong indication of hundreds of thousands of years of deposition:

> Just before the destruction of Eniwetok and Bikini atolls in the Pacific atomic tests, the U. S. Geological Survey opened up an important window into the past for evangelical Christians. This "window" was to give us an insight into the long and extensive process of the making of certain biological produced rock formations. Here was to be found a natural record of at least many hundreds of thousands of years of the growth and building activity of coral animals and other lime-secreting organisms (emphasis his).[3]

It does indeed seem to be proof against the short time scale of Scripture, as deduced from the genealogies of Genesis 5, 10, and 11[4] as well as three of Jesus's statements[5] that relate to the age of the Earth.

Thick Carbonate Cap Also Discovered on Guyots

One must always be careful about assuming a contradiction in the Bible. History is littered with examples of believers and non-believers alike who think they have found an

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[1] Saller, A.H. and R.R. Koepnick, 1990. Eocene to early Miocene growth of Enewetak Atoll: insight from strontium-isotope data. *GSA Bulletin* 102:381–390.

[2] Strahler, A.N., 1987. *Science and Earth History: The Evolution/Creation Controversy*, Prometheus Books, Buffalo, NY, p. 224.

[3] Wonderly, D., 1977. *God's Time-Records in Ancient Sediments*, Crystal Press Publishers, Flint, MI, p. 23.

[4] Freeman, T.R., 2008. Do the Genesis 5 and 11 genealogies contain gaps? In, Mortenson,T. and T.H. Ury (editors), *Coming to Grips with Genesis: Biblical Authority and the Age of the Earth*, Master books, Green Forest, AR, pp. 283–313.

[5] Mortenson,T., 2008. Jesus' view of the age of the Earth. In, Mortenson,T. and T.H. Ury (editors), *Coming to Grips with Genesis: Biblical Authority and the Age of the Earth*, Master books, Green Forest, AR, pp. 315–346.

absolute contradiction to a clear verse or section in Scripture. Time and time again, new information brings into question the "contradiction." Unfortunately, current advocates of scriptural contradictions do not seem to have learned from history. They also seem to be unaware of new information on carbonate caps on guyots that questions their original belief, or else they ignore it and persist.

Legs 143 and 144 of the Deep Sea Drilling Project drilled into the tops of a number of guyots in a large area west of the Hawaiian Islands centered at about 18°N and 180°E, and in the Marshall Islands centered at about 10°N and 165°E. The former area includes the submarine Mid-Pacific Mountains. Resolution Guyot with suggested perimeter reefal mounds, supposedly mimicking an atoll, was drilled in the Mid-Pacific Mountains. Figure A3.1 shows a profile of this guyot.

The scientists discovered that numerous guyots in the Mid-Pacific Mountains were capped by thick carbonate, *just like on Eniwetok Atoll.*[6,7] The carbonate caps range between 3,000 to 5,250 feet (900 to 1,600 m) thick and lie over basalt lava. The thick carbonate was a surprise.[8] This indicated the flat tops of these guyots resulted from *deposition and not erosion*.[9,10,11,12] However, seismic profiles indicate that the lava below the carbonate rock is also generally horizontal,[13] which means that even the basalt top of the seamount represents a guyot. It also means that many guyots likely sunk around 9,000 feet (2,745 m) instead of an average of 5,000 feet (1,525 m), assuming the basalt top was planed near sea level!

Furthermore, these guyots are *similar* to the atolls that have thick carbonate caps. Why should such a thick carbonate cap cover both atolls at sea level and guyots far below sea level in the same area?

A closer examination of the drill cores on both atolls and guyots indicates the carbonates are *not* from a reef (see below). The situation is much more complex and tells a different story than a simple reefal accumulation taking place over hundreds of thousands of years as claimed of Strahler and Wonderly. Unfortunately, there does not appear to be enough information to piece together a good theory yet. Nevertheless, two creationist hypotheses have been proposed to account for the thick carbonates on some atolls and

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[6] 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.

[7] 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.

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

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

[10] Smith, D.K., 1988. Shape and analysis of Pacific seamounts. *Earth and Planetary Science Letters* 90:457–466.

[11] 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.

[12] Flood, P.G., 2001. The 'Darwin Point' of Pacific Ocean atolls and guyots: a reappraisal. *Palaeogeography, Palaeoclimatology, Palaeoecology* 175:147–152.

[13] 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.

guyots: (1) a broken up carbonate bank late in the Flood[14] and (2) rapid post-Flood carbonate deposition.[15] I will briefly mention the two hypotheses, which can be considered a Flood and a post-Flood model, respectively.

Flood Model Explanation

Some uniformitarian scientists have suggested the guyots that have a thick carbonate cap, especially those with a large area at the top, might be the remains of large *carbonate banks*. These carbonate banks have since been broken up, eroded, and sunk to different levels below sea level. This provides a possible Flood solution to the thick carbonates on atolls and guyots.

The Carbonate Cap is Not Reefal Material

It was once thought that the 4,133 to 4,608 feet (1,260 to 1,405 m) of carbonates on Eniwetok Island and other islands were reefal material from a slowly sinking atoll during hundreds of thousands to millions of years. However, the interpretation of Eniwetok Atoll containing thousands of feet of reefal material is likely a misinterpretation based on simplified assumptions.[8,14] Reefal organisms that were found in the carbonate are generally *rare* and in isolation.[6,16] They are also not secularly attached to their substrates,[17] as would be expected in a true reef. Furthermore, dolomite is the dominant rock type in the lower portion of some carbonate caps,[18] whereas reefs are composed of organic carbonate.

The perimeter mounds on Resolution Guyot and other guyots—once thought to be atoll reefs—have been shown not to be from a reef after they were drilled:

> Perimeter mounds around the summits of many guyots were once thought to be analogous to hard, wave-resistant, organic reefs that surround deep lagoons on modern Pacific atolls … By analogy to modern atolls, such as Anewetak [Eniwetok] and Pikinni [Bikini], the internal reflectors were thought to represent surfaces indurated by exposure during sealevel falls.[19]

The scientists were surprised to learn these thick carbonates were not reefs at all, and when they added up all the information, they concluded the carbonate caps were *carbonate banks with fossils*.[11,20] That is a far cry from a real reef. Carbonate banks resemble many other thick accumulations of carbonates in the rocks of the continents, which creationists dispute as real reefs.

A few early geologists came to the same conclusion but were apparently ignored. For instance, Harry Hess did not think that the Marshall Island guyots were drowned atolls.[20] Another early observer, Edwin Hamilton thought guyots were not sunken atolls because

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[14] Oard, M.J., 1999. The paradox of Pacific guyots and a possible solution for the thick 'reefal' limestone on Eniwetok Island. *Journal of Creation* 13(1):1–2.

[15] Whitmore, J.H., 2009. Modern and ancient Reefs. In, Oard, M.J. and Reed, J.K. (editors), *Rock Solid Answers: The biblical Truth Behind 14 Geological Questions*, Master Books, Green Forest, AR, pp. 149–166.

[16] 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.

[17] Rougerie, F. and J.A. Fagerstrom, 1994. Cretaceous history of Pacific basin guyot reefs: a reappraisal based on geothermal endo-upwelling. *Palaeogeography, Palaeoclimatology, Palaeoecology* 112:239–260.

[18] *Sager et al.*, Ref. 8, p. 205.

[19] *Sager et al.*, Ref. 8, pp. 201, 205.

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

of the presence of basaltic erosional debris near their tops.[21] He suggested they sank because of differential vertical tectonics, since guyots and atolls are found at different ocean depths.[22] I believe Hamilton was not far from the truth.

Could the Carbonate-Capped Guyots and Atolls Represent a Broken up Plateau?

Investigators have concluded that some guyots, especially in the Western Pacific, are *drowned carbonate platforms that have broken up*.[23] The large surface area of some guyots reinforces this deduction and seems anomalous for the idea that these guyots are sheared volcanic seamounts. In the western Pacific Ocean, the tops of many guyots are larger than 200 mi^2 (500 km^2)! On Dutton Ridge, a series of guyots just east of the junction of the Mariana and Izu-Bonin Trenches, there are a number of guyots with tops larger than 200 mi^2 (500 km^2). The largest is Lamont Guyot with a surface area of 610 mi^2 (1,570 km^2).[24] Dutton Ridge is thought to be a broken up carbonate platform, not only because of the large size of their tops, but also because the guyots are found at variable depths, ranging from 4,260 to 7,800 feet (1,300 to 2,375 m) below sea level. It appears differential vertical tectonics broke up these platforms, allowing the sections to founder. Mai Tai Guyot and Sio Guyot in the eastern Mariana Basins of the western Pacific have summit areas of 585 mi^2 (1,500 km^2) and 1,100 mi^2 (2,820 km^2), respectively.[25] All of these are much too large to be the sheared top of seamounts. The Mid-Pacific Mountains are also thought to be a broken up and drowned carbonate platform.[6]

At this point, there is a problem with the definition of a guyot. If a guyot is a flat-topped seamount, broken up carbonate platforms on volcanic rocks would not necessarily conform to that definition. Therefore, a guyot could also represent the flat tops of broken-up carbonate platforms.

In the Marshall Islands, scientists found a close juxtaposition of atolls and guyots,[26,27] suggesting the drilled atolls are carbonate banks just like the guyots (Figure A3.1). In fact, it is common for atolls and guyots to be located close together. Keating exclaimed:

> …it is common to find guyots and atolls situated adjacent or within a few tens of kilometers from each other. It has been difficult to rationalize how environmental factors which control reef growth could vary over only a few kilometers such that on one seamount the reef community has drowned and a guyot has

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

[22] Hamilton, Ref. 23, p. 44.

[23] Wilson *et al.*, Ref. 16, p. 889.

[24] Smoot, N.C., 1989. The Marcus-Wake seamounts and guyots as paleofracture indicators and their relation to the Dutton Ridge. *Marine Geology* 88:117–131.

[25] Kellogg, J.N., B.S. Wedgeworth, and J. Freymueller, 1987. Isostatic compensation and conduit structures of western pacific seamounts: results of three-dimensional gravity modeling. In, Keating, B.H., P. Fryer, R. Batiza, and G.W. Boehlert (editors), *Seamounts, Islands, and Atolls*, Geophysical Monograph 43, American Geophysical Union, Washington D. C., pp. 85–96.

[26] Hess, Ref. 22, p. 779.

[27] Wilson *et al.*, Ref. 16, p. 890.

formed while the adjacent reef complex survives and continues as an atoll…[28]

If the carbonate on guyots is not from ancient reefs slowly sinking into the depths, then what is its origin? Much of it now appears to have been inorganic carbonate, probably precipitated from seawater.[16,17] Since Eniwetok atoll is so close to other guyots, this atoll could simply be part of a large, dismembered carbonate bank. Eniwetok Atoll would be considered either an uplifted part of the Marshall Islands, or else possibly remained near sea level while surrounding parts sank, becoming guyots. Since Eniwetok is barely above sea level, a modern reef has developed on top of the carbonate bank. Regardless, the creationist problem of accounting for up 4,608 feet (1,405 m) of supposed reef growth is not as challenging as it first appeared.

A Flood Hypothesis

Considering what we know about carbonate banks I suggest they, along with some fossils, were most likely deposited during the Flood. Oceanic carbonate deposits are similar to those found on the continents. The continental deposits have been sometimes interpreted as ancient reefs by uniformitarian scientists. Late in the Flood, the carbonate banks were broken up by differential vertical tectonics. Some ended up near sea level where fringing reefs have since grown on some of them. These are now atolls. Others ended up well below sea level as guyots.

(Eniwetok is an example of how differing paradigms can drive widely variant interpretations of the same data. Uniformitarians envision slow, steady, modern processes (reef building) beginning in the distant past; not because the evidence is compelling, but because their framework compels it. Sadly, some Christians accept the uniformitarian *interpretations* without checking all of the available data and if needed, faithfully waiting for new findings if the conclusion at first appears contradictory to Scripture. Even without new data on guyots, it is possible for Flood geologists to come to a reasonable explanation of their origins. As creationists we need to use great caution before accepting the uniformitarian claims about the ancient past. We also need to have a greater appreciation for the role of assumptions in science along with an acute awareness of our own fallibility. This is especially important considering how many unknowns there still are in science.

An Alternative Post-Flood Solution

Creation geologist, John Whitmore, thinks it is possible the thick carbonate caps on atolls and guyots, and some reefal organisms, accumulated rapidly after the Flood.[15] Ariel Roth points out reef growth can be rapid under certain conditions.[29] They have grown as fast as 3.9 to 17 inches/yr (9.9 to 43.2 cm/yr). At this rate, a 5,000-foot (1,400 m) reef could grow in as little as 3,240 years! This would be enough post-Flood time to grow even the thickest modern coral reef, as the one on Eniwetok Atoll.

The conditions that determine the rate of reef growth include: the amount of nutrients in the water (too much inhibits growth), the presence of symbiotic algae, and the opti-

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[28] Keating, B.H., 1987. Structural failure and drowning of Johnston atoll, Central Pacific Basin. In, Keating, B.H., P. Fryer, R. Batiza, and G.W. Boehlert (editors), *Seamounts, Islands, and Atolls*, Geophysical Monograph 43, American Geophysical Union, Washington, D. C., p. 58.

[29] Roth, A.A., 1998. *Origins—Linking Science and Scripture*, Review and Herald Publishing, Hagerstown, MD, pp. 235–241..

mum temperatures of 83 to 86°F (28 to 30°C). It is possible bacteria may also aid in carbonate deposition. Reef organisms are destroyed by storms, active bio-eroders (parrotfish, sea urchins), chemical dissolution, boring organisms (sponges, clams, various worms), exposure to ultraviolet light, increased carbon dioxide, exposure above sea level, and heavy sedimentation. Some of the destroying processes, like storms, can add detritus to the reef mass and actually cause the reef to build in area. The Ice Age ocean environment was different from the present day environment. Most likely, initially it was conducive to rapid reef growth and slowed gradually to today's rate.

Whitmore (2007) offers the following post-Flood hypothesis for the accumulation of the thick carbonate material on Eniwetok Island and the thick carbonate caps on guyots:

> The reef began as a volcanic platform. Carbonates began to form on the platform as the result of the activity of bacteria and other organisms. Most of the carbonate was deposited at depth below sea level. Carbonate producing organisms were brought to the platform as larval forms, transported by ocean currents. This explains the occasional occurrence of various corals and mollusks within the deeper parts of the drill core. Carbonate was able to form at depth because of the volcanic heat source warming the water. As the carbonate mound grew, spring activity from the volcanic platform supplied necessary acids to dissolve caverns in the limestone. The volcanic heat source allowed the process of geothermal endo-upwelling to begin and allowed the convection process to be efficient. The combination of nutrient supply and heat may have allowed the carbonate mound to grow much faster than observed coral reef growth rates today. As the carbonate mound approached sea level, phototrophic reef coral were permanently established and thrived as a result of the upwelling process.[30]

Further information on these carbonate caps and increased knowledge of Flood and post-Flood processes should help determine which hypothesis is more likely, or whether another hypothesis is needed.

[30] Whitmore, Ref. 15, pp. 161–162.