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REPLY

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INTRODUCTION

In the last year, three peer-reviewed papers have appeared addressing the issue of rock-record evidence of superstorms in the Bahamas during the last interglacial period (marine isotope substage 5 [MIS 5e]), with specific regard to an area in north Eleuthera Island, Bahamas: Hearty and Tormey (2017), Rovere *et al.* (2017), and Mylroie (2018). Each paper had a different interpretation of the geologic situation, and as might be expected, a debate has developed, with a discussion (Hearty and Tormey, 2018a) and reply (Rovere *et al.*, 2018) regarding the first two papers and now an additional discussion (Hearty and Tormey, 2018b) on the third paper, which has generated this reply. This reply follows the pattern of presentation found in Hearty and Tormey (2018b).

ANALYSIS

Hearty and Tormey (2018b) make an issue of the number and placement of their publications, the degree of ongoing Bahamian research relative to this author (which they find lacking), and the number of islands and sites visited (their Table 1). While some readers may consider this a bragging scenario, and argue that the rocks don't care about reputation, it is essentially a credentialing issue. In the subject at hand, superstorms, credentialing is worthy of consideration. A large number of readers of these three papers will be those who work in climate and climate-change science. They may be unfamiliar with Bahamian geology and are unlikely to ever have seen the field sites in question. These readers need to be able to evaluate the various opinions provided by the authors of the three papers, and that evaluation will be informed, in part, by the publication record of all involved. As a result, this author, before responding to the various items brought up in Hearty and Tormey (2018b), needs to establish his credentials.

North Eleuthera Stratigraphy

The basic Bahamian stratigraphy established by Carew and Mylroie (1985) and further modified by Carew and Mylroie (1995b, 1997) is a simplistic field-based stratigraphy for use in real time in the field. The author agrees with Hearty and Tormey that the Carew and Mylroie (1995b, 1997) stratigraphy does not adequately represent the complexities of the Owls Hole Formation and other units as understood today. The more sophisticated stratigraphies of Kindler and Hearty (1997) and especially Kindler *et al.* (2010) require the use of geochronology to allow proper stratigraphic placement of any outcrop. Because results from geochronology techniques do not appear until months or perhaps years after the fieldwork is completed, those stratigraphies are difficult to apply in real time in the field. The simplistic stratigraphy of Carew and Mylroie (1995b, 1997) has good utility in the field for reconnaissance purposes (see Mylroie and Carew, 2010, Figure 7, as an example). In regard to continued research into Bahamian stratigraphy, the present author has cowritten field guides to Cat Island (Mylroie *et al.*, 2006), Eleuthera (Kindler *et al.*, 2010; Panuska *et al.*, 2002), Long Island (Curran *et al.*, 2004), New Providence (Carew *et al.*, 1992, 1996; Mylroie *et al.*, 2012), Rum Cay (Mylroie *et al.*, 2008), San Salvador (Mylroie and Carew, 2010), and South Andros Island (Carew *et al.*, 1998). The bulk of the author's work has been in island cave and karst science, best summarized in Lace and Mylroie (2013, and references therein; in April 2018, Springer, the publisher, reported 26,970 chapter downloads since the book's release in May 2013). The main interest of the author in Bahamian stratigraphy has been to establish the geologic framework in which cave and karst processes work in these carbonate islands. In a 100% carbonate environment, geologists ignore karst processes at their peril.

Aminostratigraphy Reliability

Hearty and Tormey (2018b) consider criticisms of amino acid racemization (AAR) to be "subjective" and "unsupported by the facts" and write that scientists should be "unbiased," statements designed to impugn the reputation of those who disagree, most specifically Rovere *et al.* (2017) and this author. The first work in the Bahamas using the AAR technique for stratigraphic purposes was done by this author and colleagues

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(Carew *et al.*, 1984), who eventually found the technique to be unreliable (Mirecki, Carew, and Mylroie, 1993) and discontinued using it. Contrary to the Hearty and Tormey (2018b) comments concerning AAR reliability versus carbon-14 and uranium–thorium dating, this author and coauthors have found both radiometric techniques to be more reliable and more accurate than AAR (*e.g.*, Carew and Mylroie, 1995a). Paleomagnetic secular variation studies collaborated by this author have proved useful in differentiating the terra rossa paleosols covering the various Owls Hole Formation units (Panuska, Mylroie, and Carew, 1999). Electron spin resonance has been attempted by this author and colleagues (Deeley *et al.*, 2011) with mixed success. The point is that the disagreement concerning the use of AAR for stratigraphic purposes in the Bahamas is a matter of scientific, not personal, debate.

Runup Deposits, Chevron Ridges, and Fenestrae

It is agreed that runup and washover are two separate things; however, if runup has occurred up to 43 m, as Hearty and Tormey (2017) indicate, then washover has occurred at lower elevation dunes at that same time. In any event, Hearty and Tormey (2017) fail to explain the lack of marine signature (other than fenestrae) associated with what had to be both runups and washovers, specifically tempestites. The chevron ridges have been interpreted as eolian (Engel, Kindler, and Godefroid, 2015; Kindler and Strasser, 2000, 2002) and so were not considered by this author; that eolian interpretation should have been mentioned in Mylroie (2018). Fenestrae in Bahamian eolianites as washover and runup indicators are problematic. To produce fenestrae, the eolian calcarenite must be uncemented. To preserve them, that uncemented calcarenite must withstand subsequent disturbance. Because the fenestrae are reported in numerous layers within Bahamian eolianites from the same sea-level highstand, subsequent runups and washover to create new fenestrae must not disturb and destroy preexisting fenestrae lower in the unit. Although this preservation is conceivable for fenestrae where runup is at its distal height, as occurs in normal beach action, it does not seem likely to occur at lower elevations where washover and scour must have happened. If the fenestrae are runup features, as Hearty and Tormey (2018b) insist, then superstorms were a common occurrence of MIS 5e and earlier interglacials, because fenestrae are distributed throughout the MIS 5e and earlier dunes. The Cow and Bull and related boulders are a singular event according to Hearty and Tormey (2018b); they feel the other MIS 5e superstorms were of less magnitude. If the boulders were emplaced at the end of MIS 5e as the biggest superstorm event of that highstand, as Hearty and Tormey (2018b) argue, then the accumulated fenestrae of the entire MIS 5e sea-level highstand would have been vulnerable to removal and a marine shell and shell-fragment signature would have been emplaced, as seen in modern washovers; none are observed.

Close Inspection of Outcrops

Mylroie (2018) never used the term "myth" regarding comments on ripup clasts. The outcrop at Two Pines contains a calcarenite protosol that runs through the outcrop from lower elevations to higher elevations. That interpretation was agreed on by all eight authors of the 2010 Eleuthera field guide, in which Two Pines is one of the field trip stops (Kindler *et al.*, 2010). None of those authors felt that the observed phenomena were the result of runup, washover, or scour. The reader can be assured those investigators were "looking closely enough," despite the Hearty and Tormey (2018b) statement to the contrary.

Megaboulders

Calculating the forces necessary to lift and then translate boulders of the size seen at the Cow and Bull requires accurate assessment of boulder size and density at the time of emplacement. Hearty and Tormey (2017, 2018b), despite recognizing that the boulders have undergone denudation, offer no quantification of that critical aspect. Mylroie (2018) cited data for tropical denudation rates for eogenetic carbonates (*e.g.*, Mylroie and Mylroie, 2017) that suggest a value of 1 to 5 m per 100 ka. Whether the caves inside the boulders formed before or after boulder emplacement affects those calculations as well. Hearty and Tormey (2018b) suggest that the "irregular" boulder surface that contains the caves may have been in existence in the boulders before emplacement, which would change density calculations dramatically compared to whether the caves formed after emplacement. The calcite speleothems found in the caves conform in orientation to development after boulder emplacement; if the voids were preexisting, speleothems from that earlier phase might be expected, and none are seen. Therefore, the most likely interpretation is that the caves are postemplacement in origin.

Flowstone and terra rossa paleosols are easily confused. Breached flank margin caves with flowstone floors have been misinterpreted as bioerosion notches formed at the junction of two eolianites and a terra rossa paleosol (Carew and Mylroie, 1991; Mylroie and Carew, 1991). Once the Eleuthera boulders were emplaced, terra rossa paleosol development would continue on the exposed rocks around the boulder but stop under the boulder. This process would, through post-MIS 5e time, accentuate the difference in appearance of the original terra rossa paleosol, preserved under the boulder, with the more developed terra rossa paleosol seen adjacent to the boulder.

Hearty and Tormey (2018b) disagree with the model for speleogenesis of the caves under the boulders presented by Mylroie (2018). Referring back to the credential issues brought up by Hearty and Tormey (2018b) at the beginning of their discussion, those authors have no publication record or additional credential with regard to cave and karst processes. Their statements regarding speleogenesis in the boulders reflect that ignorance. The reference to Jones (2010) ignores that the MIS 5e notch on Cayman Brac may have been misidentified as a fossil bioerosion notch, as shown earlier (Carew and Mylroie, 1991). The Jones (2010) paper also ignores that not all speleothems are the same (Taboroši, Mylroie, and Kirakawa, 2006) and that those formed in open- air conditions are markedly different. The author has conducted cave and karst research on Cayman Brac (Mylroie, Mylroie, and Lace, 2015), mapped the notches mentioned by Jones (2010), and found they are breached flank margin caves. This scenario means that the speleothems formed in a sealed cave environment and are now in an open-air environment, where Jones

(2010) observed them. The interpretation of the notch by Jones (2010) as a fossil bioerosion notch is incorrect, which lead to the incorrect assessment of the included speleothems. The dense, hard calcite speleothems from the Eleuthera boulders formed in sealed cave environments. The caves are phreatic dissolutional voids. They are not suffusion features, tafoni, sea caves, fracture caves, or caves of any other origin except dissolution below a water table. For a review of all these cave types, the reader is referred to Chapters 1 and 4 in Lace and Mylroie (2013); Owen (2013) specifically provides a review of Bahamian tafoni.

Karst Towers

This author agrees with Hearty and Tormey (2018b) when they ask, "where are all the other karst towers?" That question was raised in Mylroie (2018), and the additional implication is, where are all the other boulders? There is clearly something unique about the Cow and Bull area of north Eleuthera that allowed the formation of these boulders. One cannot discount one interpretation (karst towers) as requiring too many special conditions when the emplacement of boulders by superstorms also requires special conditions (or similar boulders would be everywhere in the Bahamas). The karst tower model was not strongly supported by Mylroie (2018); however, it did provide the best mechanism for the formation of the caves found inside the towers or boulders. Hearty and Tormey (2018b) state that "the karst tower idea is directly contradicted by both of Mylroie's (2018) alternatives of roll down and margin failure." Mylroie (2018) applied to the boulder question Chamberlin's (1897) multiple working hypotheses approach, as seen in the American Geological Institute's *Glossary of Geology* "multiple working hypotheses" entry: "The name given by Chamberlin (1897) to a method of 'mental procedure' applicable to geologic studies, in which several rational and tenable explanations of a phenomenon are developed, coordinated, and evaluated simultaneously in an impartial manner" (Neuendorf, Mehl, and Jackson, 2005, p. 428). Hearty and Tormey (2017) present only their superstorm hypothesis and dismiss alternative explanations without evaluation. Only after the Mylroie (2018) criticism of their approach do Hearty and Tormey (2018b) come back with an evaluation of the alternatives, which has appropriately created a spirited debate, as Chamberlin (1897) recommended.

Rolling and Sliding of Megaboulders

Hearty and Tormey (2017, 2018b) do not know how much coastal retreat has occurred at the Cow and Bull area. Therefore, they cannot state what the dune configuration was at the north Eleuthera coast during MIS 5e. That coast has undergone subaerial denudation for more than 100 kiloyears post-MIS 5e and Holocene cliff retreat as a result of modern wave action. As Mylroie (2018, Figure 7) demonstrates, that wave erosion retreat can be significant even within the 3000-year time window since sea level has been at its current elevation. The forces necessary to move objects downslope are much smaller than those necessary to lift and translate an object as a free body. As long as the slope continues, the body—or in this case, the boulder—will be able to move, even if the distance translated is a kilometer or more. The boulder distance from the Atlantic coastline is not relevant. Hearty and Tormey (2018b) consider trying to calculate the forces involved to be "a stab in the dark." If so, one cannot make absolute statements about how far a boulder could have rolled or slid. If the roll or slide model is correct, their comments about the age of younger rocks in the area are also not relevant (Mylroie, 2018, Figure 6). Hearty and Tormey (2018b) also seek to relitigate Rovere *et al*. (2017) in this section, which is also not relevant to Mylroie (2018).

Catastrophic End of MIS 5e

Hearty and Tormey (2017, 2018b) invoke superstorms to explain chevron ridges that are actually eolian, fenestrae that are rainfall slurries, and megaboulders that are found only in one spot in all of the Bahamas (including the Turks and Caicos). In conclusion, they require two types of superstorms: a routine superstorm that occurs throughout MIS 5e to emplace the many fenestrae layers in the dunes and one exceptional superstorm at the end of MIS 5e that emplaces the boulders, without removing fenestrae evidence from some or all earlier superstorms. They offer no explanation for why similar boulders are not found elsewhere in the Bahamas. The best explanation remains, as Hearty (1997) proposed as one of three possibilities and Mylroie (2018) supported, a local bank margin failure generating a return wave that would have the force necessary to either lift and translate blocks or break and roll down blocks to the condition seen today. Postemplacement activities, such as postemplacement denudation, cave formation, coastal cliff retreat, continued boulder movement downslope, or just rotation of boulders on their pedestals, need to be considered.

CONCLUSION

The debate over the features in the Bahamas that may suggest MIS 5e superstorm activity has been important. The Cow and Bull and related boulders have been attention-grabbers, with Hearty and Tormey (2017) suggesting superstorm emplacement, Rovere *et al.* (2017) suggesting routine storm emplacement, and Mylroie (2018) disagreeing with both and preferring a local bank margin failure event. Debates such as these are settled not by discussions and replies but by more fieldwork. This author encourages other workers to go and look. Let us all know what you find.

LITERATURE CITED

Carew, J.L. and Mylroie, J.E., 1985. The Pleistocene and Holocene stratigraphy of San Salvador Island, Bahamas, with reference to marine and terrestrial lithofacies at French Bay. *In:* Curran, H.A. (ed.), *Pleistocene and Holocene Carbonate Environments on San Salvador Island, Bahamas—Guidebook for Geological Society of America, Orlando Annual Meeting Field Trip*. Ft. Lauderdale, Florida: CCFL Bahamian Field Station, pp. 11–61.

Carew, J.L. and Mylroie, J.E., 1991. Some pitfalls in paleosol interpretation in carbonate sequences. *Carbonates and Evaporites,* 6(1), 69–74.

Carew, J.L. and Mylroie, J.E., 1995a. Quaternary tectonic stability of the Bahamian Archipelago: Evidence from fossil coral reefs and flank margin caves. *Quaternary Science Reviews,* 14, 144–153.

Carew, J.L. and Mylroie, J.E., 1995b. A stratigraphic and depositional model for the Bahama Islands. *In:* Curran, H.A. and White, B. (eds.), *Terrestrial and Shallow Marine Geology of the Bahamas and Bermuda*. Geological Society of America Special Paper *300*. Boulder, Colorado: Geological Society of America, pp. 5–31.

Carew, J.L. and Mylroie, J.E., 1997. Geology of the Bahamas, *In:* Vacher, H.L. and Quinn, T.M. (eds.), *Geology and Hydrology of Carbonate Islands*. New York: Elsevier, pp. 91–139.

Carew, J.L.; Curran, H.A.; Mylroie, J.E.; Sealey, N.E., and White, B., 1996. *Field Guide to Sites of Geological Interest, Western New Providence Island, Bahamas*. San Salvador Island, Bahamas: Bahamian Field Station, 36p.

Carew, J.L.; Mylroie, J.E.; Wehmiller, J.F., and Lively, R., 1984. Estimates of Lake Pleistocene sea level high stands from San Salvador, Bahamas. *In:* Teeter, J.W. (ed.), *Proceedings of the Second Symposium on the Geology of the Bahamas* (Ft. Lauderdale, Florida), pp. 153–175.

Carew, J.L.; Mylroie, J.E., and Schwabe, S.J., 1998. The geology of South Andros Island, Bahamas. *A Reconnaissance Report for the Ninth Symposium on the Geology of the Bahamas Field Trip*. (San Salvador Island, Bahamas), 30p.

Carew, J.L.; Mylroie, J.E., and Sealey, N.E., 1992. Field guide to sites of geological interest, western New Providence Island, Bahamas. *Field Trip Guidebook of the 6th Symposium on the Geology of the Bahamas* (Port Charlotte, Florida), 23p.

Chamberlin, T.C., 1897. The method of multiple working hypotheses. *Journal of Geology,* 5, 837–848.

Curran, H.A.; Mylroie, J.E.; Gamble, D.W.; Wilson, M.A.; Davis, R.L.; Sealey, N.E., and Voegeli, V.J., 2004. *Geology of Long Island Bahamas. A Field Trip Guide*. San Salvador, Bahamas: Gerace Research Centre, 24p.

Deeley, A.B.; Blackwell, B.A.B.; Mylroie, J.E.; Carew, J.L.; Blickstein, J.I.B., and Skinner, A.R., 2011. Testing cosmic dose rate models for ESR: Dating corals and molluscs on San Salvador, Bahamas. *Radiation Measurements,* 46(9), 853–859. doi:10.1016/j.radmeas.2011.02.008.

Engel, M.; Kindler, P., and Godefroid, F., 2015. Speculations on superstorms—Interactive comment on "Ice melt, sea level rise and superstorms: Evidence from paleoclimate data, climate modeling, and modern observations that 2 °C global warming is highly dangerous" by J. Hansen *et al*. *Atmospheric Chemistry and Physics Discussions,* 15, C6270–C6281.

Hearty, P.J., 1997. Boulder deposits from large waves during the last interglaciation on North Eleuthera, Bahamas. *Quaternary Research,* 48, 326–338.

Hearty, P.J. and Tormey, B.R., 2017. Sea-level change and superstorms; geologic evidence from the last interglacial (MIS 5e) in the Bahamas and Bermuda offers ominous prospects for a warming Earth. *Marine Geology,* 390, 347–365. doi:10.1016/j.margeo.2017.05.009.

Hearty, P.J. and Tormey, B.R., 2018a. Listen to the whisper of the rocks, telling their ancient story. *Proceedings of the National Academy of Sciences,* 115, E2902–E2903. doi:10.1073/pnas.1721253115.

Hearty, P.J. and Tormey, B.R., 2018b. Discussion of: Mylroie, J.E., 2018. Superstorms: Comments on Bahamian fenestrae and boulder evidence from the last interglacial. *Journal of Coastal Research,* 34(6), 1503–1511.

Jones, B., 2010. Speleothems in a wave-cut notch, Cayman Brac, British West Indies: The integrated product of subaerial precipitation, dissolution, and microbes. *Sedimentary Geology*, 232, 15–34.

Kindler, P. and Hearty, P.J., 1997. Geology of the Bahamas: Architecture of Bahamian Islands. *In:* Vacher, H.L. and Quinn, T. (eds.), *Geology and Hydrogeology of Carbonate Islands—Developments in Sedimentology,* Volume 54. Amsterdam: Elsevier, pp. 141–160.

Kindler, P. and Strasser, A., 2000. Palaeoclimatic significance of co-occurring wind- and water-induced sedimentary structures in the last-interglacial coastal deposits from Bermuda and the Bahamas. *Sedimentary Geology,* 131, 1–7.

Kindler, P. and Strasser, A., 2002. Palaeoclimatic significance of co-occurring wind- and water-induced sedimentary structures in last-interglacial coastal deposits from Bermuda and the Bahamas: Response to Hearty *et al.*'s comment. *Sedimentary Geology,* 147, 437–443.

Kindler, P.; Mylroie, J.E.; Curran, H.A.; Carew, J.L.; Gamble, D.W.; Rothfus, T.A.; Savarese, M., and Sealey, N.E., 2010. *Geology of Central Eleuthera, Bahamas: A Field Trip Guide*. San Salvador, Bahamas: Gerace Research Centre, 74p.

Lace, M.J. and Mylroie, J.E. (eds.), 2013. *Coastal Karst Landforms*. Coastal Research Library, Volume 5. Dordrecht, The Netherlands: Springer, 429p. doi:10.1007/978-94-007-5016-6_1.

Mirecki, J.E.; Carew, J.L., and Mylroie, J.E., 1993. Precision of amino acid enantiomeric data from fossiliferous Late Quaternary units, San Salvador Island, Bahamas. *In:* White, B. (ed.), *Proceedings of the 6th Symposium on the Geology of the Bahamas* (Port Charlotte, Florida), pp. 95–101.

Mylroie, J.E., 2018. Superstorms: Comments on Bahamian fenestrae and boulder evidence from the last interglacial. *Journal of Coastal Research,* 34(6), 1471–1483.

Mylroie, J.E. and Carew, J.L., 1991. Erosional notches in Bahamian carbonates: Bioerosion or groundwater dissolution? *In:* Bain, R.J. (ed.)., *Proceedings of the 5th Symposium on the Geology of the Bahamas* (Port Charlotte, Florida), pp. 185–191.

Mylroie, J.E. and Carew, J.L., 2010. *Field Guide to the Geology and Karst Geomorphology of San Salvador Island*. San Salvador, Bahamas: Gerace Research Centre, 88p. http://geraceresearchcentre.com/publications.html.

Mylroie, J.E. and Mylroie, J.R., 2017. The role of karst denudation on accurate assessment of glacioeustasy and tectonic uplift on carbonate coasts, *In:* Parise, M.; Gabrovsek, F.; Kaufmann, G., and Ravbar, N. (eds.)., *Advances in Karst Research: Theory, Fieldwork, and Applications. Geological Society, London, Special Publications,* 466(1), 171. doi:10.1144/SP466.2.

Mylroie, J.E.; Carew, J.L.; Curran, H.A.; Freile, D.; Sealey, N.E., and Voegeli, V.J., 2006. *Geology of Cat Island, Bahamas: A Field Trip Guide*. San Salvador, Bahamas: Gerace Research Centre, 43p.

Mylroie, J.E.; Carew, J.L.; Curran, H.A.; Godefroid, F.M.; Kindler, P., and Sealey, N.E., 2012. *Geology of New Providence Island, Bahamas: A Field Trip Guide*. San Salvador, Bahamas: Gerace Research Centre, 57p.

Mylroie, J.E.; Carew, J.L.; Curran, H.A.; Martin, J.B.; Rothfus, T.A.; Sealey, N.E., and Siewers, F.D., 2008. *Geology of Rum Cay, Bahamas: A Field Trip Guide*. San Salvador, Bahamas: Gerace Research Centre, 59p.

Mylroie, J.R.; Mylroie, J.E., and Lace, M.J., 2015 (abstract). The flank margin caves of Cayman Brac. *Geological Society of America Abstracts with Program,* 47(7), 555–556.

Neuendorf, K.K.E.; Mehl, J.P., Jr., and Jackson, J.A. (eds.), 2005. *Glossary of Geology,* 5th edition. Alexandria, Virginia: American Geological Institute, 779p.

Owen, A.M., 2013. Tafoni development in the Bahamas. *In:* Lace, M.J. and Mylroie, J.E. (eds.), 2013. *Coastal Karst Landforms*. Coastal Research Library, Volume 5. Dordrecht, The Netherlands: Springer, 429, pp. 177–205. doi:10.1007/978-94-007-5016-6_1.

Panuska, B.C.; Mylroie, J.E., and Carew, J.L., 1999. Paleomagnetic evidence for three Pleistocene paleosols on San Salvador Island. *In:* Curran, H.A. and Mylroie, J.E. (eds.), *Proceedings of the Ninth Symposium on the Geology of the Bahamas and Other Carbonate Regions* (San Salvador Island, Bahamas), pp. 93–100.

Panuska, B.C.; Boardman, M.R.; Carew, J.L.; Mylroie, J.E.; Sealey, N.E., and Voegeli, V., 2002. *Eleuthera Island Field Trip Guide, 11th Symposium on the Geology of the Bahamas and Other Carbonate Regions*. San Salvador, Bahamas: Gerace Research Centre, 20p.

Rovere, A.; Casella, E.; Harris, D.L.; Lorscheid, T.; Nandasena, N.A.K.; Dyer, B.; Sandstrom, M.R.; Stocchi, P.; D'Andrea, W.J., and Raymo, M.E., 2017. Giant boulders and last interglacial storm intensity in the North Atlantic. *Proceedings of the National Academy of Sciences,* 114(46), 12144–12149. doi:10.1073/pnas.1712433114.

Rovere, A.; Casella, E.; Harris, D.L.; Lorscheid, T.; Nandasena, N.A.K.; Dyer, B.; Sandstrom, M.R.; Stocchi, P.; D'Andrea, W.J., and Raymo, M.E., 2018. Reply to Hearty and Tormey: Use the scientific method to test geologic hypotheses, because rocks do not whisper. *Proceedings of the National Academy of Sciences,* 115(13), E2904–E2905. doi:10.1073/pnas.1800534115.

Taboroši, D.; Mylroie, J.E., and Kirakawa, K., 2006. Stalactites on tropical cliffs: Remnants of breached caves or subaerial tufa deposits? *Zeitschrift fur Geomorphologie,* 50, 117–139.