COMMENTS AND REPLIES

Online: *GSA Today*, Comments and Replies
Published Online: June 2008

Comment

Impacts, mega-tsunami, and other extraordinary claims

Richard B. Firestone, *Lawrence Berkeley National Laboratory, Berkeley, California 94720, USA;* ***Allen West,*** *GeoScience Consulting, P.O. Box 1636, Dewey, Arizona 86327, USA*

Carl Sagan's quote, "extraordinary claims require extraordinary evidence," used by Pinter and Ishman (2008) to refute our research, actually referred to alien abductions and the search for extraterrestrial intelligence. The original is the Principal of Laplace: *The weight of evidence for an extraordinary claim must be proportioned to its strangeness.* Impacts are not extraordinary claims, and our data are extensive.

We limit our comments to data and interpretations presented in our recent peer-reviewed paper (Firestone et al., 2007), which supersedes previous non–peer-reviewed publications. Pinter and Ishman incorrectly argue that evidence for the Younger-Dryas (YD) event is due to a "constant, noncatastrophic rain of sand-sized micrometeorites" and ignore the multi-proxy records upon which the YD hypothesis is based. In stratified sections at each of 10 sites, from California to Belgium and Manitoba to Arizona, we found a <5-cm-thick sediment layer dated ca. 12.9 ka that contained a majority of 14 markers, forming distinct stratigraphic peaks at above-background concentrations. These markers include magnetic microspherules (up to 2144/kg), magnetic grains (16g/kg) enriched in iridium (117 ppb, 6000× terrestrial values), vesicular carbon spherules (1458/kg), glass-like carbon (16 g/kg), nanodiamonds, fullerenes containing extraterrestrial concentrations of ^{3}He (84× air), and soot and charcoal (2 g/kg). Except for small quantities of magnetic grains and charcoal, the markers were undetectable in the sediment either above or below the impact layer, representing stratigraphic sequences spanning >55 k.y. This is inconsistent with Pinter and Ishman's assertion of a "constant" rain of meteoritic debris and demonstrates that a layer of concentrated extraterrestrial (ET) markers was deposited ca. 12.9 ka.

We proposed that the Carolina Bays were formed by shock-waves from the YD impact event centered near the Laurentide Ice Sheet, where the highest concentration of markers was found. The same impact markers are distributed throughout bay sediments and rims at 15 bays tested, but not beneath them. The presence of the same assemblage of markers in the Carolina Bays suggests they were in existence ca. 12.9 ka, although their age is currently unresolved. Pinter and Ishman fail to reference the long history of impact evidence summarized by Eyton and Parkhurst (1975), who suggested the bays are impact-related. We have found the first evidence of impact markers clearly associated with the Carolina Bays, supporting the hypothesis that they were formed during an extraterrestrial impact.

Pinter and Ishman criticize the lack of a known YD impact crater. Alvarez and colleagues (1980) faced similar criticisms about the Cretaceous-Tertiary (K-T) impact until Chicxulub was discovered. Pinter and Ishman (2008) base their objections on the impact of a single ET object, though we made no such claim. Instead, we proposed that a heavily fragmented comet, made up of low-density components (Solem, 1994), exploded in multiple airbursts. The expanse of the YD impact layer is consistent with multiple airbursts causing continent-wide devastation and climate change, as described by Toon et al. (1997).

Evidence now exists that many megafaunal taxa abruptly became extinct near the YD boundary. For example, Haynes (2005) found that at >50 sites across North America, no megafaunal fossils or Clovis tools are found within or above the black mat, which overlies the layer containing impact markers. Haynes writes, "[T]he sudden extinction of the Pleistocene megafauna would be dramatically revealed by explaining that all were gone an instant before the black mat was deposited." Regarding wildfires, we showed that at the onset of the enigmatic YD deglacial event, the Greenland ice cores display one of the most extensive episodes of biomass burning in the past 100,000 yr. We need only apply Occam's razor to determine that the impact, extinctions, and onset of YD cooling are related.

Pinter and Ishman misunderstood our results. Again quoting Carl Sagan (1995, p. 27), "The truth … may contradict deeply held prejudices. It may not be consonant with what we desperately want to be true. But our preferences do not determine what's true. … Cleverly designed experiments are the key." We continue to test the Younger Dryas Impact hypothesis, one that is firmly based on empirical work and not conjecture.

REFERENCES CITED

Alvarez, L.W., Alvarez, W., Asaro, F., and Michel, H.V., 1980, Extraterrestrial cause for the Cretaceous-Tertiary extinction: Science, v. 208, p. 1095–1108, doi: 10.1126/science.208.4448.1095.

Eyton, J.R. and Parkhurst, J.I., 1975, A reevaluation of the extra-terrestrial origin of the Carolina Bays: Occasional Publication, Dept. of Geography Paper No. 9, University of Illinois at Urbana–Champaign, 45 p.

Firestone, R.B., and 25 others, 2007, Evidence for an extraterrestrial impact 12,900 years ago that contributed to the megafaunal extinctions and the Younger Dryas cooling: Proceedings of the National Academy of Sciences, v. 104, p. 16,016–16,021.

Haynes, C.V., Jr., 2005, Clovis, pre-Clovis, climate change and extinction, *in* Bonnichsen R., Lepper, B.T., Stanford, D., and Waters, M.R., eds., Paleoamerican Origins: Beyond Clovis: College Station, Texas A&M University Press, p. 113–132.

Pinter, N., and Ishman, S.E., 2008, Impacts, mega-tsunami, and other extraordinary claims: GSA Today, v. 18, no. 1, p. 37–38, doi: 10.1130/GSAT01801GW.1.

Sagan, C., 1995, Wonder and skepticism: Skeptical Enquirer, v. 19, p. 24–30.

Solem, J.C., 1994, Density and size of comet Shoemaker-Levy 9 deduced from a tidal breakup model: Nature, v. 360, p. 349–351.

Toon, O.B., Zahnle, K., Morrison, D., Turco, R.B., and Covwy, C., 1997, Environmental perturbations caused by the impacts of asteroids and comets: Reviews of Geophysics, v. 35, p. 41–78.

Manuscript received 4 February 2008; accepted 15 February 2008.