COMMENTS AND REPLIES

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

Reply

Impacts, mega-tsunami, and other extraordinary claims

Nicholas Pinter *and* ***Scott E. Ishman,*** *Dept. of Geology, Southern Illinois University, Carbondale, Illinois 62901-4324, USA*

We welcome the comments of Abbott et al., Firestone and West, and Bunch et al.; in fact, we anticipated and hoped for the opportunity to further discuss the rash of recent impact claims and alternative interpretations.

Abbott et al. reiterate claims for multiple large Holocene ocean impacts, resulting in "mega-tsunami" recorded by "chevrons." Long-term meteorological records from stations near two chevron sites show the features to be precisely aligned with dominant winds (Pinter and Ishman, 2008), and their morphology is that of parabolic dunes. Abbott et al. argue that it is impossible to transport marine microfossils into these chevrons by wind. In actuality, coastal dune sand is commonly full of marine micro- (and macro) fossils. Two samples of Pleistocene eolianite that we collected in California from 114 m and 230 m elevation contained numerous well-preserved foraminifera spanning 11 genera.

Abbott et al. also argue that iron- and chromium-stained foraminifera in chevrons and ocean cores represent splashes of impact melt. $CaCO_3$ melts are documented for the Chicxulub impact site, but these are a far cry from "well-preserved carbonate microfossils" encased in silicate melt. Salge (2007) describes silica and associated carbonate at Chicxulub as "carbonate melt particles," recrystallized and decomposed calcite, and CO_2 back-reacting to calcite. Abbott et al. also state "[r]ecent experiments have replicated grasses intact within silicate impact melts." However, the Harris and Schultz (2007) abstract merely suggests a mechanism for "grass-like remains in impact melt breccias." Fully carbonized plant remains are documented in the geological record (e.g., Scott, 2008), but few researchers would accept unaltered plant material or foraminiferal tests in direct contact with silicate or metallic impact melt.

The comments by Firestone and West and Bunch et al. reiterate the claim for a catastrophic North American impact event at 12.9 ka, as presented in Firestone et al. (2006, 2007a). Firestone and West try to distance themselves from earlier claims (e.g., "cosmic-ray jets," "deadly nerve toxins" in Pleistocene algal mats, etc.), yet Firestone et al. (2007b) identify a new 33-ka airburst impact event (i.e., no crater) based on micrometeorite "bullets" lodged in mammoth tusks. Regarding the "12.9 ka event," Firestone et al. (2007a) present an unusual assortment of evidence well outside criteria accepted by the impact community (e.g., Reimold, 2007). A common theme among the bevy of marginal impact claims is that they eschew accepted criteria in favor of new and untested markers.

Our article offers an alternative hypothesis. Bunch et al. advocate that spikes in microspherule frequency require an impact event—we suggest that much of this material represents micrometeorite ablation fallout, which can and should be concentrated at any depositional hiatus or in any condensed section (see calculations at www.geology.siu.edu/GSATSupplement.pdf). Further concentration could result from sediment reworking or from terrestrial sources. It is suggestive that Firestone et al.'s highest spherule counts are from Michigan and Alberta, downwind of the ca. 13 ka eruption sequence at Glacier Peak, Washington (Mastin and Waitt, 2000).

Bunch et al. and Firestone and West also highlight iridium at up to 117 ppb, higher than many Cretaceous-Tertiary sites. This comparison is disingenuous. The 117 ppb concentration and another of 51 ppb Ir were from spherule and magnetic grain separates, fully consistent with a noncatastrophic micrometeorite source (see www.geology.siu.edu/GSATSupplement.pdf). Firestone et al.'s **bulk** Ir concentrations peaked at just 2.3–3.8 ppb; maximum values were below detection at six of their 10 sites. Firestone et al. (2007a) note that these values are anomalously low, requiring them to invoke an Ir-depleted impactor.

Our hypothesis of ubiquitous micrometeorite debris, concentrated by variation in clastic input and other terrestrial mechanisms, is eminently testable. We predict elevated concentrations of most or all of Firestone et al.'s markers at multiple time horizons in similar sequences. Our research group and several others are now separating microspherules collected from a range of sites and ages. The 12.9 ka impact hypothesis may be confirmed, or it may soon run into a wall of contrary data.

The latest Pleistocene and early Holocene span a period of dramatic paleo-environmental changes. Against such a background, workers seeking grand unifying explanations should be aware of the danger of "selection bias." Selection bias was invoked following claims for Paleolithic artifacts at the Calico site in California. At Calico, ~200 crude man-made objects were identified among countless fractured and unfractured clasts in a chert-rich fanglomerate. After years of acrimonious debate, scientific consensus recognized that the presumed artifacts represented "a biased sample of lithics from the total population of naturally fractured lithics at that site" (Duvall and Venner, 1979)—i.e., a few markers collected in good faith from an abundant background, combined with a good story and some wishful thinking. The real lesson of Calico may be that 30+ years later, a few hardcore proponents cling to the original story. We have no desire to squelch new scientific hypotheses, but the danger is these "extraordinary claims," once disseminated in the popular imagination, can be almost impossible to dispel.

REFERENCES CITED

Duvall, J.G., and Venner, W.T., 1979, A statistical analysis of the lithics from the Calico site (SBCM 1500A), California: Journal of Field Archaeology, v. 6, p. 455–462.

Firestone, R., West, A., and Warwick-Smith, S., 2006, The cycle of cosmic catastrophes: Flood, fire, and famine in the history of civilization: Rochester, Vermont, Bear & Company, 392 p.

Firestone, R.B., and 25 others, 2007a, 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.

Firestone, R.B., West, A., Zsolt, S., Zsolt, R., and Hagstrum, J.T., 2007b, Micrometeorite impacts in Beringian mammoth tusks and a bison skull: Eos (Transactions, American Geophysical Union) v. 88, no. 52, Abstract U23A-0865, http://ie.lbl.gov/Mammoth/Impact.html.

Mastin, L.G., and Waitt, R.B., 2000, Glacier Peak; history and hazards of a Cascade volcano: U.S. Geological Survey Fact Sheet, FS 0058-00.

Reimold, W.U., 2007, The impact crater bandwagon: Meteoritics & Planetary Science, v. 42, p. 1467–1472.

Scott, A.C., 2008, Forest fire in the fossil record, *in* Cerdà, A., and Robichaud, P., Restoration Strategies after Forest Fires: New Hampshire, Science Publishers Inc., in press.

Manuscript received 22 February 2008; accepted 4 March 2008.