Impacts, mega-tsunami, and other extraordinary claims

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Recognition of the importance of impact cratering ranks among the most significant advances in earth and planetary sciences of the twentieth century, but recently there has been a proliferation of reports of impact events and sites that eschew simple, less spectacular alternative explanations. Here we focus on (1) Holocene-age ocean impacts and associated “mega-tsunami,” and (2) a catastrophic impact event suggested at 12.9 ka. Carl Sagan once said that “extraordinary claims require extraordinary evidence”; we argue that these impacts do not meet that standard.

In November 2006, the New York Times (Blakeslee, 2006) reported the identification of a growing number of impacts and associated mega-tsunamis during the past 10,000 yr by the “Holocene Impact Working Group.” In contrast, using astronomical and planetary data, Bland and Artemieva (2006) calculated that impacts capable of “producing hazardous tsunami” occur only once every ~100,000 yr. Identification of Holocene mega-tsunamis was based largely on “chevrons,” a new term for coastal landforms attributed to mega-tsunami run-up (e.g., Masse et al., 2006). Madagascar chevrons were linked to an Indian Ocean “cra-ter” identified by ocean-floor topography and “splashes of iron, nickel and chrome fused” to foraminiferal tests in nearby ocean cores (Blakeslee, 2006; Abbott et al., 2007). The melting points of nickel and chrome fused materials are >1400 °C, whereas CaCO3 decomposes at ~500 °C. No studies of the K-T impact have reported foraminiferal tests with fused metals. Identifying impact sites by searching for dimples on Earth’s surface is a dubious proposition. For example, Speranza et al. (2004) documented a sheep watering hole identified as the “Sirente Crater.”

To test the Holocene impact/mega-tsunami story, we collected meteorological data from two “chevron” sites: Montauk, New York, and Faux Cap, Madagascar (Gusiakov, 2006). In both cases, these features were precisely aligned with the dominant wind direction (Fig. DR1 [see the GSA Data Repository1]) and had been mapped previously as parabolic dunes (LeBigre and Reaud-Thomas, 2001). We suggest that these Holocene features are clearly eolian, and that the term “chevron” should be purged from the impact-related literature.

Just as close scrutiny of the Holocene impacts belies an extraterrestrial source, an impact on the southeastern Laurentide ice sheet at 12.9 ka proposed at the 2007 American Geophysical Union Joint Assembly (Firestone et al., 2007a, 2007b) engenders similar doubts. This purported impact is cited as a trigger for the Younger Dryas climate event, extinction of Pleistocene megafauna, demise of the Clovis culture, the dawn of agriculture, and other events (Firestone et al., 2007a, 2007b). Evidence of the 12.9-ka impact includes magnetic grains, microspherules, iridium, glass-like carbon, carbonaceous deposits draped over mammoth bones, fullerens enriched in 3He (Becker et al., 2007), and micron-scale “nanodiamonds” (Firestone et al., 2007c). We suggest that the data are not consistent with the 4–5-km-diameter impactor that has been proposed, but rather with the constant and certainly noncatastrophic rain of sand-sized micrometeorites into Earth’s atmosphere.

The 12.9-ka impact story has struggled to bring its disparate evidence under a single umbrella. The impact story originated in Firestone and Topping (2001) and the Firestone et al. (2006) book, both of which contain observations and claims so wild that other work by these authors invites careful scrutiny. The nature of the 12.9-ka event changes radically with each iteration, from a supernova-generated “cosmic ray jet” (Firestone et al., 2006) to a massive atmospheric airburst (Firestone et al., 2007a, 2007b) to “multiple ET airbursts along with surface impacts” (Firestone et al., 2007c). Airbursts are a convenient explanation, given the lack of an impact crater, tektites, shocked quartz, or high-pressure minerals. Airburst events are associated with small impactors, perhaps <160 m diameter (e.g., Chapman and Morrison, 1994). Furthermore, the 12.9-ka event is identified as an oblique strike with “high-speed projectile material” (Firestone et al., 2007a) creating the elliptical “Carolina Bays” of the southeastern United States. Yet, of all impacts in the solar system, only a handful represent strikes capable of generating visibly elliptical forms (Pierazzo and Melosh, 2000). No meteorite material has ever previously been recovered from the Carolina Bays. Firestone and colleagues return to an impact origin for the Bays, ignoring a half-century of mainstream research focused on geomorphic mechanisms and age control documenting formation over extended time (Grant et al., 1998; Ivester et al., 2007). Similar elliptical depressions in Argentina, once claimed as an oblique impact swarm, were recently debunked and are now recognized as eolian (Bland et al., 2002).

The 12.9-ka impact story also has struggled with the broad range of impact-related materials reported. Firestone and Topping (2001) identified chondrules, suggesting that the impactor was a chondrite. Magnetic grains and spherules (Firestone et al., 2007a, 2007b, 2007c) are consistent with an iron-rich meteoroid, whereas silicate material (Firestone et al., 2007c) suggests a stony meteoroid and “glass-like carbon” and carbon spherules suggest a carbonaceous source. Firestone et al. (2006, 2007a) suggest geochemical affinities with lunar crustal material. Any one of these might be a credible extraterrestrial source, but together they are a Frankenstein monster, incompatible with any single impactor or any known impact event.

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1GSA Data Repository item 2008049, Figures DR1 (wind directions at Hither Hills State Park, Montauk, New York, USA, and Faux Cap, Madagascar) and DR2 (five photos of glassy and metallic microspherules and spherular carbon condensates), is available at www.geosociety.org/pubs/ft2008.htm. You can also obtain a copy by writing to editing@geosociety.org.
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