

Reply to Boslough: Prior studies validating research are ignored

In PNAS, M. Boslough (1) raises issues about carbon spherules and nanodiamonds unrelated to our magnetic spherule focused research (2). Boslough should instead address the questions he raises to the appropriate investigators.

Boslough's letter contains inaccurate and misleading statements, suggesting he misread our report. Boslough incorrectly states that A. West devised the spherule protocol, instead of archaeologist W. Topping, who was also responsible for some of the spherule results reported by Firestone et al. (3). Boslough then asserts, "Samples collected by others have failed to reproduce his findings" (1). Boslough continues to overlook our results and others'. We cite five independent groups that have successfully reproduced magnetic spherule results and other evidence.

Boslough's "discovery" of a purportedly "recent" carbon spherule in Younger Dryas Boundary (YDB) sediment at Gainey, MI, ignores the prior published research of Firestone et al. (4) that characterizes the problematic nature of carbon spherule dating at the Gainey site, distinct from any possibility of contamination.

Every user, including Surovell et al. (5), accepted the magnetic spherule protocol's efficacy. Boslough too, tacitly accepted its validity until the negative results of Surovell et al. were challenged, after which Boslough concluded that the protocol must be "faulty," rather than Surovell's conclusions. Boslough's position is puzzling at best. Furthermore, one of Surovell's coauthors, Vance Haynes, independently validated the correct use of the protocol by finding thousands of magnetic spherules

in YDB sediment at Murray Springs, Arizona. Thus, Surovell et al.'s conclusions were contraindicated by one of their own coauthors.

Regarding coauthorship, there is no overlap with Firestone et al. (3), except for the Topper site director, Albert Goodyear. He designed the important experiment performed at the Topper quarry and assisted in interpreting its results, but otherwise played no role in identifying or characterizing magnetic spherules, which was accomplished independently of his input.

We performed an informal "double-blind study" exactly as described, the procedures of which were tailored to and successfully accomplished our stated objective: ensuring that sample stratigraphy was unknown to the examiner. Respecting the requested anonymity of a third-party facilitator is normal practice and reasonable given the contentious nature of this debate. We unequivocally affirm the neutrality and independence of our facilitator with respect to the YDB-impact hypothesis.

Our report's (2) primary purpose was to resolve the conflicting results of two spherule studies. Like other investigators, we found Firestone et al.'s (3) results to be reproducible, whereas Surovell et al.'s (5) were not. We also found it irrefutable that Surovell et al. did not follow the prescribed protocol, with fatal results. However, we took a neutral position on the YDB impact hypothesis: "Our results are consistent with, but do not prove, that a previously proposed cosmic impact occurred at 12.9 ka BP. The ultimate source of the magnetic microspherules in YDB sediment remains a mystery warranting further investigation" (2).

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- 1** Boslough M (2013) Faulty protocols yield contaminated samples, unconfirmed results. *Proc Natl Acad Sci USA* 110:E1651.
 - 2** LeCompte MA, et al. (2012) Independent evaluation of conflicting microspherule results from different investigations of the Younger Dryas impact hypothesis. *Proc Natl Acad Sci USA* 109(44):E2960–E2969.
 - 3** Firestone RB, et al. (2007) Evidence for an extraterrestrial impact 12,900 years ago that contributed to the megafaunal extinctions and the Younger Dryas cooling. *Proc Natl Acad Sci USA* 104(41):16016–16021.
 - 4** Firestone RB (2009) The case for the Younger Dryas extraterrestrial impact event: Mammoth, megafauna, and clovis extinction, 12,900 Years Ago. *Journal of Cosmology* 2:256–285.
 - 5** Surovell TA, et al. (2009) An independent evaluation of the Younger Dryas extraterrestrial impact hypothesis. *Proc Natl Acad Sci USA* 106(43):18155–18158.

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The authors declare no conflict of interest.

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