Problematic dating of claimed Younger Dryas boundary impact proxies

The PNAS paper by Kennett et al. (1) uses statistical methods in an attempt to improve the geochronological control for purported Younger Dryas boundary (YDB) impact proxies. The underpinning data for these analyses are problematic, however, as discussed by Meltzer et al. (2) and Holliday et al. (3). Several examples illustrate the problems. At Barber Creek the YDB zone is at ∼100 cm below the surface, but in situ wood charcoal dated to 10,500 ± 50 ^{14}C y B.P. (∼12.5 k cal yrs) is documented below 100 cm (3). The large SD for the modeled age of the YDB here (1) (12,865 ± 535 cal yrs) easily accommodates the high-precision date on the charcoal from below the spherule zone. At Blackville the sediments dated by optically stimulated luminescence are mixed and thus the dates cannot be considered reliable (3). The supposed impact proxies at Bull Creek are from 307- to 312-cm depth (3). The radiocarbon date of ∼12,960 cal yrs is from 298 to 307 cm and is a bulk sample on soil organic matter, thus representing a mean residence time for the soil carbon. Impact proxies are, therefore, older than ∼12,960 y by some unknown amount; they are also found in abundance in strata <3,000 y old. The Usselo soil in northwest Europe spans ∼1,400 y based on ∼50 radiocarbon ages, dating primarily to the Allerød and into the YD (2).

For Abu Hureyra, Thy et al. (4) report that siliceous scoria from that site and four others in northern Syria are not unique to the YDB, dating from 11,300–10,500 cal yrs ago and "associated with and likely formed by human induced fire." Nine other "proxy-rich" sites with poor, nonexistent or contradictory dating are argued to contain a YDB layer because of high content of claimed proxies. This is circular reasoning.

At Big Eddy, 28 radiocarbon ages were used in the statistical analyses (1). This dataset includes numerous reversals, however, rendering statistical manipulations largely meaningless.

From Murray Springs, the one known sample section for hypothesized impact indicators is from an area of the site where the purported proxies were found on a disconformity of unknown duration (2). Modern alluvium at the site also produced a suite of impact indicators. Similarly, at the Lindenmeier site the YDB is placed at the strata C-D "interface," but that contact is an erosional unconformity of unknown age (5).

The YDB is placed at 12,800 ± 300 y by Kennett et al. (1), but their modeled age ranges with SDs of >300 y up to 2,405 y are presented for layers of claimed impact indicators at nine sites. These layers are argued to represent the YDB based solely on the premise that if they could be YDB, they therefore must represent the YDB, but the sites mentioned show that this is faulty logic.

The data presented above and elsewhere (2, 3) provide evidence for multiple horizons with "impact proxies" at times other than the YDB, and raise doubts about the utility of the statistical manipulations to address the dating of the YDB, which can be no better than the data on which they are based.

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1 Kennett JP, et al. (2015) Bayesian chronological analyses consistent with synchronous age of 12,835–12,735 Cal B.P. for Younger Dryas boundary on four continents. *Proc Natl Acad Sci USA* 112(32):E4344–E4353.

2 Meltzer DJ, Holliday VT, Cannon MD, Miller DS (2014) Chronological evidence fails to support claim of an isochronous widespread layer of cosmic impact indicators dated to 12,800 years ago. *Proc Natl Acad Sci USA* 111(21): E2162–E2171.

3 Holliday VT, Surovell T, Meltzer DJ, Grayson DK, Boslough M (2014) The Younger Dryas impact hypothesis: A cosmic catastrophe. *J Quaternary Sci* 29(6):525–530.

4 Thy P, Willcox G, Barfod GH, Fuller DQ (2015) Anthropogenic origin of siliceous scoria droplets from Pleistocene and Holocene archaeological sites in northern Syria. *J Archaeol Sci* 54:193–209.

5 Haynes CV, Agogino GA (1960) *Geological Significance of a New Radiocarbon Date from the Lindenmeier site. Proceedings 9* (Denver Museum of Natural History, Denver) Series 2, pp 5–23.

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