



Reply to van Hoesel et al.: Impact-related Younger Dryas boundary nanodiamonds from The Netherlands

Van Hoesel et al. (1) refer to nanodiamonds at the top of the Usselo horizon at Aalsterhut, The Netherlands, having an average age of 10.845 ± 0.015 ^{14}C ka (12.70 ± 0.06 cal ka) (1); they found no nanodiamonds outside that layer. Earlier, nanodiamonds were reported at the top of the Usselo in Lommel, Belgium, ~30 km southwest of Aalsterhut, acknowledged as the Younger Dryas boundary layer (YDB) [Tian et al. (2)]; those researchers also found no nanodiamonds outside that layer.

Van Hoesel et al. (1) claim that the nanodiamond-rich layer at Aalsterhut postdates the YDB by 200 y. However, that claim is indefensible. Based on eight radiocarbon dates from Murray Springs, averaging 10.89 ± 0.05 ^{14}C ka and dates from the Greenland Ice Sheet Project 2 (GISP2) ice core (3), the calibrated YDB age is defined as 12.8 ± 0.15 cal ka [IntCal09 (4)], which overlaps the 12.70 ± 0.060 cal ka age of van Hoesel et al. (1). Nanodiamond-rich layers occur above Clovis-age archaeological materials at multiple North American sites, and this stratigraphic boundary is well-dated to the same time (refs. 3–5 and references therein). The radiocarbon dates from Arlington Canyon were never used to date the YDB because they are systematically older, likely resulting from the burning of large trees [old wood effect (5)].

The calibrated radiocarbon ranges from Aalsterhut and Murray Springs are virtually indistinguishable (Fig. 1). The age estimate for each is shown as probability distributions, defining the beginning and end of deposition

(modeled as boundaries in OxCal 4.2). The Aalsterhut distribution comes from 14 dates (1), and Murray Springs is derived from eight radiocarbon dates (refs. 3–5 and references therein). The age distributions for these two sites are comparable and fall within the estimated YDB age range. Therefore, all dates for the nanodiamond-rich layers found at those two key sites are consistent with the age of the cataclysmic YDB impact event, now clearly defined at the beginning of the Younger Dryas cooling episode in the Greenland ice sheet (6).

James H. Wittke^a, Ted E. Bunch^{a,1}, James P. Kennett^b, Douglas J. Kennett^c, Brendan J. Culleton^c, Kenneth B. Tankersley^d, I. Randolph Daniel, Jr.^e, Johan B. Kloosterman^f, Gunther Kletetschka^{g,h}, Allen Westⁱ, and Richard B. Firestone^j

^aDepartment of Geology, School of Earth Science and Environmental Sustainability, Northern Arizona University, Flagstaff, AZ 86011; ^bDepartment of Earth Science, Marine Science Institute, University of California, Santa Barbara, CA 93106; ^cDepartment of Anthropology, Pennsylvania State University, University Park, PA 16802; ^dDepartment of Anthropology and Department of Geology, University of Cincinnati, Cincinnati, OH 45221; ^eDepartment of Anthropology, East Carolina University, Greenville, NC 27858; ^fExploration Geologist, 1016 NN, Amsterdam,

The Netherlands; ^gFaculty of Science, Charles University in Prague, 12843 Prague, Czech Republic; ^hInstitute of Geology, Czech Academy of Science of the Czech Republic, v.v.i., 16500 Prague, Czech Republic; ⁱGeoScience Consulting, Dewey, AZ 86327; and ^jLawrence Berkeley National Laboratory, Berkeley, CA 94720

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The authors declare no conflict of interest.

¹To whom correspondence should be addressed. E-mail: tbear1@cablone.net.

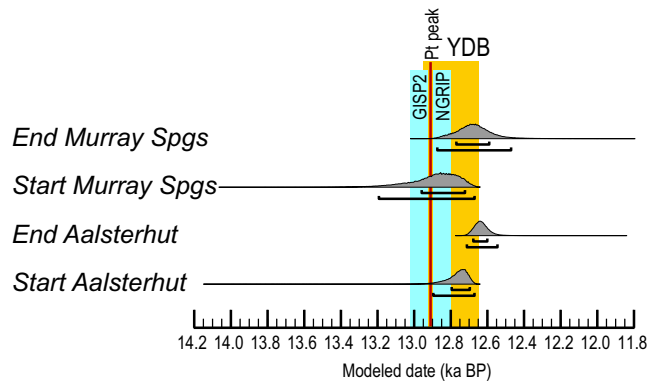


Fig. 1. Aalsterhut calibrated age range estimates from ref. 1. Murray Springs from refs. 3 and 5. Pt peak in GISP2 from ref. 6, shown relative to YD onset from the GISP2 and North Greenland Ice Core Project (NGRIP) (turquoise). YDB in yellow.