LETTER



# Complications and challenges for securing Mediterranean timelines

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Pearson et al. (1) present important data; unfortunately, errors mar their work. They report 186 $^{14}$C dates for relative year 834 (RY834) to RY1019 of the 1,028-y Gordion (GOR) juniper tree-ring chronology (1). "A gap of 103 years was added to the start of the single year sequence and 744 years were added at the end to represent the entire chronology" (ref. 1, SI appendix, figure S1). This is incorrect. There are inclusively 97 y from RY834 to RY737 and 745 y from RY1019 to RY1764. Corrected, the 95.4% OxCal wiggle-match versus IntCal13 is 760 to 756 BC for the felling date, ~5 y older than stated (1). The last ring $\chi^2$ fit reported, 745 ± 4 BC (1), appears incomplete. The inclusive 95.4% fit ranges (2) against the weighted average (3) of the Irish oak (IrO) plus bristlecone pine (BCP) dataset (1, 4, 5) with a minimum at 747 BC are 759 to 741 BC, all data (ALLD), 759 to 744 BC excluding the five largest GOR outliers (EXCL5) (1). There are interlaboratory and sample differences (1, 4), reflected in differing $\chi^2$ best-fit minima if we separate the data comparisons: against ETH IrO (4) 756 BC, ALLD, and EXCL5; against AA BCP (4, 5) 747 BC, ALLD, and 746 BC EXCL5. Secure absolute dating is lacking. The proposed date clarification by superposed epoch analysis (1) is problematic. It is stated to be based on a "1,979-year" juniper chronology. However, the pre-Gordion elements of this supposed tree-ring chronology are not robustly cross-dated nor correctly placed in calendar time (6), invalidating use to refine the fit.

Pearson et al. (1) suggest latitude determines the observed $^{14}$C differences. Recent evidence provides little support for substantive systematic differences between the relevant latitudes, ~37 to 53°N, with BCP, especially, close to the Northern Hemisphere average (7). The intraannual cycle in atmospheric $^{14}$C levels (8), reflected through differences in tree growing seasons and main $^{14}CO_2$ uptake timing, seems the more likely major contributor (9), or laboratory differences. The same laboratory IrO versus GOR comparison (1) confirms indications—removing the complicating factor of AMS $^{14}$C versus previous technologies—for intra-annual offsets Mediterranean versus IntCal13 of the order of 10 $^{14}$C years (9).

An influx of "old carbon" is noted at "1548 BC" (ref. 1, p. 8413, figure 2). The same event (presumably) is then dated "around 1558 BC" (p. 8414), a 10-y difference. If dated "1548 BC," it is not related to the single tree Ca depletion reported at approximately "1562 to 1558 BC" and the wider ring at approximately "1560 BC" (ref. 1, p. 8414, figure 4). Nonetheless, the possibility of a mid–16th-century BC date for the Thera/Santorini eruption deserves investigation (1, 4, 5, 9). If positive evidence is found, it would place the floruit of New Palace Crete (Middle Minoan III to Late Minoan IA, and Aegean contemporaries) before New Kingdom Egypt, coeval with the previous Hyksos world—a fundamental shift from previous orthodoxy (10). However, current $^{14}$C evidence, even allowing for revised calibration datasets 1700 to 1480 BC (1, 4, 5), and a small Mediterranean $^{14}$C offset, points somewhat earlier still, toward the last decades of the 17th century BC (9).


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