The Early Bronze Age Log Coffin Burials of Britain: The Origins and Development of a Burial Rite(s)

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APPENDIX S1: RADIOCARBON MODELLING

Here, for the two sites that warrant site specific chronological models we present this analysis. We also include an alternative approach to analysing all the legacy data. In this we have grouped results from sites using Needham's periodisations (Needham 1996) for the British Bronze Age, together with revisions to this model which include other artefact forms (Needham 2009; Needham *et al.* 2010; Woodward & Hunter 2015, 461–71). We discuss this approach below. All these models apply Bayesian analysis in the program OxCal v4.3 (Bronk Ramsey 2009; 2017; Bronk Ramsey & Lee 2013). We have analysed these measurements using the calibration data of IntCal20 (Reimer *et al*. 2020). The OxCal CQL2 commands and the brackets shown in the figures define the models; the OxCal CQL2 commands in the text below are quoted by convention in Courier font. The date ranges quoted below in italics are the Highest Posterior Density intervals derived from these Bayesian models. They are quoted at 95% probability, unless otherwise stated.

Site specific models

For two sites, Gristhorpe and Piper Hole Farm, we have sufficient radiocarbon measurements to produce site-specific chronological models. We discuss these site-specific models here, before introducing our analysis of the dataset as a whole.

Gristhorpe results: At Gristhorpe, sufficient measurements exist on the coffin to produce a Bayesian 'wiggle match' (Christen & Litton 1995; Galimberti *et al.* 2004). Wiggle matching combines a group of radiocarbon measurements produced on tree rings that are separated by a known number of additional annual tree rings. The radiocarbon measurements can then be 'matched' to the shape of the radiocarbon calibration curve.

A 173-year composite sequence from the coffin was sampled by six radiocarbon measurements at Gristhorpe (Batt 2013). Each of these measurements was produced on a sample of a block of ten annual rings. The interval between the mid-points of each sample and the next sample was 30 years. After the youngest dated sample from this timber there were 20 sapwood rings. We can use this prior information to slightly revise the wiggle match produced in the original publication Batt (2013; Fig. S1). The results from this model have good overall agreement (Agreement n=6; Acomb= 89.7%; (An= 28.9%)). The last ring preserved on the Gristhorpe log coffin wiggle match sequence formed in *2050–2010 cal BC* (*93% probability* or *1975–1960 cal BC 3% probability*; *Year 0+20 sapwood*; Fig. S1).

To provide an estimate of the felling date of the timber we need to have an estimate for the number of additional sapwood rings present if 20 sapwood rings were preserved on the timber. Bayliss and Tyers (2004, 961) provide a methodology for this process, which provides an estimate for the felling date of *2050–1995 cal BC* (*92% probability* or *1980–1950 cal BC 3% probability*; *felling estimate*; Fig. S2).

Two additional results from the site were produced from the burial; a measurement on the tooth dentine (OxA-16844) and from the femur (OxA-19219). Teeth form in childhood, whereas long bones gradually remodel over the lifespan of an individual (eg, Sealy *et al.* 1995; Hedges *et al.* 2007). The measurement on the tooth should therefore, in radiocarbon terms, be older than that on the long bone. Furthermore, the long bone would be older in radiocarbon terms than the date of death of the individual, as remodelling of such robust elements occurs over several decades. If the timber for the coffin was felled specifically for the burial, and not stockpiled, the felling date too should be younger in radiocarbon terms than the measurement on the femur. We have presented the measurement on the tooth and the measurement on the femur using the `Sequence` function in OxCal to represent this relationship (Fig. S3). Our revised estimate for the femur result is *2150–2020 cal BC* (*93% probability* or *1995–1980 cal BC 3% probability*; *OxA-19219*; Fig. S3). We can compare the measurements produced on the human skeletal remains with our estimate for the felling date (Fig. S3), this shows that the bone result is slightly older in radiocarbon terms than our felling estimate for the timber used for the log coffin. In the model for all log coffins that we present below, we use this understanding of the relationships between the dated events in our analysis.

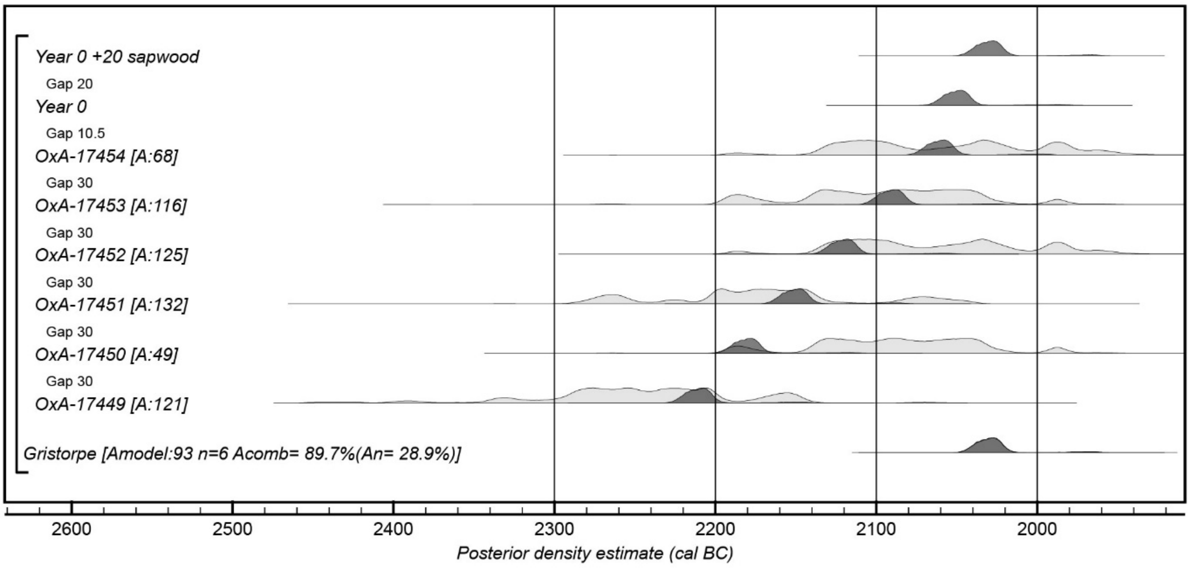

Fig. S1.
Probability distributions of dates from the Gristhorpe log coffin. The approach of Batt (2013) has been updated here to estimate the last measured sapwood ring. We use this estimate in order to provide an estimate for the felling date of the timber used for the log coffin in Fig. S2. The large square bracket down the left-hand side and the OxCal CQL2 keywords define the overall model

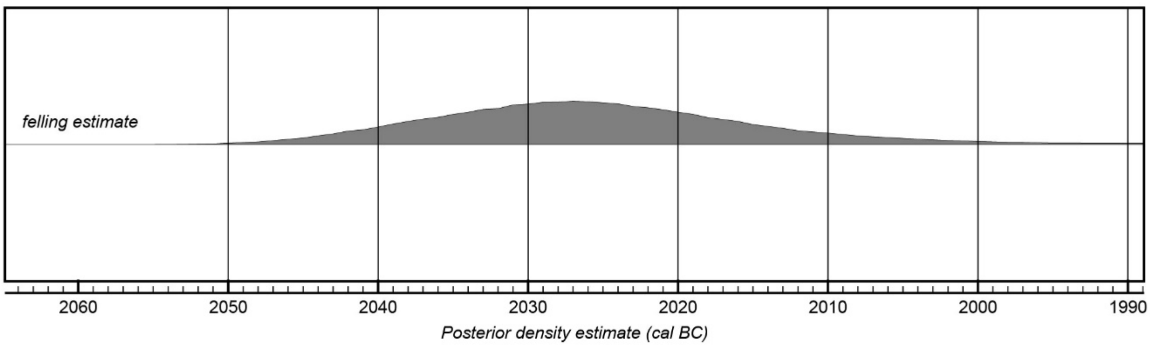

Fig. S2.
Estimate for the felling date of the Gristhorpe log coffin which we have obtained using the estimate 'Year 0+20 sapwood' calculated as illustrated in Fig. S1 and applying a revised sapwood estimate as outlined in Bayliss & Tyers (2004)

Piper Hole Farm results: We have two results from Piper Hole Farm, one which stratigraphically pre-dates the log coffin (SUERC-64506) and one which post-dates it (SUERC-64505). We have used this relationship to estimate the date of deposition of the coffin at this site in *2130–1890 cal BC* (*95% probability*; *Piper Hole Farm log coffin*; Fig. S4).

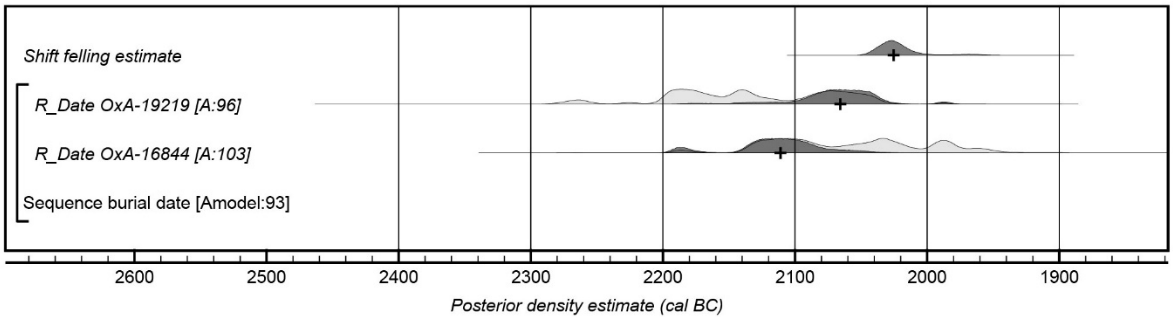

Fig. S3.
A comparison of the estimate for the felling date of the Gristhorpe log coffin with the two estimates on the skeletal remains from the coffin. We have applied a `Sequence` to these measurements on the skeletal remains to reflect their relative ordering of the radiocarbon ages; this provides us with calibrations for these measurements (shown in outline), and revised posterior density estimates (shown as solid distributions). The medians of these distributions are show in black '+'. We can see that the posterior estimate for the femur is slightly older than the posterior estimating the felling date of the timber for the coffin. The large square bracket down the left-hand side and the OxCal CQL2 keywords define the overall model

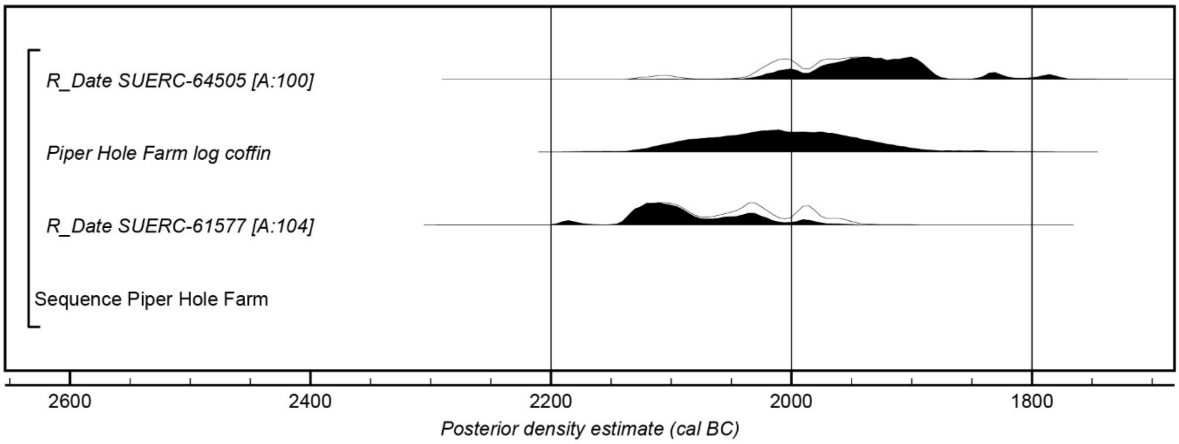

Fig. S4.
Estimate for the date of deposition of the Piper Hole Farm log coffin. The large square bracket down the left-hand side and the OxCal CQL2 keywords define the overall model

Alternative model

Here we present an additional approach to modelling the log coffin data shown in Figure S5 which uses the posterior density estimates generated in Figure 5, we constrain these outputs with additional prior information about the relative ordering of different types of Bronze Age material culture and practices over time. Where there is associated material culture we have grouped results from sites using Needham's periodisations (Needham 1996) for the British Bronze Age, together with revisions to this model which include other artefact forms (Needham 2009; Needham *et al.* 2010; Woodward & Hunter 2015, 461–471). We have identified sites as Period 1/2, or Period 2/3 or Period 3/4 where there appears to be elements of practices or material culture from different traditions. This follows the practice of Needham (e.g. in Melton *et al.* 2013), not least because many of the log coffin burials do not have closely diagnostic artefacts.

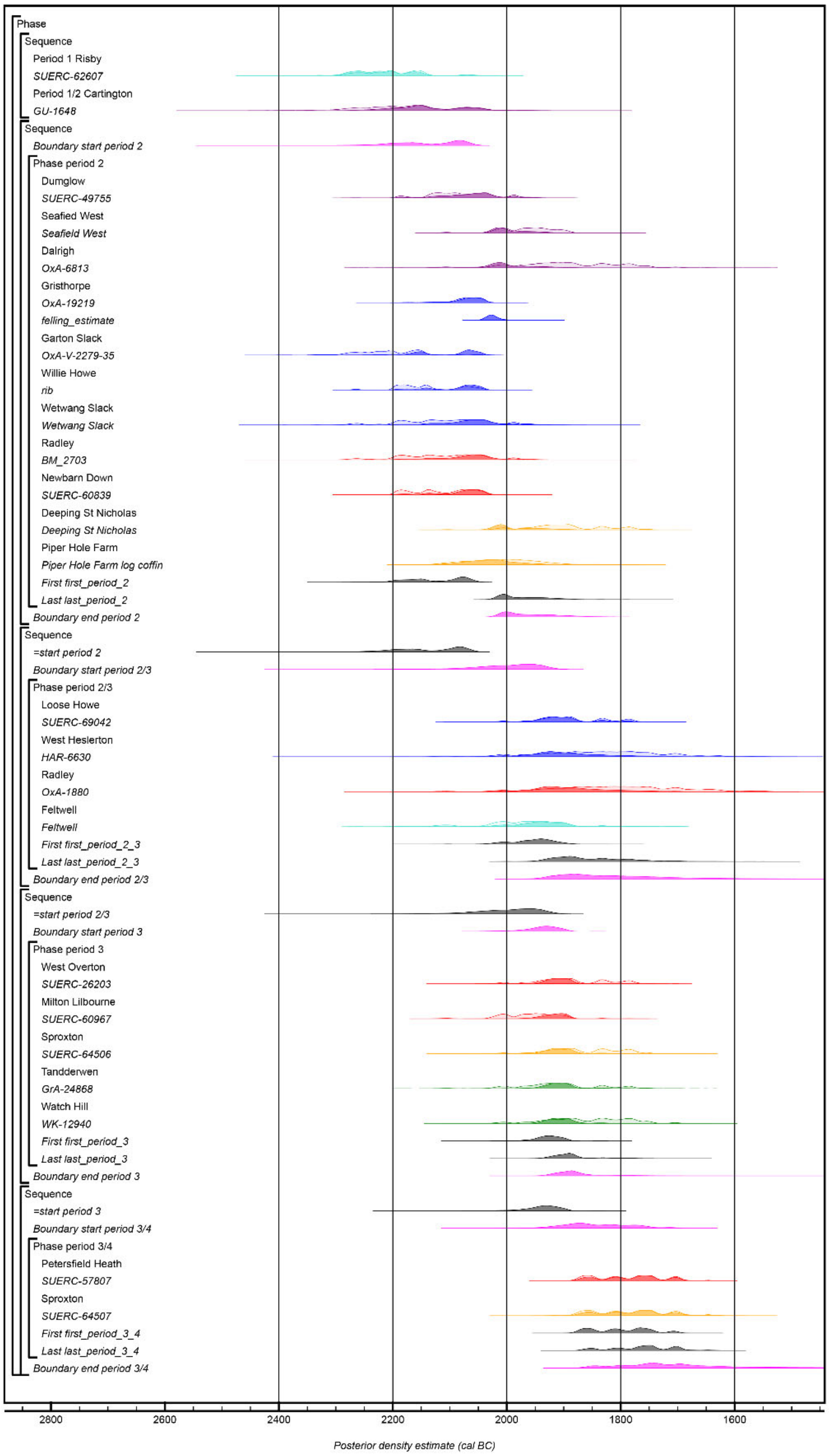

Fig. S5.

Posterior density estimate calculated in Figure 5 have been used to explore the timing of types of Bronze Age activity. We define these forms of activity in Table S1. The brackets and CQL2 keywords define the model, which is also described in the text. The results are given the same colouring for the regions as in Figure 5. (North-east England and Scotland purple, Northern England blue, Southern England red, the Midlands orange, Eastern England turquoise, Wales and the West of England green

Details of the ways we have grouped material culture are given in Table S1, together with the structure shown in Figure S2. In the model presented in Figure S1, we have suggested that the result we have (*SUERC-62607*) associated with Period 1material culture occurred before the result associated with Period 1 / 2 material culture (*GU-1648*). We have then related the results from Period 2, Period 2/3, Period 3 and Period 3/4 in an OxCal `Phase` defined by a `Boundary` parameter. We have suggested further temporal relationships between these groups of results, we have defined Period 2/3 as starting after the beginning of Period 2. Similarly, Period 3 is constrained to start after Period 2/3. Period 3/4 is constrained to being after Period 3. We have not included the Period 7 data in this model as they are so temporally distinct. We have taken this approach because it allows these signatures of material culture some temporal overlap, but still use some of the prior information developed by detailed studies of these groups of material culture. We here use this *process* of model building to help think about the chronological currency of such assemblages. We summarise some of the output from this analysis in Table S1. Other aspects of the model applied here are defined by the OxCal CQL2 commands and the structures shown in Figure S5.

Alternative model outputs

As we can see from Figure S5, at this precision, no clear patterning emerges from the association between these archaeological signatures and the date estimates. However, this exercise may be identifying patterns to explore in future research.

For the earlier results from Period 1 and Period 1/2, our distributions are still relatively imprecise because we have so few data; we estimate the earliest log coffin burial associated with Needham Period 1 material culture at Risby in *2305–2135 cal BC* (*95% probability*; *SUERC-62607*; Fig. S5). At Cartington we see log coffin burial associated with Period 1/2 style material culture in *2265–2020 cal BC* (*94% probability* or *1995–1980 cal BC 1% probability*; *GU-1648*; Fig. S5). For Period 2, we can see that evidence for log coffin burial across in many different regions. While the number of results and shape of the calibration curve mean that none of the estimates for activity for this archaeological signature is very precise. The estimate for the start of activity for Period 2 log coffin burial suggests this occurred in *2260–2050 cal BC* (*95% probability*; *start period 2*; Fig. S5). This result is quite bimodal (due to the calibration curve and the way we have presented the data). We give other estimates for the start of different Needham period definitions for material culture assemblages in Table S1.

It appears that there is some chronological overlap between different styles of material culture associated with log coffin burial; there appears to be overlap in the currency. types of activities associated with these different archaeological material culture signatures associated with log coffin burial. We show the currency of these different traditions associated with log coffin burials in Figure S6. This emphasises that log coffin burial was a relatively rare but long-lived tradition between the 22nd and 18th centuries cal BC, this burial rite cut across patterns in associated material culture.

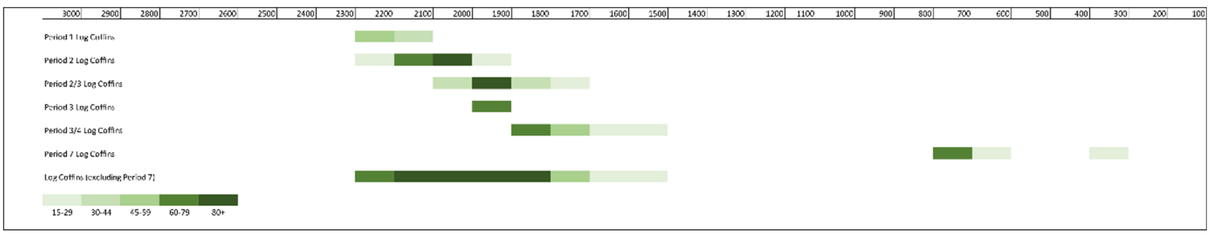

Fig. S6.

Schematic illustration showing the probability that log coffin burial was going on associated with different styles of Bronze Age material culture in each century. Higher probability is denoted by darker shading. The estimates are derived from the posterior density estimates calculated in Fig. S1 for Periods 1–3/4, and in Fig. 5 for Period 7

TABLE S1: MODELLED RADIOCARBON DETERMINATIONS FROM LOG COFFIN BURIALS IN RELATION PERIODISATION FOR THE BRITISH BRONZE AGE

Archaeological signature (after Needham 1996; Needham et al. *2010)*	*Parameter name (Figure S1) and archaeological interpretation*	*Highest Posterior Density interval (cal BC; 95% unless otherwise indicated)*
Period 1 Early Beakers & 'Chalcolithic' copper metal-working traditions. Inhumation burial predominates	*SUERC-62607* (Period 1 log coffin burial)	*2305–2135*
Period 2 Late Beakers, Food Vessels & early bronze metalworking traditions. Cremation burial predominates	*Start period 2* log coffin burial *End period 2* log coffin burial	*2260–2050* *2030–1850*
Period 3 Late Food Vessels, Urns, 'Wessex I' grave assemblages & Willerby bronze metalworking traditions. Cremation burial predominates	*Start period 3* log coffin burial *End period 3* log coffin burial	*2015–1885* *1945–1745*
Period 3/4 Urns, 'Wessex II' grave assemblages & Arreton bronze metalworking traditions, including Camerton-Snowshill daggers. Cremation burial predominates	*Start period 3/4* log coffin burial *End period 3 /4* log coffin burial	*1950–1735 (93%)* or *1725–1705 (3%)* *1880–1040*

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