Radiocarbon Dating

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Introduction

Thirteen radiocarbon age determinations have been obtained on samples of charred plant material and cremated human bone from Latton Lands.

Methods

Seven samples were processed and measured by Accelerator Mass Spectrometry (AMS) at the Centre for Isotope Research, Groningen University, The Netherlands in 2004, following the procedures described by Aerts-Bijma *et al* (1997; 2001), Lanting *et al* (2001) and van der Plicht *et al* (2000).

Six samples submitted to Scottish Universities Environmental Research Centre (SUERC) were prepared using methods outlined in Slota *et al* (1987), and measured by Accelerator Mass Spectrometry as described by Xu *et al* (2004).

Both laboratories maintain continual programmes of quality assurance procedures, in addition to participation in international inter-comparisons (Scott 2003). These tests indicate no laboratory offsets and demonstrate the validity of the precision quoted.

Results

The radiocarbon results are given in table *, and are quoted in accordance with the international standard known as the Trondheim convention (Stuiver and Kra 1986). They are conventional radiocarbon ages (Stuiver and Polach 1977).

Calibration

The calibration of the results, relating the radiocarbon measurements directly to calendar dates, are given in table * and in figures x-xx. All have been calculated using the calibration curve of Reimer *et al* (2004) and the computer program OxCal (v3.10) (Bronk Ramsey 1995, 1998, 2001). The calibrated date ranges cited in the text are those for 95% confidence. They are quoted in the form recommended by Mook (1986), with the end points rounded outwards to 10 years if the error term is greater than or equal to 25 radiocarbon years. The ranges quoted in italics are *posterior density estimates* derived from mathematical modelling (see below). The ranges in plain type have been calculated according to the maximum intercept method (Stuiver and Reimer 1986). All other ranges are derived from the probability method (Stuiver and Reimer 1993).

Bayesian modelling

A Bayesian approach has been adopted for the interpretation of the chronology from this site (Buck *et al* 1996). Although the simple calibrated dates are accurate estimates of the dates of the samples, this is usually not what archaeologists really wish to know. It is the dates of the archaeological events, which are represented by those samples, which are of interest, in the case of Latton Lands, its the chronology of the infilling of the causewayed enclosure ditch. The dates of this activity can be estimated not only using the absolute dating information from the radiocarbon measurements on the samples, but also by using the stratigraphic relationships between samples.

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Fortunately, methodology is now available which allows the combination of these different types of information explicitly, to produce realistic estimates of the dates of interest. It should be emphasised that the *posterior density estimates* produced by this modelling are not absolute. They are interpretative *estimates*, which can and will change as further data become available and as other researchers choose to model the existing data from different perspectives.

The technique used is a form of Markov Chain Monte Carlo sampling, and has been applied using the program OxCal v3.10 (http://www.rlaha.ox.ac.uk/), which uses a mixture of the Metropolis-Hastings algorithm and the more specific Gibbs sampler (Gilks *et al* 1996; Gelfand and Smith 1990). Details of the algorithms employed by this program are available from the on-line manual or in Bronk Ramsey (1995; 1998; 2001). The algorithm used in the models described below can be derived from the structures shown in fig x.

Objectives and sampling strategy

The radiocarbon programme was designed to achieve the following objectives:

- To provide a date for the infilling of the double causewayed ditch.
- To provide a precise date for the rare mortuary practise of the Bustum burial.
- To provide a precise date for the potentially early Iron Age metal working activity.
- To confirm the presence of Iron Age emmer wheat in the pit 1289.

The first stage in sample selection was to identify short-lived material, which was demonstrably not residual in the context from which it was recovered. The taphonomic relationship between a sample and its context is the most hazardous link in this process, since the mechanisms by which a sample came to be in its context are a matter of interpretative decision rather than certain knowledge. All samples consisted of single entities apart from context 1700 where several grains of emmer wheat were required to provide enough carbon (Ashmore 1999). Material was selected only where there was evidence that a sample had been put fresh into its context. The main category of materials, which met these taphonomic criteria, were:

- recognisable dumps of charred material which where interpreted as the result of single archaeological 'events'.
- charcoal with a direct functional relationship to its context i.e. fuel from metal working pits and the cremation pyre.
- cremated bone from the Bustum burial.

Additionally samples of emmer wheat were submitted to confirm the Iron Age presence of this material at the site and *not* to date their context.

Results

The double causewayed enclosure

Six samples, including one from the terminus, were submitted from the fills of the one of the ditches. A single sample (SUERC-12231) came from one of the lower fills (context 2547) stratigraphically below a possible recut. Determinations were also made on five samples from secondary fills; the two determinations from context 2545 are not statistically consistent (SUERC-12230 and GrA-33508 ($T'=12.1$; $\nu=1$; $T'(5\%)=3.8$; Ward and Wilson 1978) although those from context 2365 (GrA-33710 and SUERC-12229) are ($T'=0.3$; $\nu=1$; $T'(5\%)=3.8$; Ward and Wilson 1978) and could therefore be of the same actual age. A single sample (GrA-33509) also came from the secondary fill of a terminus; the five determinations from the secondary fills are not statistically consistent ($T'=19,5$; $\nu=4$; $T'(5\%)=9.5$; Ward and Wilson 1978).

The model shown in fig x shows good agreement between the stratigraphy and the radiocarbon measurements (A overall=84.5%). The model provides an estimate for the start of infilling of *2020-1690 cal BC (95% probability; Boundary start infilling ditch:* fig x) and probably *1900-1720 cal BC (68% probability).* This therefore provides a *terminus ante quem* for the digging of the causewayed enclosure ditch. Infilling of the ditch probably occurred over a number of centuries.

The Iron Age metal working pits

Two single samples from two metal working pits produced statistically consistent results (T'=1.7; ν=1; T'(5%)=3.8; Ward and Wilson 1978) and therefore could be of the same age. The results indicate a middle Iron Age date for the metal working.

The Iron Age cultivation of emmer wheat

The two determinations made on samples of emmer wheat (SUERC-12226 and GrA-33708) from pit 1289 are statistically consistent (T'=0.2; ν=1; T'(5%)=3.8; Ward and Wilson 1978). This confirms a late Iron Age date for the presence of emmer wheat at the site. The presence of emmer wheat in an Iron Age context from North Wiltshire would be unusual though not unprecedented. The subspecies is generally regarded as a contaminant rather than a cultivar at this time. This is likely to represent regional variations in farming practise and might be taken as further evidence to suggest agriculture at the site in the Iron Age which is atypical and/or specialised for the region and the period (see Griffiths this volume, and Poole this volume).

The Bustum burial

Three determinations were made on samples from the Bustum burial. Two determinations were made on samples of charcoal and one from the cremated human bone; all the samples originated from the same context and represent the same archaeological event. The three measurements are not statistically consistent (T'=18.0; ν=1; T'(5%)=3.8; Ward and Wilson 1978) and therefore represent material of different ages. The two charcoal samples are statistically consistent (T'=2.9; ν=1; T'(5%)=3.8; Ward and Wilson 1978). The measurement on the cremated bone may therefore simply represent one of the one in twenty cases where a radiocarbon result lies outside the 'true age' of the sample (Bowman 1990).

GrA-33707 (160 cal BC-cal AD 70) provides the best estimate for the date of the Bustum and analysis shows there is a 93.2% probability that the burial occurred before the Roman invasion of AD 43. Given the rarity of Bustum burials and the suggestion that the practise was introduced to Britain by the Romans this is an important result (see Geber this volume).

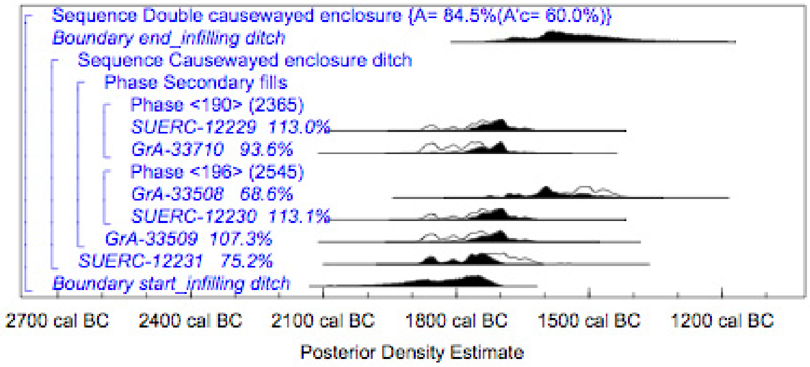

Figure x. Probability distributions of dates from the causewayed enclosure ditch. Each distribution represents the relative probability that an event occurs at a particular time. For each of the dates two distributions have been plotted; one in outline, which is the result of simple radiocarbon calibration and a solid one, based on the chronological model. The large square brackets down the left hand side along with the OxCal key words define the overall model exactly.

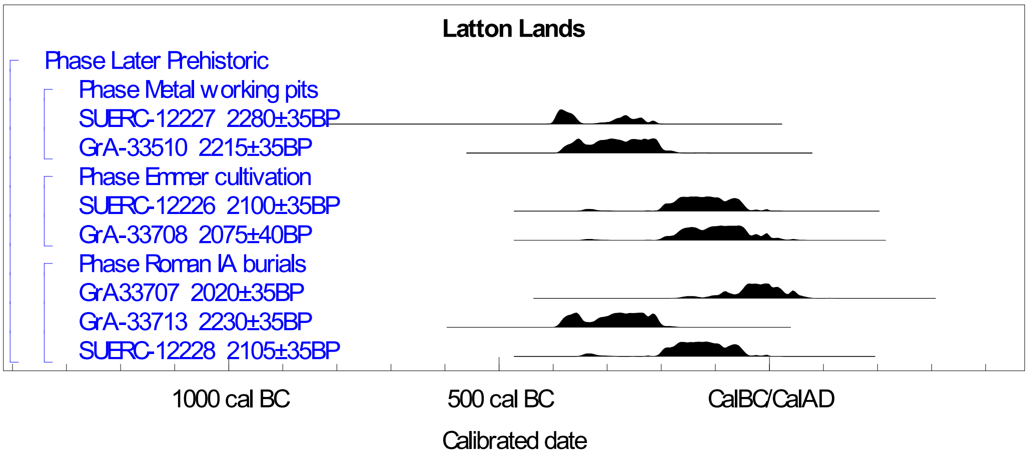

Figure xx. Probability distributions of radiocarbon dates for the later prehistoric features. Each distribution represents the relative probability that an event occurred at a particular time. These distributions are the result of simple radiocarbon calibration (Stuiver and Reimer 1993).

Table *: Radiocarbon dates from Latton Lands

Laboratory number	**Sample ID**	**Material**	**Radiocarbon Age (BP)**	**δ^{13}C (‰)**	**Calibrated Date (95% confidence)**	***Posterior Density estimate (95% probability)***
SUERC-12226	LALA01 Context 1700 Sample 159A	Emmer wheat, *Triticum dicoccum*	2100 ±35	-23.1	340–40 cal BC	-
GrA-33708	LALA01 context 1700 sample 159B	Emmer wheat, *Triticum dicoccum*	2075 ± 40	-22.4	200 cal BC-cal AD 20	-
SUERC-12227	LALA04 Context 3872 Sample 225	charcoal, *Prunus* sp.	2280 ±35	-26.0	400–210 cal BC	-
SUERC-12228	LALA01 Context 1104 Sample 157	charcoal, *Hedera helix*	2105 ±35	-27.2	350–40 cal BC	-
SUERC-12229	LALA02 Context 2365 Sample 190A	charcoal, *Prunus* sp.	3430 ±35	-25.6	1880–1630 cal BC	*1810-1620 cal BC*
GrA-33710	LALA02 context 2365 sample 190B	charcoal, *Prunus* sp.	3455 ± 35	-25.8	1880-1620 cal BC	*1860-1660 cal BC*
SUERC-12230	LALA02 Context 2545 sample 196A	charcoal, Maloideae	3430 ±35	-25.9	1880–1630 cal BC	*1820-1800 (1%) or 1780-1630 (94%) cal BC*
GrA-33508	LALA02 context 2545 sample 196B	Charcoal, *Alnus/Corylus*	3245 ± 40	-26.6	1620-1430 cal BC	*1730-1710 (1%) or 1690-1450 (94%) cal BC*
SUERC-12231	LALA02 Context 2547 Sample 197	charcoal, Maloideae	3410 ±40	-24.9	1880–1610 cal BC	*1880-1700 cal BC*
GrA-33510	LALA04 context 3672 sample 218	charcoal, *Prunus spinosa*	2215 ± 35	-26.5	390-170 cal BC	-
GrA-33707-	LALA01 context 1104 sample 165	charcoal, *Prunus spinosa*	2020 ± 35	-23.2	160 cal BC-cal AD 70	-
GrA-33713	LALA01 context 1104 sk1100	Cremated human bone, lower limb	2230 ± 35		400-190 cal BC	-

		fragment				
GrA-33509	LALA02 context 2382 sample 199	charcoal, Maloideae	2215 ± 35	-25.7	1890-1630 cal BC	*1820-1630 cal BC*

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