Radiocarbon Dating: Suffolk Rivers Project

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Introduction

Thirty radiocarbon age determinations were obtained on samples extracted from four palaeoenvironmental cores (Beccles #1, Beccles #2, Hengrave, and Ixworth) taken as part of the Suffolk Rivers Project.

Methods

The 13 samples submitted to the Scottish Universities Environmental Research Centre (SUERC), East Kilbride (SUERC) were pre-treated following standard procedures, graphitised following the methods outlined in Slota *et al* (1987), and measured by Accelerator Mass Spectrometry (AMS) according to Xu *et al* (2004).

The 17 samples submitted to the Centre for Isotope Studies, The University of Groningen, The Netherlands (GrA) were processed and measured by Accelerator Mass Spectrometry as described by Aerts-Bijma *et al* (1997; 2001) and van der Plicht *et al* (2000).

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 1, 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 calibrations of the results, relating the radiocarbon measurements directly to calendar dates, are given in Table 1 and in Figures 1–4. They have been calculated using the calibration curves of Reimer *et al* (2004) and Keuppers *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 in Table 1 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).

Sampling

The first stage in sample selection should be to identify short-lived material. This is because 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. Unfortunately not all the samples were identified as short-lived material (eg the unidentified wood fragments from Beccles #1 and Ixworth).

All samples consisted of single entities (Ashmore 1999), apart from a number where material had to be bulked together to provide enough carbon.

Beccles #1

Objectives

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- To determine the timing of the onset of biogenic (*in-situ*) organic accumulation at the site.
- To identify variations in the rate of organic accumulation with the floodplain during its depositional history.
- To determine the timing of the onset and cessation of minerogenic sedimentation.

The samples and sequence
Beccles #1
Samples were dated from eight horizons within a 545cm core taken from close to a prehistoric trackway preserved witin peat at Beccles (River Waveney). In stratigraphic sequence they were:
GrA-33477 (unidentified plant remains) from the base (534cm) of a dark brown herbaceous very well humified peat, from near to the base of the sequence.
GrA-33476 (*Alnus glutinosa*, stem) from the centre (350cm) of a dark red- brown herbaceous very well humified peat.
SUERC-12037 (unidentified bark fragment) from the top (202 cm) of a dark red- brown herbaceous very well humified peat
GrA-33475 (*Alnus glutinosa*, stem) from the base (199cm) of a red- brown herbaceous very well humified peat.
The two samples (SUERC-12036 & GrA-33473) from the top (118cm) of a red- brown herbaceous very well humified peat (unidentified wood & Poaceae fragments and internode) are not statistically consistent (T'=20.1; ν=1; T'(5%)=3.8; Ward and Wilson 1978) and represent material of different ages.
SUERC-12035 (Poaceae fragments) from the base (115cm) of a dark grey-brown very well humified silty peat, thought to have been deposited prior to the start of inter-tidal estuarine conditions.
GrA-33472 (*Alnus glutinosa*, small wood fragment) from the base (99cm) of a dark grey-brown organic-rich silt, thought to have been deposited under inter-tidal estuarine conditions.
GrA-33471 (*Alnus glutinosa*, small wood fragment) from the base (84cm) of a dark grey-brown well humified silty peat.

Results
Figure 1 shows that the results are not in a stratigraphic sequence. The basal date GrA-33477 correlates wit the pollen evidence in showing that the onset of organic accumulation started in the early Holocene. However, the measurements in the upper 350cm of the core do not provide a robust chronological framework, due to a number of inversions between dates.

Beccles #2

Objectives
- To determine the timing of the onset of minerogenic sedimentation onto the underlying peat
- To identify variations in the rate of minerogenic accumulation within the coastal lowland environment during its depositional history.
- To provide a chronological understanding of the variations in sedimentology within the minerogenic unit, which are believed to be related to changes in relative sea level.

Samples and sequence
Five samples were submitted from a second core taken at Beccles that contained evidence for deposition of sediments in a lowland intertidal coastal environment. In stratigraphic sequence the samples were:

GrA-35067 (unidentified plant remains) from the base (283cm) of a blue-grey clayey silt, thought to have been deposited in an inter-tidal estuarine environment, and located immediately above freshwater peat deposits.
GrA-33479 (monocot stem – modern cal AD 1956-1957) from the base (254cm) of a grey-brown organic-rich silt, thought to have been deposited under inter-tidal estuarine conditions.
SUERC-12039 (herbaceous stems) from the base (250cm) of a blue-grey clayey silt, assumed to have been deposited in an inter-tidal estuarine environment.

GrA-35050 (unidentified plant fragments) from the base (222cm) of a grey-brown organic-rich silt, thought to have been deposited in an inter-tidal estuarine environment.
SUERC-12038 (Poaceae fragment) from the base (134cm) of a blue-grey clayey silt, assumed to have been deposited in an inter-tidal estuarine environment.

Results
The results shown in Figure 2 suggest that an intact sequence does not survive, although the two modern results might be explained by the use a Eijkelcamp corer in the minerogenic rich sediments.

Hengrave

Objectives
- To determine the timing of the onset of biogenic (*in-situ*) organic accumulation at the site.
- To identify variations in the rate of organic accumulation with the floodplain during its depositional history.
- To provide an understanding of the timing of enhanced minerogenic sedimentation within the peat depositional archive.

Samples and sequence
Nine samples were dated from 300cm core taken through a possible palaeochannel within te floodplain of the River Lark, near Hengrave. In stratigraphic sequence the samples were:

SUERC-12031 (unidentified plant stems) from the base (299cm) of a herbaceous well humified slightly silty peat.
GrA-33482 (Poaceae fragment) from (256cm) within a herbaceous well humified slightly silty peat.
SUERC-12030 (Poaceae fragment) from (232cm) within a herbaceous well humified slightly silty peat.
GrA-35054 (Poaceae stems) from the base (199cm) of a herbaceous well humified sandy peat.
SUERC-12030 (Unidentified plant remains cf. seed/flower head) from the base (163cm) of a herbaceous well humified slightly sandy peat.
GrA-33481 (Poaceae stems and internode) from the base (150cm) of a herbaceous well humified silty peat.
SUERC-12028 (Poaceae fragments) from the base (99cm) of a herbaceous humified peat.
GrA-35051 (Poaceae fragment) from the base (59cm) of a herbaceous well humified silty peat.
SUERC-12027 (Poaceae fragment) from the top (26cm) of a herbaceous well humified silty peat.

Results
Figure 3 shows that the results are not in a stratigraphic sequence and as such do not provide a chronological framework for either answering the objectives of the dating programme or for interpreting the palaeoenvironmental work.

Mickle Mere (Ixworth)

Objectives
- To determine the timing of the onset of *in-situ o*rganic sedimentation at the site.
- To identify variations in the rate of sedimentary accumulation with the floodplain during its depositional history.
- To determine the timing of the of minerogenic sedimentation.

Samples and sequence
Five samples were dated from a 350cm core taken trough organic deposits preserved within palaeochannel features within Mickle Mere, Ixworth. In stratigraphic sequence the samples were:

GrA-33483 (*Alnus glutinosa*, stem) from the base (344cm) of a well humified peat which is underlain by silty sands.
SUERC-12026 (*Alnus glutinosa*, wood fragment) from the base (263cm) of an organic silt unit which is underlain by well humified peat.
GrA-33485 (*Alnus glutinosa*, stem) from the base (249cm) of a well humified peat which is underlain by an organic silt.
SUERC-12025 (unidentified wood fragments) from the base (149cm) of a well humified slightly silty peat which is underlain by herbaceous well humified peat.
GrA-35056 (Poaceae fragment) from the base (140cm) of a light grey-brown organic sand, which overlies a dark brown well humified peat.
SUERC-12021 (Poaceae fragment) from the base (137cm) of a dark brown very well humified silty peat which is underlain by an organic-rich horizon.
GrA-350555 (unidentified seed) from the base (86cm) of a dark brown very well humified peat which is underlain by a silty peat.

Results
The basal date of 9660–9250 cal BC (GrA-33483) correlates with the pollen evidence in suggesting that organic sedimentation started in the early Holocene at the site. The other results do not, however, support the pollen evidence in suggesting an intact Holocene palaeoenvironmental sequence, and a chronological framework cannot be provided for the upper part of the sequence.

Discussion
The results highlight the need for meticulous identification and documentation of samples submitted for radiocarbon analysis prior to being sent to laboratories. Such preliminary work is imperative for trying to disentangle results such as those obtained as part of this project.

Table 1. Radiocarbon results from the Suffolk Rivers Project

Laboratory code	Sample ID	Material	δ13C (‰)	Radiocarbon Age (BP)	Calibrated date (95% confidence)
Beccles #1					
GrA-33471	84cm(B)	*Alnus glutinosa*, small wood fragment (R Gale)	-27.3	2080±50	350 cal BC–cal AD 30
GrA-33472	99cm	*Alnus glutinosa*, small wood fragment (R Gale)	-27.3	2090±70	360 cal BC–cal AD 60
SUERC-12035	115cm (B)	Poaceae fragments	-24.2	1595±35	cal AD 390–550
SUERC-12036	118cm (A)	Unidentified wood	-28.1	1975±35	50 cal BC–cal AD 120
GrA-33473	118cm (B)	Poaceae fragments and internode	-28.3	2215±40	390–170 cal BC
GrA-33475	199cm	*Alnus glutinosa*, stem (R Gale)	-27.6	2695±40	920–790 cal BC
SUERC-12037	202cm	Bark fragment, inidentified (R Gale)	-27.5	2835±35	1120–900 cal BC
GrA-33476	350cm	*Alnus glutinosa*, stem (R Gale)	-28.2	2785±40	1030–830 cal BC
GrA-33477	534cm (C)	unidentified plant fragments	-27.1	9960±130	10040–9220 cal BC
Beccles #2					
SUERC-12038	134cm (B)	Poaceae fragment	-27.9	915±35	cal AD 1020–1220
GrA-35050	222cm (B)	unidentified plant fragments	-27.7	225± 40	cal AD 1530-1950
SUERC-12039	250cm	herbaceous stems (R Gale)	-24.2	1770±35	cal AD 130–380
GrA-33479	254cm (A)	Monocotyledon stem (R Gale)	-29.7	105.45±1.09 %Mod.	cal AD 1956-1957
GrA-35067	283cm (A)	unidentified plant fragments	-26.4	1445±40	cal AD 540-660
Hengrave					
SUERC-12027	26cm (A)	Poaceae stems	-27.8	125±35	cal AD 1660–1955*
GrA-35051	59cm (B)	Poaceae stems	-28.0	1025±45	cal AD 890-1150
SUERC-12028	99cm (B)	Poaceae fragments	-25.9	955±35	cal AD 1010–1170
GrA-33481	150cm (A)	Poaceae stems and internode	-27.4	1965±40	50 cal BC–cal AD 130
SUERC-12029	163cm (A)	Unidentified plant remains cf. seed/flower head	-27.4	1750±35	cal AD 210–390
GrA-35054	199cm (B)	Poaceae stems	-27.0	1740±45	cal AD 130-420
SUERC-12030	232cm (A)	Poaceae fragments	-26.1	1000±35	cal AD 980–1160
GrA-33482	256cm (A)	Poaceae fragments	-27.3	1620±35	cal AD 340–540
SUERC-12031	299cm (A)	unidentified plant stems	-27.3	1720±35	cal AD 230–420
Ixworth					
GrA-35055	86cm (A)	unidentified seed	-26.8	1935±40	40 cal BC- cal AD 140
SUERC-12021	137cm (B)	Poaceae fragments	-27.0	1560±35	cal AD 410–590
GrA-35056	140cm (B)	Poaceae fragments	-25.4	1465±45	cal AD 530-660
SUERC-12025	149cm (A)	unidentified wood fragments	-27.4	2905±35	1260–990 cal BC
GrA-33485	249cm	*Alnus glutinosa*, stem (R Gale)	-29.0	6265±45	5330–5070 cal BC
SUERC-12026	263cm	*Alnus glutinosa*, wood fragment (R Gale)	-26.6	5980 ±40	4990–4770 cal BC
GrA-33483	344cm (A)	*Alnus glutinosa*, stem (R Gale)	-27.7	9900 ±60	9660–9250 cal BC

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Figure 1. Probability distributions of dates from Beccles Trackway (Beccles#1). 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).

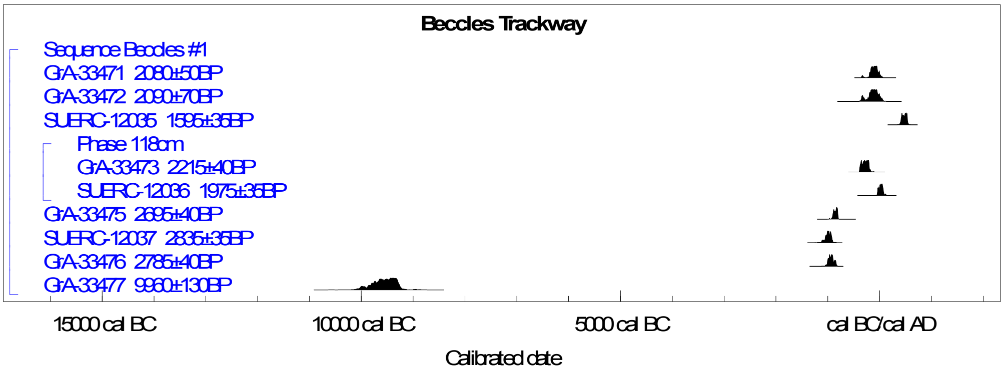

Figure 2. Probability distributions of dates from Beccles Trackway (Beccles#2). Each distribution represents the relative probability that an event occurred at a particular time. These distributions are the result of simple radiocarbon calibration (Stuiver and Reimer 1993).

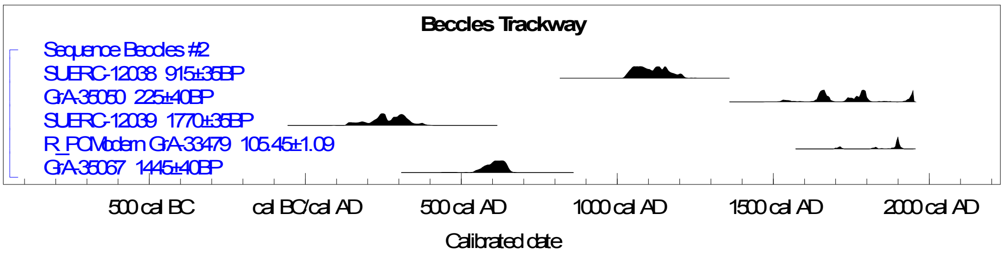

Figure 3. Probability distributions of dates from Hengrave. Each distribution represents the relative probability that an event occurred at a particular time. These distributions are the result of simple radiocarbon calibration (Stuiver and Reimer 1993).

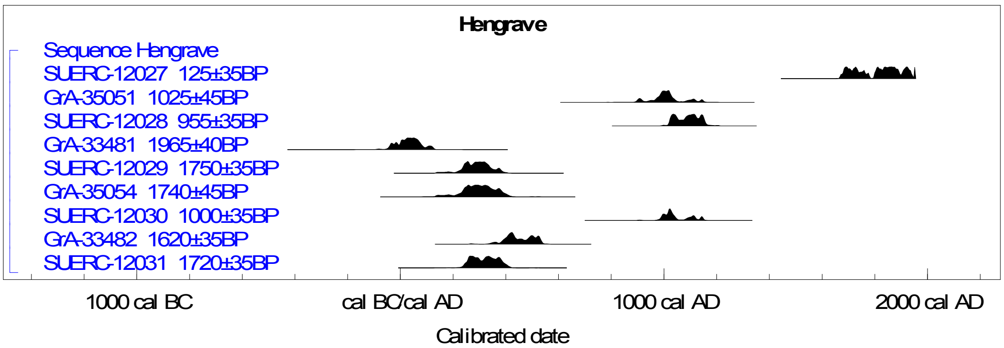

Figure 4. Probability distributions of dates from Mickle Mere (Ixworth). Each distribution represents the relative probability that an event occurred at a particular time. These distributions are the result of simple radiocarbon calibration (Stuiver and Reimer 1993).