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Sizewell, Suffolk: A Palaeoenvironmental Assessment of Deposits Encountered Along the Proposed Leiston Substation 132kV Cable Route

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By

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Summary

Deposits of palaeoenvironmental potential were encountered during archaeological excavations along the proposed Leiston Substation 132kV cable route, Suffolk. Birmingham Archaeo-Environmental undertook palaeoenvironmental assessments on a c. 0.50m thick organic unit encountered during trial trenching. Sediment accumulation commenced in the Late Bronze Age/Early Iron Age and continued until the early Anglo-Saxon period. The site was located on the waterlogged floodplain of a SizewellBelt tributary, with stagnant or slow moving water present on the sampling site during sediment accumulation. Beetle and pollen assessments indicate a largely open grassland landscape around the wetland area, with some heathland and patchy hazel scrub. Cereal pollen and grassland herbs indicate that pastoral and agricultural activity was probably taking place close to the site, whilst the presence of large herbivores is suggested by the beetle assemblages. Human farming/settlement activity was therefore probably taking place locally from the later Bronze Age through to the early Medieval period. In addition to further analyses of the trench deposits, the report also recommends a suite of palaeoenvironmental assessments to be carried out on a deeper organic sequence encountered during borehole investigations. This will fully utilise the palaeoenvironmental record available and provide further insights into landscape changes and the timing and nature of human impact on the environment.

KEYWORDS: Leiston, Sizewell, Pollen, Beetles, Radiocarbon, Borehole Survey

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1. INTRODUCTION

The site is located on the North Sea coast immediately south of Sizewell Power Station. Deposits of palaeoenvironmental potential were discovered during ground investigations along the proposed cable route for Leiston Substation, Sizewell, Suffolk (TM 4719 6316). Previous borehole investigations had been undertaken in order to install water and gas monitoring wells, and indicated the presence of organic-rich deposits. The cable route was initially highlighted as having a high potential to encounter deposits of palaeoenvironmental importance due to its proximity to the floodplain of a tributary of the Sizewell Belts (situated to the north). The spatial variation of these deposits was however poorly understood.

Birmingham Archaeo-Environmental (BA-E) was subsequently subcontracted by Suffolk County Council Archaeological Service (SCCAS) to undertake a high-resolution coring survey along the cable route. This was required in order to evaluate the stratigraphic sequence preserved across the site and to assess the potential of the deposits for palaeoenvironmental analyses.

The fieldwork confirmed the presence of organic-rich deposits along the pipeline route. Targeted archaeological trial trenching commenced shortly after the completion of the coring survey, from which organic deposits were subsampled for further assessment (see Hill & Gearey, 2008).

The organic-rich unit, encountered in the centre and to the east of the study area (Figure 1), probably accumulated through a process of *in-situ* organic accumulation in a floodplain setting. Alternatively, the deposits could have accumulated within aa palaeochannel.

Palaeoenvironmental assessments of the deposits were therefore recommended to provide an insight in to the timing and nature of the environmental changes across the site. An additional phase of fieldwork was also undertaken shortly after the first site visit. Due to the extent to which organic deposits were encountered during manual coring (up to 2 m depth proximal to the tributary of the Sizewell Belts), trenching could not fully excavate the complete stratigraphic sequence. Suitable sampling for palaeoenvironmental assessment could also not be collected using a manual corer due to the sand-rich sequence, which resulted in repeated borehole collapse and sample contamination. Consequently, BA-E subcontracted Global Probing and Sampling Ltd to undertake dynamic window sampling on the site.

This report presents the results of the palaeoenvironmental assessments that were undertaken on the organic unit sampled during the phase of trial trenching (pollen, diatom, beetle assessments and radiocarbon dating). In addition, the report summarises the results of the window sampling fieldwork and includes recommendations for further analyses on the sedimentary archive.

2. METHODS

In order to obtain an understanding of environment on and around the sampling site during the development of the organic unit, samples were taken from Trench 30, the approximate location of which is provided in Figure 1. A *c.* 0.50 m thick organic unit was encountered within the trench, from which monolith and bulk samples were collected (see Figure 2).

2.1 Pollen Assessment
A total of 9 subsamples were assessed for pollen. Sampling was undertaken at 0.08 m intervals throughout the sequence (0.72, 0.80, 0.88, 0.96, 1.04, 1.12, 1.20, 1.28 and 1.36 m). Pollen preparation followed standard techniques including potassium hydroxide (KOH) digestion, hydrofluoric acid (HF) treatment and acetylation (Moore *et al*., 1991). At least 125 total land pollen grains (TLP) excluding aquatics and spores were counted for each sample.

2.2 Beetle Assessment
A total of three samples were processed and assessed for Coleoptera (beetle) remains. The organic unit from Trench 30 was split into three sub-samples: 0.80-0.99 m, 0.99-1.18 m and 1.18-1.36m depths. This assessment was to establish:

1. Are insect remains present?
2. And if so, are they of interpretative value?
3. Do the insect remains from these samples provide information about the nature of the environment in the area at the time of these deposits formed?
4. What were the water conditions in the feature?
5. Do the insects provide information on possible land use in the area?
6. How do these insect faunas compare to others from Suffolk and other sites of this period?

The samples were processed using the standard method of paraffin flotation outlined in Kenward *et al.* (1980) at the University of Birmingham. The insect remains were then sorted from the paraffin flot and the sclerites identified under a low power binocular microscope at x10 magnification. Where possible, the insect remains were identified by comparison with specimens in the Gorham and Girling collections housed at the University of Birmingham. The taxonomy used for the beetles follows that of Lucht (1987). A summary of the key beetle species encountered is provided in Table 1.

2.3 Diatom Assessment
Considering the proximity of the site to the coastal zone, diatom assessments were undertaken in order to assess the potential for these proxies to provide information regarding the role of changes in relative sealevel on sediment formation processes at the sampling site. A total of nine subsamples were taken from the organic unit for diatom assessment from the same depths as those assessed for pollen (0.72, 0.80, 0.88, 0.96, 1.04, 1.12, 1.20, 1.28 and 1.36m). These were prepared following the standard procedure described by Plater *et al*. (2000).

2.4 Radiocarbon Dating
A total of three samples were submitted for radiocarbon dating to SUERC, East Kilbride, to provide an absolute chronology. Sub-samples were taken from the top (0.80m), middle (1.04m) and bottom (1.28m) of the organic unit, where it was considered organic preservation provided sufficient amounts of organic carbon for dating purposes. Each sample underwent acid/alkali/acid treatment prior to dating. Radiocarbon dates were calibrated using Intcal04 (Reimer *et al*., 2004).

2.5 Borehole Survey
Global Probing and Sampling Ltd were subcontracted to undertake dynamic window sampling on the site. Window sampling enables complete sedimentary sequences to be taken at 1 m depth intervals up to a depth of up to *c*. 10 m or until bedrock is encountered. The drill rig ensures that an intact sedimentary sequences can be extracted, restricting the potential for contamination during sampling. Sampling was undertaken where Core 23 was located during the initial site evaluation (refer to figure 1).

Organic-rich sands and well humified peats were encountered in the north-eastern corner of the cable route (core 23; Figure1) to a depth of up to *c.* 2.3 m. As a consequence, two window sample boreholes were extracted for palaeoenvironmental assessments. The boreholes were returned to the Birmingham Archaeo-Environmental laboratory at the University of Birmingham for detailed stratigraphic analysis. Sediments were recorded using the Troels-Smith (1955) classification scheme. The scheme breaks down a sediment sample into four main components and allows the inclusion of extra components that are also present, but that are not dominant. Key physical properties of the sediment layers are also identified according to darkness (Da), stratification (St), elasticity (El), dryness of the sediment (Dr) and the sharpness of the upper sediment boundary (UB). A summary of the sedimentary and physical properties classified by Troels-Smith (1955) and a stratigraphic breakdown of the sampled boreholes is provided in Appendix I.

3. PRELIMINARY RESULTS OF FIELDWORK

3.1 Pollen Assessments

The majority of the pollen samples contained good concentrations of well preserved pollen. Only samples from 0.80m and 1.36m depths provided low pollen counts, although a full slide was traversed for each sample to ensure a sufficient count was obtained. The results are presented in the form of a pollen diagram (Figure 3), produced using TILIA and TILIA*GRAPH (Grimm 1991). A stratigraphic column and the radiocarbon dates are also provided on this figure.

Pollen preservation was good, although the abundance of broken and crumpled grains was observed to be high. In addition, some pre-Quaternary spores (PQS's) were also noted. Although there was no clear relationship between the abundance of PQS's and stratigraphic changes, the presence of these spores suggests some re-worked material derived from local geological sources has been incorporated into the sediment.

The base of the pollen diagram is dominated by trees and shrubs, collectively contributing 75%TLP. *Alnus* (alder) is well represented in the basal sample with only occasional grains of *Tilia* (lime) and *Pinus sylvestris* (pine). *Corylus avellana*-type (Hazel, but may include sweetgale) dominates the shrub taxa with *Calluna vulgaris* (heather) also recorded. The diagram shows a relatively rapid decline in *Alnus* above the base at 1.27m but shrubs including *Corylus avellana*-type and *Calluna vulgaris* maintain values of up to 40%. Herb taxa are well represented across the diagram with Poaceae, Lactuceae undiff. and *Plantago lanceolata* well represented. In addition, herbs including Ranunculaceae undiff. (buttercups), *Rumex* (sorrels) and Chenopodiaceae (Fat hen family) also contribute. *Cerealia*-type indet. are present increasing to <5% TLP around 0.97m depth. This depth also sees increases in *Calluna* and Lactuceae and concomitant reductions in *Alnus*.

The impression is of an open, grassy landscape but with hazel scrub and heath land persisting locally across the period of time represented by the diagram. Following the initial fall in alder at the base of the diagram, percentages of this tree are sufficient to indicate that some scattered alder remained on the damper soils, presumably around the edges of the woodland. The comparatively high values for herbs including ribwort plantain and dandelions gives the impression of a pastoral, meadow-like environment in the close proximity of the site. The presence of cereal pollen within the sequence may reflect arable cultivation in the close vicinity of the site, but this pollen type can include wild grasses specifically *Glyceria* (sweet vernal grasses).

3.2 Beetle Assessments

The insect taxa recovered from the flots are listed in Table 1. The taxonomy used for the Coleoptera (beetles) follows that of Lucht (1987). The numbers of individual insects present is estimated using the following scale: + = 1-2 individuals ++ = 2-5 individuals +++ = 5-10 individuals ++++ = 10+ individuals +++++ = 20+ individuals.

When discussing the insect assemblages recovered, two considerations should be taken into account:

1) The identification of the insects present are provisional and made without direct comparison to reference Coleoptera. In addition, many of the taxa present could be identified to species level during a full analysis, producing more detailed information. As a result, all identifications should be regarded as incomplete and possibly biased.

2) The various proportions of insects or plant remains suggested are notional and likely to be subjective.

All three samples examined produced moderately rich insect faunas. In all cases only beetles (Coleoptera) were noted. The preservation of the insect fragments was good in both the basal (1.18-1.36 m depth) and middle (0.99-1.18 m depth) samples; although the top sample (0.80-0.99 m depth) does have coleopterous remains exhibiting signs of damage due to desiccation.

The three faunas recovered are fairly similar and this suggests that there is little or no change in the environment represented by this deposit, or at least to an extent detectable by the beetles. It is clear that slow flowing or stagnant water was present, suggested by the range of water beetles recovered. Taxa typical of aquatic environments include *Noterus* and *Agabus* 'diving' beetles and the *Ochthebius* and *Hydreana* species of Hydraenidae (Nilsson and Holmen 1995; Hansen 1986). A similar shallow and swampy environment is also suggested by species of Hydrophilidae recovered, such as *Coelostoma orbiculare* and *Chaetarthria seminulum* (Hansen 1986).

The plant feeding (phytophage) beetles recovered also suggest that a range of waterside plants grew in this shallow body of water. This is suggested by the presence of *Notaris* and *Limnobaris,* weevils that are normally associated with rushes, reeds and other emergent vegetation (Koch 1992). *Tanysphyrus lemnae,* recovered from the basal sample, reflects duck weed (*Lemna* spp.) in the open areas of water.

All of the three samples recovered contained the remains of several individuals of *Aphodius* and *Geotrupes* 'dung' beetles. These taxa are normally associated with areas of grazing and open pasture. This type of environment also is suggested by the recovery of 'the garden chaffer' *Phyllopertha horticola*, since this species is commonly associated with old grassland and pasture (Jessop 1986).

3.3 Diatom Assessments

Few diatoms were identified in samples from the organic unit. Occasional diatoms were encountered in the sample at 0.80 m depth, but the frustules were highly fragmented preventing accurate identification. Consequently an interpretation of the depositional environment based on diatom assemblages could not be achieved. However, *Pinnularia* spp, and *Epithemia* spp. were most common in the sample from 0.80m, and are indicative of a dominance of freshwater depositional conditions. It is not clear whether such a freshwater setting prevailed throughout the depositional history of the organic unit.

The fine grained nature of the deposit should have provided suitable depositional conditions for the preservation of the biogenic silica frustules. The absence of diatoms is therefore likely to have been a result of the influence of iron oxide precipitation within the unit in addition to the influence of secondary iron-oxide precipitation within the overlying orange-brown silty sands. Orange-brown iron staining is visible within the overlying minerogenic deposits in Figure 2. Such precipitation is a result of fluctuations in redox conditions and the level of diatom frustule dissolution has been shown to increase relative to the level of iron oxide precipitation within sedimentary deposits (Mayer *et al*. 1991).

3.4 Radiocarbon Dating Results

The radiocarbon dating results are summarised in Table 2. All samples yielded sufficient organic carbon for successful dating and all analyses are reported as having proceeded normally. The basal peat sample (1.28m depth) indicates that the onset of organic accumulation occurred 2870 ± 30yrs BP (1130-930 Cal yrs BC; SUERC-19651), the later Bronze Age. The middle sample (1.04m depth) was dated to 2415 ± 30yrs BP (750-390 Cal yrs BC; SUERC-1650), later Bronze Age to Iron Age. The upper sample (0.80m depth) dates the cessation of organic accumulation to just after 1505 ± 25yrs BP (440-630 AD; SUERC 19649), the early Medieval period. Radiocarbon dating certificates are included in Appendix II.

It is concluded that the radiocarbon dating framework has provided a broadly reliable and conformable chronology. Organic accumulation began in the Late Bronze Age/early Iron Age, and continued until the early Medieval period. It is possible, given the character of the sediment, that hiatuses may be present and hence a complete record of this period of time may not be preserved.

3.5 Borehole Evaluation

A detailed summary of the sedimentary sequence encountered during window sampling is provided in Appendix I. Medium to coarse-grained brown sands were present in the upper *c*. 1.00 m. Organic mottling was evident within the upper sands, which is a likely relict of agricultural activity (plough soil). Organic-rich sands, sandy peats and herbaceous peats were then present from 1.00 m to a depth of 2.05 m. The organic deposits were in turn underlain by a thin (*c*. 0.45 m) layer of sands and gavels below which brown sands were identified to a depth of 5.00 m.

The organic deposits were present between 1.00 and 2.05 m depth. Such organic deposits were therefore encountered at a greater depth than those assessed as part of this report. As a consequence, it is likely that much of the organic sequence within the boreholes may be older. It is possible that the sequence formed in a similar floodplain environment in response to the development of the tributary of the Sizewell Belts. However, considerable stratigraphic variation was encountered within the organic unit, with organic-rich sands interbedded with herbaceous peats. In addition, thin sand horizons were present with sharp upper and lower unit boundaries. This may be an indicator of erosive periods or hiatuses in sedimentation. As a consequence, palaeoenvironmental assessments of the deposits encountered within the boreholes are required to provide an insight in to the timing and nature of the organic accumulation in the north-eastern area of the site. This will enable inter site comparisons and to reconstruct environmental changes on and around the site.

4. DISCUSSION

The basal sands and silts below 1.37m in Trench 30 suggest inorganic sedimentation was occurring within a fluvial system, prior to a change to a lower energy depositional environment and the accumulation of increasingly organic deposits sometime before 2870 ± 30yrs BP (1130-930 Cal yrs BC; SUERC-19651), the later Bronze Age. There is no evidence from the beetle assemblages for fast-flowing water, which usually produce a distinct insect fauna (e.g. Smith and Howard 2004). The insect fauna and the increased organic content of the organic sediments from which they were derived thus suggest that the sampling site was possibly a watercourse which began to infill with sediment at this time.

The processes leading to this are unclear but are probably related to shifts in local drainage patterns, although it is not known if this is related in any way to changes in relative sea levels (see below). The beetles suggest that the sampling site was characterised by emergent and aquatic vegetation including rushes, reeds and duckweed, although relatively few aquatic plants are recorded in the pollen data. Plant macrofossils analyses may confirm more precisely the character of the body of water these sediments were deposited/ formed within.

In terms of the wider, dryland areas around the sampling site, the overall absence of beetle species associated with woodland suggests a largely cleared landscape with indicators for grazing animals/pasture also present. This is supported in part by the palynological assessment, which indicates that few woody taxa other than hazel and scattered alder were present. More extensive populations of alder seem to have been present near the site at the opening of the pollen diagram, but appear to have contracted somewhat, probably as a result of farming activity (see below).

Hazel was probably growing on the drier areas beyond the sampling site but scrub/woodland was either restricted to denser stands in specific parts of the landscape or was scattered with an open understorey. In particular, the presence of heather is an indication of the sandy local soils which must have favoured scrubby heathland. Herbs including wild grasses, ribwort plantain, buttercups and dandelions are all typical of meadow/pastoral vegetation which was probably created and/or maintained by the grazing animals suggested by the beetles.

Both pollen and beetle records therefore indicate an open, grazed landscape, but with some scrubland apparent in the former record but not in the latter. This is probably largely a function of a relatively local source area (*ie*. the immediate vicinity of the wetland) for the beetle assemblages compared to a wider area of the landscape for the pollen which is thus reflecting the dryland vegetation better than the beetles.

Although the grazing of wild animals might be responsible in whole or part for the persistence of grassland, it seems probable that grazing by domestic animals from the later Bronze Age onwards was responsible for the open environments evidenced at Sizewell. Such pastoral activity seems to have continued through the Iron Age and into the early Medieval period, suggesting that this areas has long been a focus of farming/settlement activity.

The current data indicate few pronounced changes in the local environment across this period of time. A rise in herbs and reductions in total tree and shrub values in the middle part of the diagram 0.97m may reflect some intensification in pastoral farming not long after the date of 2415 ± 30yrs BP (750-390 Cal yrs BC; SUERC-1650), or perhaps in the Iron Age. The persistence of hazel in the pollen record is notable in the light of the evidence for this continuous agricultural pressure on the environment and may reflect the management of local wood resources.

The absence of diatoms prevent the identification of the influence of any changes in relative sea level on the formation of the depositional archive. The presence of saltmarsh conditions close to the site may be indicated through the presence of low levels of Chenopodiaceae (Fat hen family) in the pollen record, but this herb type includes taxa from a range of other environments including arable land. Relative sea level during the late prehistoric period was in any case close to that of the present day.

The shift from organic to inorganic silts/clays and the termination of the pollen record above 0.72m suggests increased fluvial influence during the early Medieval period. This may reflect the effects of the local agricultural activity destabilising soils and leading to increased erosion of material onto the site or may be linked to factors such as climate and sea-level change.

With the exception of recent work undertaken at the late prehistoric site of Beccles near Lowestoft (Chapman *et al*. 2006), there are no other insect faunas of Holocene date known from this part of Suffolk. The only other palaeoentomological work in the area is that of Coope (2006) on a range of Lower Palaeolithic deposits from High Lodge, Mildenhall and Pakefield, Lowestoft. The limited entomological work in Suffolk means that the insect faunas from Sizewell can be regarded of regional importance. Likewise, there are few palynological records of vegetation change and human activity available from this area and that from Sizewell provides valuable information on the timing and nature of anthropogenic activity which can be linked closely to the archaeological record from the site.

5. RECOMMENDATIONS FOR FURTHER WORK

5.1 Palaeoenvironmental Assessments

It is recommended that the insect remains from all three samples are fully identified. Further analyses will clarify and confirm the provisional interpretations suggested here. Full analysis also will provide an independent source of proxy-environmental evidence for comparison with the palynological evidence from the site.

Further analyses on the pollen assemblages obtained from the organic sequence are also recommended. This will provide further insight into the landscape conditions that prevailed during organic accumulation and enable secure links to be made between palaeoenvironmental conditions and human activity on site as revealed by the archaeological excavations. Such studies will also complement the work to be recommended on the borehole deposits (see below). However, it is recommended that prior to this, further assessment work

5.2 Borehole Assessments

Due to the valuable palaeoenvironmental results obtained from the organic deposits assessed to date, it is recommended that the borehole deposits are also considered for a suite of palaeoenvironmental assessments. The following assessment procedure is proposed:

- Radiocarbon dating of the upper and lower unit boundaries of the organic deposit. Due to the presence of relatively sharp sedimentary boundaries within the organic sequence (small sand horizons are encountered within the unit) an additional third radiocarbon date from the centre of the organic sequence is recommended to assess whether periods of erosion and/or hiatuses in sedimentation have occurred. Dating the sedimentary sequence will provide an understanding of the timing of the onset and cessation of organic accumulation to assist comparisons with the trench excavations. Bulk samples should be considered for AMS radiocarbon dating from 1.02 m, 1.53 m and 1.99 m depths (three samples in total).

- Pollen analysis should be undertaken at regular intervals through the organic unit in order to assess the palaeoecological conditions present at the time of deposition (11 samples in total);

- Beetle assessments should be undertaken on bulk samples taken from the top and bottom of the organic unit. The relative abundance of sand towards the centre of the unit precludes the need for a third beetle assessment being undertaken towards the centre of the unit (two samples in total);

- Due to the success of beetle assessments during the first phase of palaeoenvironmental recommendations, it is also recommended that assessments are undertaken for waterlogged plant macrofossil remains. This will establish the types of vegetation present during organic accumulation which can be associated with the beetle fauna encountered. Bulk samples should be assessed from the top and bottom of the organic unit (two samples in total)

6. ARCHIVE

All trench and borehole samples are stored at the Birmingham Archaeo-

Environmental laboratory at the University of Birmingham. Stratigraphic records, photographs, site plans and proxy subsamples are also held at BA-E until further notice.

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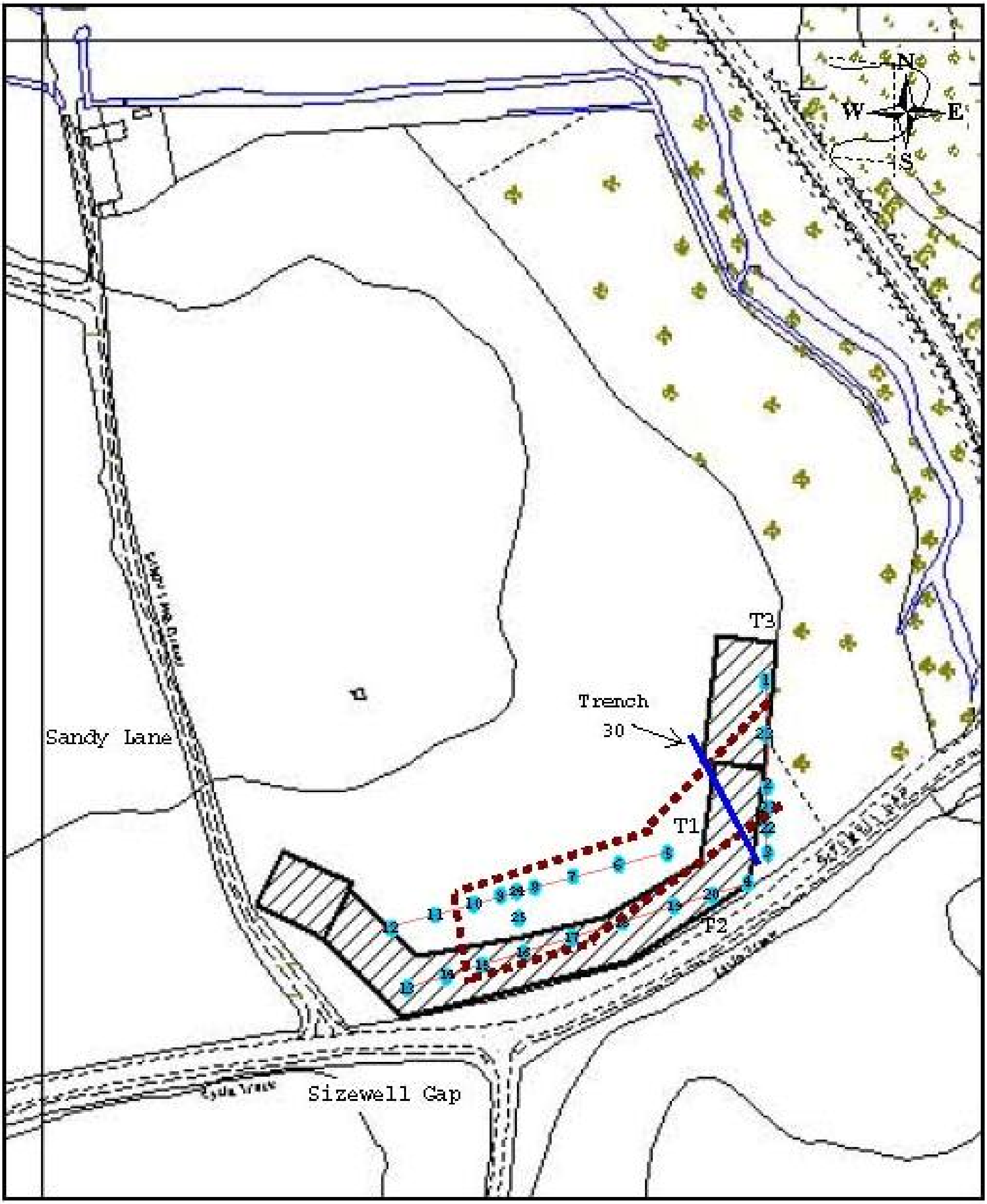

Figure 1: Proposed route of Leiston substation 132kV cable (shaded area), showing approximate locations of sedimentary cores and spatial extent of organic-rich deposits encountered during site evaluation. Approximate location of Trench 30 is also highlighted, from which samples for palaeoenvironmental assessment were taken. Location plan provided by Suffolk County Council Archaeological Service.

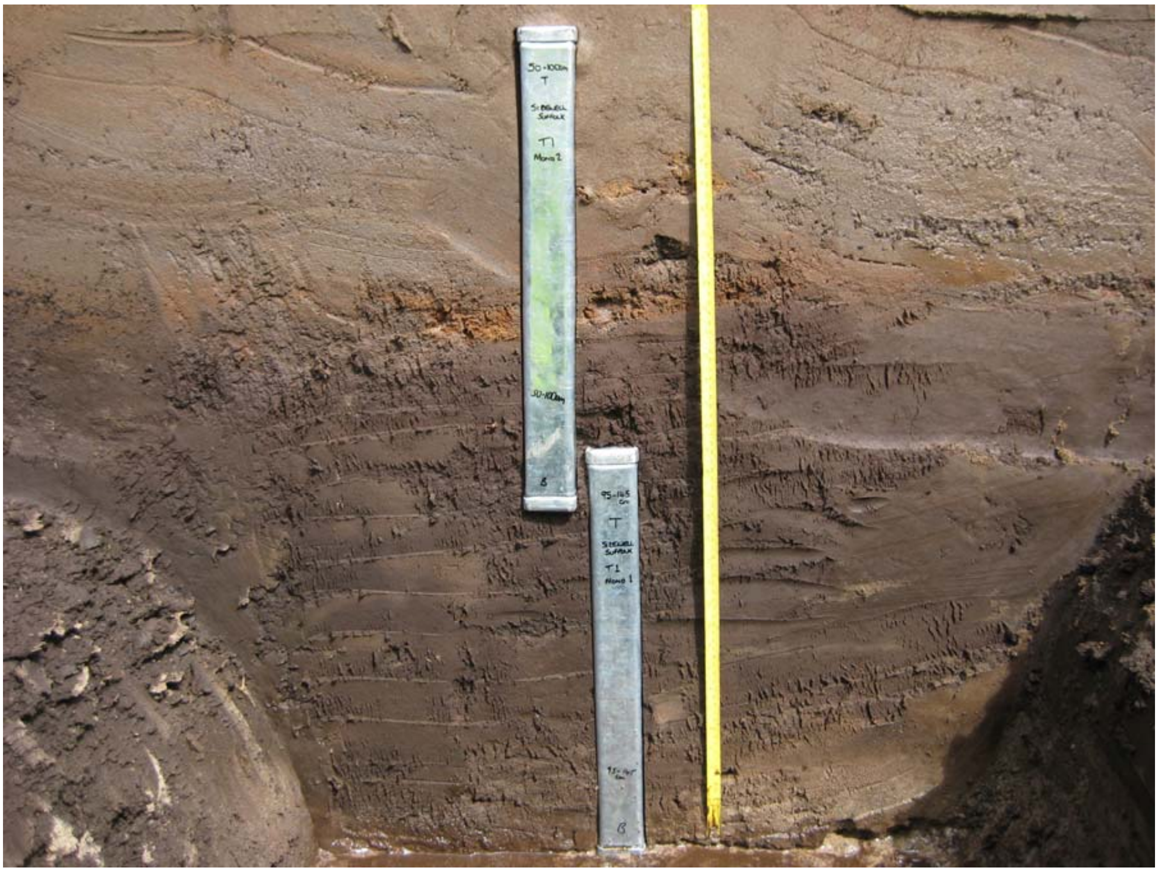

Figure 2: View of west-facing trench section in Trench 30. The organic unit was much thicker than that encountered in Trench 27, with up to c. 0.65m of organics at the northern end of the trench.

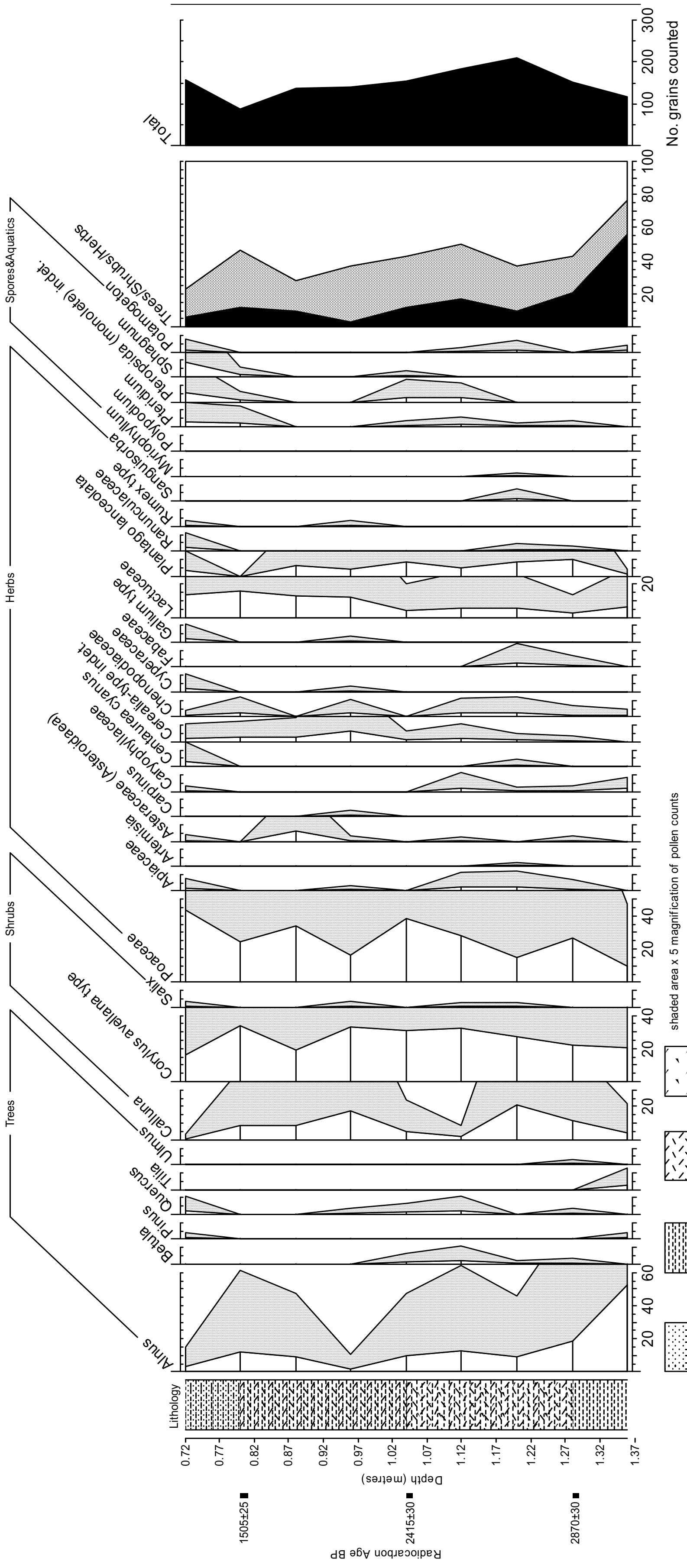

Figure 3: Pollen diagram from Sizewell

Taxa	1.18-1.36m	0.99-1.18m	0.80-0.99m
volume (L.)	5	4	4
Weight (Kg.)	**4**	**4**	**3.5**
CARABIDAE			
Elaphrus spp.	-	-	+
Clinina fossor (L.)	-	-	+
Dyschirius globosus (Herb.)	++	++	++
Trechus quadristriatus (Schrk.)	-	-	+
Pterostichus strenus (Panz.)	+++	++	-
Calathus spp	-	+	-
DYTISCIDAE			
Noterus spp.	-	-	+
Agabus spp.	+	+	-
HYDRAENIDAE			
Hydraena spp.	-	+	-
Ochthebius spp.	-	++	-
HYDROPHILIDAE			
Coelostoma orbiculare (F.)	-	-	+
Cercyon spp.	-	-	+
Megasternum boletophagum (Marsh.)	-	+	+
Hydrobius fuscipes (L.)	-	+	-
Chaetarthria seminulum (Herb.)	-	-	+
STAPHYLINIDAE			
Megatharus spp.	-	+	-
Lesteva spp.	-	+	-
Oxytelus spp.	-	+	-
Stenus spp.	+++	++++	+++
Stilicus spp.	-	+	++
Lathrobium spp.	-	++	++
Tachyporus spp.	-	-	+
Aleocharinae gen. & spp. Indet.	-	-	+
PSELAPHIDAE			
Bryaxis spp.	-	+	-
HELODIDAE			
Cyphon spp.	-	-	++
DRYOPIDAE			
Dryops spp.	-	-	+
SCARABEIDAE			
Geotrupes spp.	-	-	+
Aphodius spp.	+++	+++	++
Phyllopertha horticola (L.)	-	-	+
CHRYOSMELIDAE			
Donacia / Plateumaris	-	+	-
CURCULIONIDAE			
Apion spp.	-	+	++
Tanysphyrus lemnae (Payk.)	-	-	+
Leiosoma deflexum (Panz.)	-	+	+
Limnobaris spp.	-	+++	+
Notaris spp.	+	+++	+
Ceutorhynchus spp.	-	+	+

Table 1: Summary of the insects remains recovered during the assessment of the material from Sizewell, Suffolk

Sample/ Depth m	**Lab Code**	**Materia l**	**δ13 C o/oo**	**Radiocarbon Age BP**	**Calibrated Range 2σ**
BAE1806-0.80m	SUERC-19649	Bulk Peat	-29.1	1505±25	530-630 AD
BAE1806-1.04m	SUERC-19650	Bulk Peat	-28.6	2415+30	750-390 BC
BAE180601.28m	SUERC-19651	Bulk Peat	-28.8	2870±30	1130-930 BC

Table 2: Summary of AMS radiocarbon dating results obtained from Sizewell palaeoenvironmental assessment.

APPENDIX I

WINDOWLESS BOREHOLE SAMPLE STRATIGRAPHY

Troels-Smith (1955) classification scheme of sediments used for borehole assessment, a summary of which is provided below:

Degree of Darkness	
nig.4	black
nig.3	
nig.2	
nig.1	
nig.0	white

Degree of Stratification	
strf.4	well stratified
strf.3	
strf.2	
strf.1	
strf.0	no stratification

Degree of Elasticity	
elas.4	very elastic
elas.3	
elas.2	
elas.1	
elas.0	no elasticity

Degree of Dryness	
sicc.4	very dry
sicc.3	
sicc.2	
sicc.1	
sicc.0	water

	Sharpness of Upper Boundary
lim.4	< 0.5mm
lim.3	< 1.0 & > 0.5mm
lim.2	< 2.0 & > 1.0mm
lim.1	< 10.0 & > 2.0mm
lim.0	> 10.0mm

	Sh	*Substantia humosa*	Humous substance, homogeneous microscopic structure
I Turfa	*Tb*	*T. bryophytica*	Mosses +/- humous substance
	Tl	*T. lignosa*	Stumps, roots, intertwined rootlets, of ligneous plants
	Th	*T. herbacea*	Roots, intertwined rootlets, rhizomes of herbaceous plants
II Detritus	*Dl*	*D. lignosus*	Fragments of ligneous plants >2mm
	Dh	*D. herbosus*	Fragments of herbaceous plants >2mm
	Dg	*D. granosus*	Fragments of ligneous and herbaceous plants <2mm >0.1mm
III Limus	*Lf*	*L. ferrugineus*	Rust, non-hardened. Particles <0.1mm
IV Argilla	*As*	*A.steatodes*	Particles of clay
	Ag	*A. granosa*	Particles of silt
V Grana	*Ga*	*G. arenosa*	Mineral particles 0.6 to 0.2mm
	Gs	*G. saburralia*	Mineral particles 2.0 to 0.6mm
	Gg(min)	*G. glareosa minora*	Mineral particles 6.0 to 2.0mm
	Gg(maj)	*G. glareosa majora*	Mineral particles 20.0 to 6.0mm
	Ptm	*Particulae testae molloscorum*	Fragments of calcareous shells

To ensure suitable amounts of material were available for palaeoenvironmental consideration, two windowless boreholes were extracted. The boreholes were taken from the same location within the Sizewell study area, approximately 0.50m apart from one another. Due to the close proximity of the borehole locations, the stratigraphy is the same. As a consequence, a single stratigraphic sequence is summarized below:

0.00-0.45m

Da	St	El	Dr	UB
2+	o	o	3+	-

Ga4, Ag+, Sh+, Th+, Dh+, Ggmin+
Medium brown sand with occasional organic mottling
Ploughed topsoil

0.45-0.56m

Da	St	El	Dr	UB
2	0	0	3+	0

Ga4, Ag+, Ggmin+
Orange-brown sand

0.56-0.74m

Da	St	El	Dr	UB
3+	0	0	2	2

Ga4, Ag+, Sh+, Ggmin+
Dark brown sand with organic mottling

0.74-1.00m

Da	St	El	Dr	UB
3	0	0	2	1

Ga3, Ag1, Sh+, Ggmin+
Medium brown sand

1.00-1.40m

Da	St	El	Dr	UB
3	0	0+	2	-

Ga2, Sh2, Ag+, Th+, Dh+, Ggmin+, As+
Dark grey-brown sandy peat

1.40-1.47m

Da	St	El	Dr	UB
2	0	0	2	2

Ga3, Ag1, Sh++, Ggmin+
Grey silty sand

1.47-1.53m

Da	St	El	Dr	UB
3+	0	2	2	3

Dg2, Dh1, Sh1, Th+, Ag+
Dark brown herbaceous well humified peat

1.53-1.65m

Da	St	El	Dr	UB
2	0	0	2	3

Ga4, Ag+, Sh+
Grey-brown sand

1.65-1.96m

Da	St	El	Dr	UB
3+	0	2	2	2

Dg2, Sh2, Th+, Dh+, Ag+, Ggmin+
Dark red-brown very well humified peat

1.96-2.05m

Da	St	El	Dr	UB
2+	0	0	3	2

Ga2, Ag1, Ggmin1, Sh++
Grey-brown pebbly silty sand with organic mottling

2.05-2.48m	Da	St	El	Dr	UB
	2	0	0	3	1
	Ga2, Ggmin1, Ggmaj1, Ag+				
	Grey-brown sands and gravels				
	Gravel rounded to sub-angluar quartz, mudstone, occasional flint				
2.48-2.60m	Da	St	El	Dr	UB
	2	0	0	3	2
	Ga4, Ag+				
	Light brown fine sand horizon				
2.60-4.55m	Da	St	El	Dr	UB
	2+	0	0	3	1
	Ga4, Ag+, Ggmin+, Sh+, Gs+				
	Grey-green sand				
4.55-5.0m	Da	St	El	Dr	UB
	2+	0	0	3	1
	Ga3, Gs1, Ggmin+, Ag+				
	Oragne-brown coarse sand				

APPENDIX II

RADIOCARBON DATING CERTIFICATES

SUERC

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RADIOCARBON DATING CERTIFICATE

31 July 2008

Laboratory Code	SUERC-19649 (GU-17013)
Submitter	Dr. Tom Hill Birmingham Archaeology University of Birmingham Edgbaston Birmingham B15 2TT
Site Reference	Sizewell, Suffolk
Sample Reference	BAE1806-0.80m
Material	Peat : Humic Acid
$\delta^{13}C$ relative to VPDB	-29.1 ‰
Radiocarbon Age BP	1505 ± 25

N.B.

1. The above ^{14}C age is quoted in conventional years BP (before 1950 AD). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

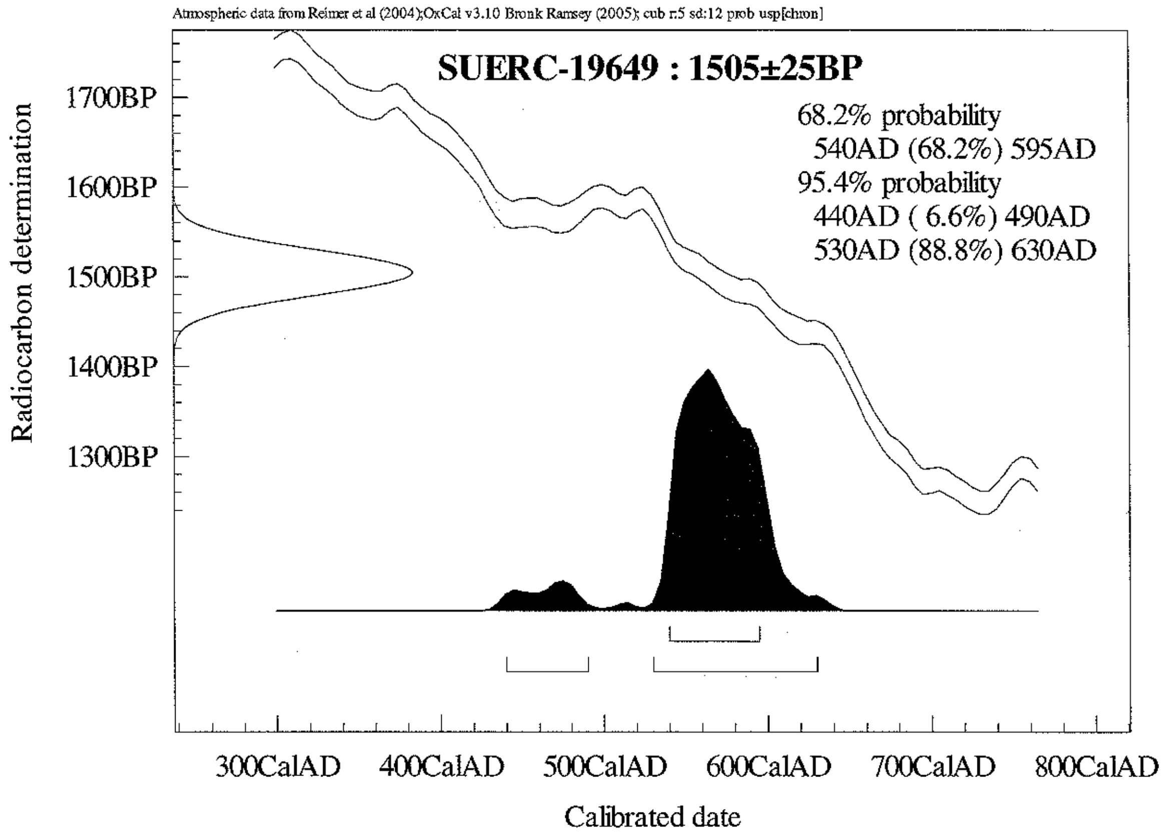
2. The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal3).

3. Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code.

Conventional age and calibration age ranges calculated by :- P. Naysmith Date :- 31-7-08

Checked and signed off by :- Gordon Cook Date :- 31-7-08

Calibration Plot



SUERC

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RADIOCARBON DATING CERTIFICATE

31 July 2008

Laboratory Code	SUERC-19650 (GU-17014)
Submitter	Dr. Tom Hill Birmingham Archaeology University of Birmingham Edgbaston Birmingham B15 2TT
Site Reference	Sizewell, Suffolk
Sample Reference	BAE1806-1.04m
Material	Peat : Humic Acid
$\delta^{13}C$ relative to VPDB	-28.6 ‰
Radiocarbon Age BP	2415 ± 30

N.B. 1. The above ^{14}C age is quoted in conventional years BP (before 1950 AD). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

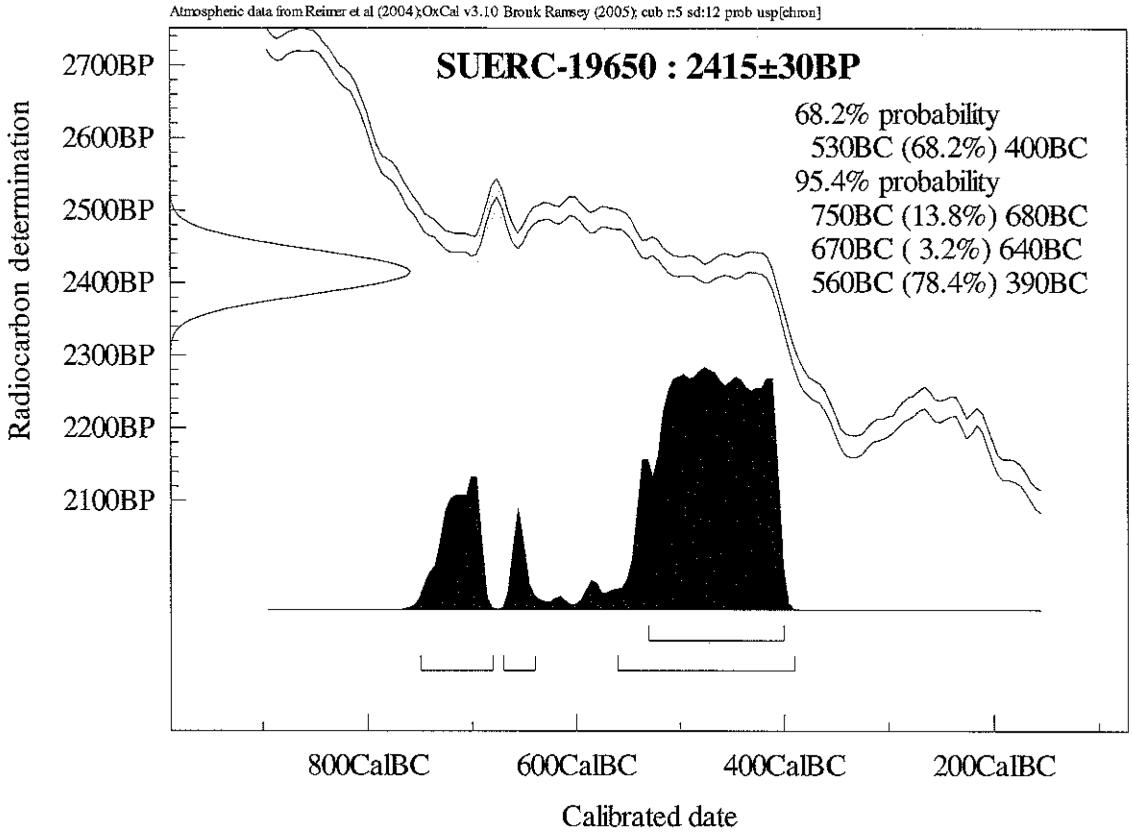
2. The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal3).

3. Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code.

Conventional age and calibration age ranges calculated by :- P. Naysmith Date :- 31-7-08

Checked and signed off by :- Gordon Cook Date :- 31·7·08

Calibration Plot



Director: *Professor A B MacKenzie*

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RADIOCARBON DATING CERTIFICATE

31 July 2008

Laboratory Code	SUERC-19651 (GU-17015)
Submitter	Dr. Tom Hill Birmingham Archaeology University of Birmingham Edgbaston Birmingham B15 2TT
Site Reference	Sizewell, Suffolk
Sample Reference	BAE1806-1.28m
Material	Peat : Humic Acid
$\delta^{13}C$ relative to VPDB	-28.8 ‰
Radiocarbon Age BP	2870 ± 30

N.B. 1. The above ^{14}C age is quoted in conventional years BP (before 1950 AD). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

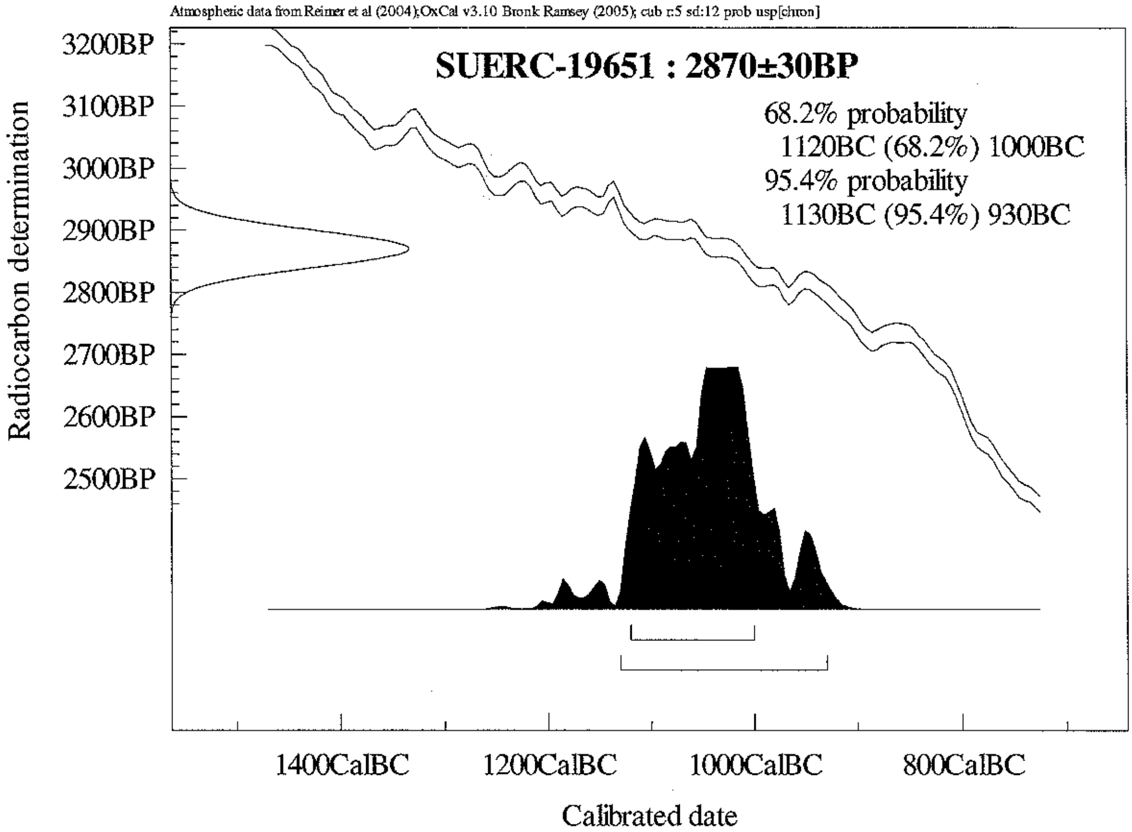
2. The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal3).

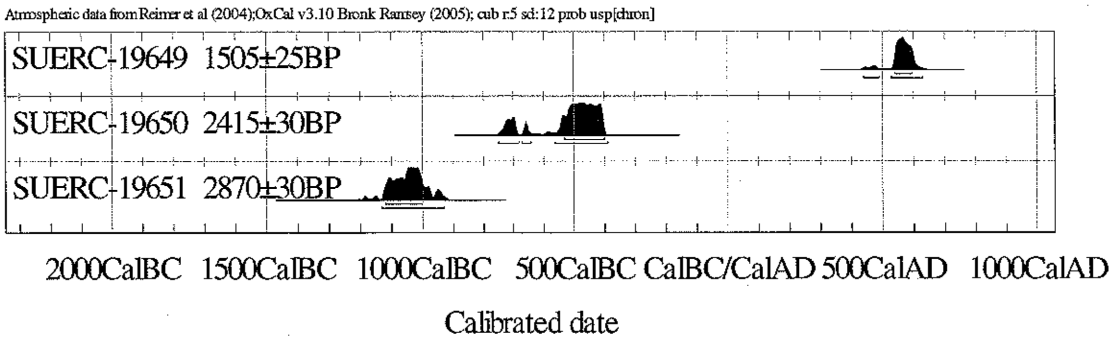
3. Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code.

Conventional age and calibration age ranges calculated by :- P Naysmith Date :- 31-7-08

Checked and signed off by :- Gordon T Cook Date :- 31-7-08

Calibration Plot





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SUERC-19650 2415±30BP
SUERC-19651 2870±30BP
2000CalBC 1500CalBC 1000CalBC 500CalBC CalBC/CalAD 500CalAD 1000CalAD
Calibrated date