University Site, Ipswich: a palaeoenvironmental assessment of deposits encountered during ground investigations

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SUMMARY

- Birmingham Archaeo-Environmental was subcontracted by Suffolk County Council Archaeological Service to undertake a palaeoenvironmental assessment of organic-rich deposits encountered during ground investigations at University Site, Ipswich.

- This report represents the results of the fieldwork and palaeoenvironmental assessment undertaken. Initial stratigraphic analysis identified one core for palaeoenvironmental assessment: an organic-rich sand unit, underlain by blue grey silts and clays. This core was subsampled for beetles and diatoms, whilst two suitable organic samples were submitted for radiocarbon dating in order to provide a chronostratigraphic framework.

- Estuarine silts and clays were accumulating across the site prior to the deposition of the organic-rich sand unit. Diatom preservation was good within most of the samples assessed and the majority of species encountered thrive in marine and brackish water environments. It was therefore inferred that the development of the silts and clays occurred within an estuarine environment where tidal inundation was common. Variations in diatom assemblages within the samples suggest the influence of marine conditions varied over time, possibly as a consequence of changes in relative sea level or palaeo-land surface elevation.

- The organic-rich sand unit probably accumulated either within a small stream or man-made drainage channel, which subsequently became infilled. Beetle assemblages were found to be well preserved within the unit, with high species abundance and diversity. There is evidence for human occupation proximal to the site, with assemblages indicative of deposits of urban waste, rubbish and squalid flooring. In addition, beetle taxa suggestive of an abundance of decaying wood may suggest subsequent settlement abandonment.

- Radiocarbon dating of samples from the top and base of the deposit produced dates of *c*. 370 ± 40 BP and 350 ± 40 BP.

- The assessment therefore concludes that the organic-rich sand unit encountered at University Site, Ipswich, accumulated within a small tributary or man-made drainage ditch, sometime between the late Medieval and early post Medieval periods. The subsequent rapid infilling of the depositional setting may have been a consequence of site abandonment and settlement neglect.

- No further diatom or beetle analyses are recommended on the samples presently available from the site. However, should greater quantities of the organic-rich sand be available at any point during subsequent ground investigations, full beetle analysis is strongly recommended.

1. INTRODUCTION

Deposits of palaeoenvironmental potential were discovered during ground investigations at a proposed University site proximal to the Ipswich Docks (TM 617003 244046). The site is located at the junction between Fore Street and Coprolite Street and overlooks Neptune Quay to the south (Figure 1). Two large trenches were excavated within the site: one running north-south through the centre of the site and one running east-west along the northern site boundary, parallel to Fore Street. Organic-rich sediments were identified under Made Ground from *c*. 1.6m below ground level (bgl). As the original trenches had already been back-filled, two smaller trenches were excavated in close proximity to the original excavations. Birmingham Archaeo-Environmental were sub-contracted to undertake the coring and subsequent stratigraphic and palaeoenvironmental analysis.

This report presents the results of palaeoenvironmental investigations (manual coring, recording, sampling and palaeoenvironmental assessment) associated with this scheme of work.

The aim of the work was threefold:

- To identify, record, characterise and sample organic deposits, encountered during previous geoarchaeological surveys.
- To assess this material for biological preservation (beetles and diatoms) and identify suitable samples for radiocarbon dating.
- To provide a detailed understanding of the subsurface stratigraphy of the organic-rich deposits and the underlying fine grained silts and clays, which might aid in the development of archaeological prospection strategies.

2. METHODOLOGY

2.1 Coring Survey

At the time of the fieldwork, the site was derelict. No buildings were present on the land under development although the site was capped with concrete. A site visit was undertaken on 16th January 2006, during which sedimentary coring was undertaken within the two excavated trenches. Made Ground was found to overlie the natural strata and varied in thickness to between 1.60m in Trench 1 (Figure 2) to the south of the site and 2.10m in Trench 2 (Figure 3) to the north. Cores were extracted using a manual gauge 'Eijkelcamp' corer. Coring continued until bedrock or basal gravels were encountered. Samples were extracted in 1.0m length sections within the corer and transferred into 1.0m lengths of guttering for storage and transport.

2.2 Stratigraphic Analysis

Whilst an initial assessment of the sedimentary archive was made on-site, detailed stratigraphic analysis of the sedimentary sequences from cores 1 and 2 were undertaken at the Birmingham Archaeo-Environmental laboratory at the University of Birmingham. Each 1.0m section of sample was carefully opened ensuring the enclosed stratigraphy remained intact prior to recording and sampling. 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 the nomenclature used is provided in Table 1. A full stratigraphic breakdown of the cores is provided in Appendix I.

The ground surface of Trench 1 was levelled to 3.35m O.D. The deposits overlying the organic sediments within the trench were excavated to a depth of *c*. 1.60m, and were composed of Made Ground, consisting mixed layers of concrete, tarmac, and brick. At *c*. 1.60m depth (1.75m O.D.), dark brown-black organic sands were encountered. A core taken from the centre of the trench established that this unit continued to a depth of *c*. 2.98m (0.37m O.D.). The unit was comprised predominantly of medium sands with humic (very well decomposed) organic remains and occasional pebbles, bone and disarticulated shells fragments (including oyster). A leg bone of the common goose (*Anser anser*) was present at 2.94m (David Brown, *pers. comm.*). From 2.98m to *c*. 4.31m (-0.96m O.D.) light grey silts and clays were encountered, with occasional pebbles and organic mottling. Grey sands were present from 4.31m to 4.36m (-1.01m O.D.). Below this depth no sediment could be extracted within the coring chamber. This is likely to be due to the saturated nature of the deposits when coring below the water table

The second trench was levelled to 3.34m O.D. and contained Made Ground to a depth of *c*. 2.10m (1.24m O.D.). Organic sands, similar to those encountered in Trench 1, were present to a depth of 2.89m (0.45m O.D.) with occasional disarticulated shell fragments and small pebbles present. This unit was underlain by light grey silts and clays to 4.05m (-0.71m O.D.) that included occasional plant remains and sparse thin (<1cm) sand horizons. Sands were once again encountered below the clays and silts to a depth of 4.12m (-0.78m O.D.). Below the sands sample extraction was not possible due to the saturated nature of the underlying deposits.

From the initial stratigraphic analysis and visual assessment of the sedimentary cores, it was suggested that the organic deposits underlying both trenches represent the same sedimentary unit. The unit is slightly thicker in the southern trench (*c*. 1.38m thick), but the base of the unit is positioned at similar depths in both trenches (0.37m and 0.45m O.D.). It was therefore recommended that palaeoenvironmental analysis was undertaken on only one of the cores. Due to the thicker organic sand unit evident within Trench 1, Core 1 was been chosen for palaeoenvironmental assessment. A summary of the stratigraphy encountered in Core 1 is provided in Table 2.

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

Table 1 Physical and sedimentary properties of deposits according to Troels-Smith (1955)

2.3 Palaeoenvironmental Analysis

In order to utilise the sedimentary archive preserved at University Site, Ipswich, beetle and diatom assessments were recommended, supported by radiocarbon dating of suitable organic samples. This was to enable an assessment to be made as to whether the site preserved an archive of significant palaeoenvironmental potential. A summary of the proxy analytical techniques applied to Core 1 is summarised in Table 3.

Depth (m)	***m (O.D.)***	***Stratigraphic summary***
0.00-1.60m	3.35 to 1.75m	Made Ground
1.60-2.98m	1.75 to 0.37m	Dark brown organic sand with occasional gravel, shell fragments, wood, bone
2.98-3.73m	0.37 to -0.38m	Light grey clayey silt with occasional pebble and organic mottling
3.73-4.31m	-0.38 to -0.96m	Light grey silty clay with organic mottling
4.31-4.36m	-0.96 to -1.01m	Grey-brown sand
Below 4.36m	Below -1.01m	Sands encountered but unable to be extracted

Table 2: Summary of Core 1 Stratigraphy

Depth (m)	***m (O.D.)***	***Stratigraphic summary***	***Beetle Analysis (bulk samples)***	***Diatom Analysis***	***Radiocarbon Dating***
0.00-1.60m	3.35 to 1.75m	Made Ground	n/a	n/a	n/a
1.60-2.98m	1.75 to 0.37m	Dark brown organic sand with occasional gravel, shell fragments, wood, bone	1.60m to 2.05m (1.75m to 1.30m O.D)		1.65m depth (1.70m O.D)
			2.05m to 2.50m (1.30m to 0.85m O.D.)		
			2.50m to 2.98m (0.85m to 0.37m O.D.)	2.97m (0.38m O.D.)	2.94m depth (0.41m O.D.)
2.98-3.73m	0.37 to -0.38m	Light grey clayey silt with occasional pebble and organic mottling		2.99m (0.36m O.D.)	
				3.65m (-0.30m O.D.)	
3.73-4.31m	-0.38 to -0.96m	Light grey silty clay with organic mottling		4.30m (-0.95m O.D.)	
4.31-4.36m	-0.96 to -1.01m	Grey-brown sand			

Table 3: Summary of proxy assessment techniques applied to Core 1

2.3.1 Beetle Assessment
Coleoptera (beetle) assessments were undertaken on bulk samples from the top, middle and bottom of the organic sand unit from Core 1. All three samples were processed using the standard method of paraffin flotation as outlined in Kenward *et al.* (1980). This paraffin flot was then sorted and identified where possible under a binocular microscope. The system for "scanning" faunas as outlined by Kenward *et al.* (1985) was followed in this assessment. When discussing the faunas recovered, two considerations were taken into account:

1) The identifications of the insects present were provisional. Many of the taxa present could be identified down to species level during a full analysis, producing more detailed information. As a result, the data presented should be regarded as preliminary.

2) The various proportions of insects are subjective assessments. Minimum numbers of individuals can be obtained through a full sample analysis.

2.3.2 Diatom Assessment
To identify the environmental conditions present during the deposition of the light grey silts and clays that underlie the organic sands, diatom analysis was recommended. If present, an assessment of diatom assemblages would establish the type of sub-aqueous depositional conditions likely to have been responsible for the development of the unit. Analysis was therefore undertaken on one sediment sample from the transition from the organic sand and underlying silts and clays, whilst three further samples were assessed for diatoms from the top, middle and bottom of the underlying silt and clay unit.

0.5cm^3 of sediment from each sample was prepared for diatoms following the standard procedure as described by Plater *et al*. (2000). Diatom samples were mounted on slides with naphrax and species were identified with reference to Hendy (1964) and van Der Werff & Huls (1958-1974). Attempts were made to count a minimum of 100 diatom valves within in each sample.

2.3.3 Radiocarbon Dating
Radiocarbon dating of the top and base of the organic sand unit was also recommended to understand the timing of the onset and cessation of deposition. The presence of the *Anser anser* bone proximal to the base of the unit was suitable for AMS dating to understand when deposition of the organic sand began. A wood sample from the top of the organic-rich sand was also submitted for AMS dating to identify when organic sedimentation stopped on site.

3. RESULTS

3.1 Beetle Analysis

The insect taxa recovered from the flots are listed in Appendix II for reference. All three samples contained well-preserved insect remains. Species abundance and diversity was also found to be good, particularly within the basal assemblage of the organic-rich sand unit at 2.50-2.98m. Smaller, more restricted assemblages were recovered from 2.05m-2.50m depth and 1.60-2.05m depth. The level of species abundance and diversity encountered is especially high when the relatively small sample sizes available through sedimentary coring are taken into consideration (typical beetle assessments utilise 10litre bulk bag samples).

The sample obtained from 2.50-2.98m depth (0.85-0.37m O.D.) contained a diverse and well-preserved assemblage. Direct evidence of the vegetation in the environment proximal to the where the deposit accumulated is restricted to the basal sample and is limited to specimens of the curculionid family, *Sitona* spp. This family of weevils is associated with a variety of plants commonly found in both meadows and disturbed ground, including vetches (*Vicia* spp.), clovers (*Trifolium* spp.) and trefoils (*Lotus* spp.) (Koch 1992). Scarabaeidae or 'dung' beetles were also recovered from this sample. However, although dung beetles commonly indicate that grazing of the land surrounding the site was taking place, this does not seem likely when taking into account the full beetle assemblage encountered.

The sample also contained a suite of synanthropic taxa that are closely associated with human habitation. These include the colydiid, *Aglennus brunneus*, the endomychid, *Mycetaea hirta,* the ptinid, *Ptinus fur*, and the common woodworm, the anobiid, *Anobium punctatum*. All these taxa form part of Kenwards 'House Fauna' (Hall and Kenward 1990, Kenward and Hall 1997, Kenward and Hall 1995) and are associated with accumulations of foul and rotting material. Such taxa have also been recovered in the archaeological record from deposits of urban waste, rubbish and squalid flooring (eg. Kenward & Hall 1995).

At 2.05-2.50m depth (1.30-0.85m O.D.), the sample produced a restricted but nonetheless well-preserved beetle assemblage. Indicators of fresh dung such as *Aphodius* spp. or *Geotrupes* spp. are absent and have been replaced by species such as the scarabaeid*, Oxyomus sylvestris*. This species indicates accumulations of rotting manure and vegetation and *not* fresh dung in pasture or meadowland (Jessop 1996, Koch 1989).

Whilst several indicators of diseased wood were also recovered from all three samples, Lignacious and saproxylic taxa are particularly prolific in this sample. For example the anobid, *Xyletinus* spp., is commonly found on powdery, decaying oak and elm (Hyman 1992). In addition, the scolytid, *Leperisinus* spp., is generally found on dead ash, whilst the tenebrionid, *Hypophloeus* spp., is a family found on a variety of decaying wood. These species are not associated with living trees and instead are more often found with dead, diseased or rotting wood. It therefore seems unlikely that they are derived from nearby woodland from which timber has been used for construction or firewood.

The upper sample from 1.60-2.05m depth (1.75-1.30m O.D.) also produced a restricted but well-preserved assemblage. The scarabaeids, or 'dung beetles' reappear in this sample, whilst the staphylinid, *Oxytelus rugosus*, associated with dung and accumulations of rotting, organic material (Tottenham 1954), is recorded.

3.2 Diatom Analysis

Diatoms were found in all four samples, with high species abundance and diversity throughout. In addition, frustule preservation was good, assisting species identification. Therefore, counts of at least 100 diatom frustules were achieved in all samples. Figure 4 summarises the key diatom species encountered within each sample under assessment. The majority of species were either 'polyhalobous' or 'mesohalobous' species, which require predominantly marine and brackish waters (salinity ranging from over 30g l^{-1} to 0.2g l^{-1} respectively) for optimal frustule growth. Species are presented as raw counts and not as percentages of total diatom valves (%TDV) as no qualitative or quantitative interpretations of diatom assemblages are required at this assessment stage.

The diatom sample taken from 4.30m depth (-0.95m O.D.) towards the base of the silty clay unit was dominated by the planktonic polyhalobous species *Paralia sulcata*, with the mesohalobous benthic species *Diploneis didyma*, *Nitzschia punctata* and *Nitzschia navicularis* also recorded. The diatoms *Rhophalodia gibberula* and *Cocconeis placentula* ('oligohalobian indifferent' species), requiring predominantly freshwater environmental conditions to survive are also present, although in lower abundances.

At 3.65m depth (-0.30m O.D.), within the clayey silts, *Paralia sulcata* continues to dominate, again supported by *Diploneis didyma*, *Nitzschia punctata* and *Nitzschia navicularis*. The mesohalobous species *Achnanthes brevipes* is also present . There is however an increase in abundance of species requiring freshwater depositional conditions to survive, including the oligohalobian indifferent species *Rhophalodia gibberula* and *Synedra capitata*. The 'oligohalobian halophilous' species *Epithemia turgida*, although present in low numbers, is restricted to freshwater environments and is not tolerant of brackish and marine waters.

The remaining two samples were taken from the top of the clayey silt unit (2.99m depth; 0.36m O.D.) and from the base of the overlying organic-rich sand (2.97m depth; 0.38m O.D.). Similar species were again encountered, with *Paralia sulcata* dominating and *Diploneis didyma*, *Nitzschia punctata* and *Nitzschia navicularis* contributing. The mesohalobian species *Campylodiscus echeneis*, *Achnanthes brevipes* and *Diploneis interrupta* were also present. Although the diatom assemblages were broadly similar within the two samples, there was an overall subtle increase in the influence of species requiring freshwater-dominated conditions within the overlying organic-rich sands (in evidence through the presence of *Cocconeis placentula* and *Hantzschia amphioxys*). Diatom preservation was found to be poorer within the organic-rich sand, with frustule disarticulation commonly hindering species identification. This was likely a consequence of the higher energy depositional environment required for the transportation and development of the coarser grained organic-rich unit.

3.3 Radiocarbon Dating

One wood sample and one bone fragment was submitted to Beta Analytic, Florida, for AMS radiocarbon dating. The results are set out in Table 4 (see also Appendix III). Calibration was undertaken using INTCAL98 (Stuiver and Van der Pilcht 1998). All samples provided sufficient carbon for accurate measurement and analyses are reported as having proceeded normally.

Sample	**Code**	**Altitude (m O.D.)**	**Sample description**	**Sample pre-treatment**	**C13/C12 Ratio**	**Conventional radiocarbon age**	**Calibrated range BC/AD (2 sigma - 95% confidence)**
UNIIPS-1.65m	Beta-226829	1.70m	wood	acid/alkali/acid	-25.9 o/oo	350 +/- 40 BP	1450-1650 Cal. AD
INIIPS-2.94m	Beta-226830	0.41m	Bone collagen	Collagen extraction: with alkali	-22.1 o/oo	370 +/- 40 BP	1440-1640 Cal. AD

Table 4: Results of the radiocarbon dates from Core 1

4. INTERPRETATION

The diatom assessment has identified that estuarine depositional conditions were responsible for the development of the basal clays and silts that underlie the organic-rich sand unit. This is further supported by the relative proximity of the site to the Ipswich Docklands and the tidally-influenced River Orwell, and perhaps by the presence of a leg bone fragment of *Anser anser* toward the base of the organic-rich sand (common goose are commonly found in estuarine lowlands). Frustule preservation was good throughout the samples, and species abundance and diversity was high. The fine-grained nature of the sediment, combined with the diatom species encountered, suggests deposition occurred predominantly on upper tidal flats and lower saltmarshes.

The overall dominance of *Paralia sulcata* throughout the samples indicates tidal inundation dominated the depositional environment, enabling the accumulation of the marine planktonic diatom species. Although the planktonic nature of the species can sometimes result in its over-representation within diatom assemblages, the abundance of *Paralia sulcata* may in fact indicate that the site was located within a tidal inlet of the River Orwell (Vos & deWolf, 1988).

There are subtle fluctuations in the influence of freshwater diatom species within the diatom assemblages, which could be inferred as a possible indicator of changes in the influence of relative sea level on lowland coastal evolution. The basal silty clay assemblage for example (4.30m depth) contains less freshwater-influenced species than the diatoms present within the overlying clayey silts at 3.65m depth. The diatom assemblage from 2.99m depth, in turn, contains fewer freshwater species than that at 3.65m depth. Therefore, whilst tidally-controlled sedimentation is likely to have dominated the depositional environment, variations in freshwater influence, probably in response to variations in the influence of sea level or palaeo-land surface elevation, can be inferred.

The final diatom assemblage, sampled from the base of the organic-rich sand (2.97m depth), contained lower species abundances with frustule disarticulation common. The sharp lower unit boundary of the organic-rich silt combined with the dominance of marine diatom species within the underlying clayey silt, suggests an erosive episode occurred prior to sedimentation of the organic-rich sand. The diatoms within the organic-rich sand however continue to be dominated by *Paralia sulcata*, which therefore suggests episodic tidal submergence continued, at least during the initial onset of organic-rich sand sedimentation. The presence of aerophilous species such as *Diploneis interrupta* and *Hantzschia amphioxys* however, indicates that deposition occurred higher up the tidal frame than previously due to the need for prolonged periods of tidal emergence for these species to survive.

Radiocarbon dating indicates the onset of organic-rich sand deposition occurred *c.* 370 ± 40 BP (Beta-226830). The insects found at 2.50-2.98m depth are derived from a relatively restricted and specific range of environments associated with human habitation and activity, and suggests episodes of dumping of housing waste on the sampling site. Further evidence, in the form of dung beetles and other taxa associated with accumulations of rotting waste, may also indicate the dumping of stabling material. It is therefore possible that the organic-rich sand deposit represents a combination of both types of material. It is also possible that the basal sample represents an episode of increased human activity at the site. This might have been, for example, the construction of a small homestead or farm, which was subsequently abandoned, and the structure left to rot. This is supported by the declining 'House Fauna' component in the upper two assemblages. Whilst dung beetles associated with fresh dung are absent from the middle sample, indicators persist for decaying manure and dung heaps. In the upper sample, indicators of fresh dung return, which perhaps indicates that animals were once again kept in the close vicinity of the sampling site.

Whilst it cannot be discounted that the deposits are some form of ditch fill, the relatively well-sorted nature of the sands would indicate accumulation in an environment with a maintained depositional energy. In addition, there was a general absence of artefacts such as pottery within the unit during initial trial trenching (Mark Sommers, *pers. comm.*). The dominance of sand within the unit, along with very well humified organic remains, occasional bone, shell and gravel components, could be indicative of sediment deposition in a fluvial system, possibly within a small tributary stream. Alternatively, the organic-rich sand unit may have accumulated within a man made drainage channel. What is clear is that the feature was taking flow, whether as part of a minor tributary system or an artificial drainage channel. The feature's proximity to an area of human occupation explains the incorporation, whether deliberate or accidental, of beetle assemblages indicative of settlement, agricultural activity and eventual site abandonment.

The radiocarbon dates from the top and base of the unit are statistically inseparable. A relatively a rapid period of sedimentation may explain the narrow age range provided, in which the water feature became infilled, possibly even as a consequence of settlement abandonment and site neglect (as suggested by the beetle assemblages). Alternatively, the wood fragment dated from the upper unit boundary may have been reworked material, which had been eroded and subsequently redeposited further downstream. However, the dates confirm that the organic-rich sand unit developed some time between the late Medieval and early post-Medieval periods.

5. RECOMMENDATIONS FOR FURTHER ANALYSIS

Diatom assessment has confirmed the influence of estuarine conditions on the development of the deposits preserved at University Site, Ipswich. Considering the impact of estuarine environments on the development of the coastal lowlands of East Anglia, relatively little palaeoenvironmental work has been undertaken on such coastal sequences. The influence of relative sea-level change on coastal settlements during the historic period is likely to be high, suggesting such archives should be considered for further analysis. Any further ground investigations in the regions proximal to the Suffolk coastal lowlands should be considered for geoarchaeological assessment and analysis, in order to contribute to the developing picture of coastal evolution in East Anglia. However, it is recommended that no further diatom analysis be undertaken on the stratigraphic archive of the University Site.

Further beetle analysis of the organic-rich sand sampled during the palaeoenvironmental assessment is also not recommended. This is due to the relatively small size of the samples obtained during sedimentary coring. However, should greater quantities of the organic-rich sand be available at any point during subsequent ground investigations, full analysis is strongly recommended. Likewise, any future archaeological investigations in this area should consider sampling deposits for palaeoenvironmental assessment of the kind detailed in this report.

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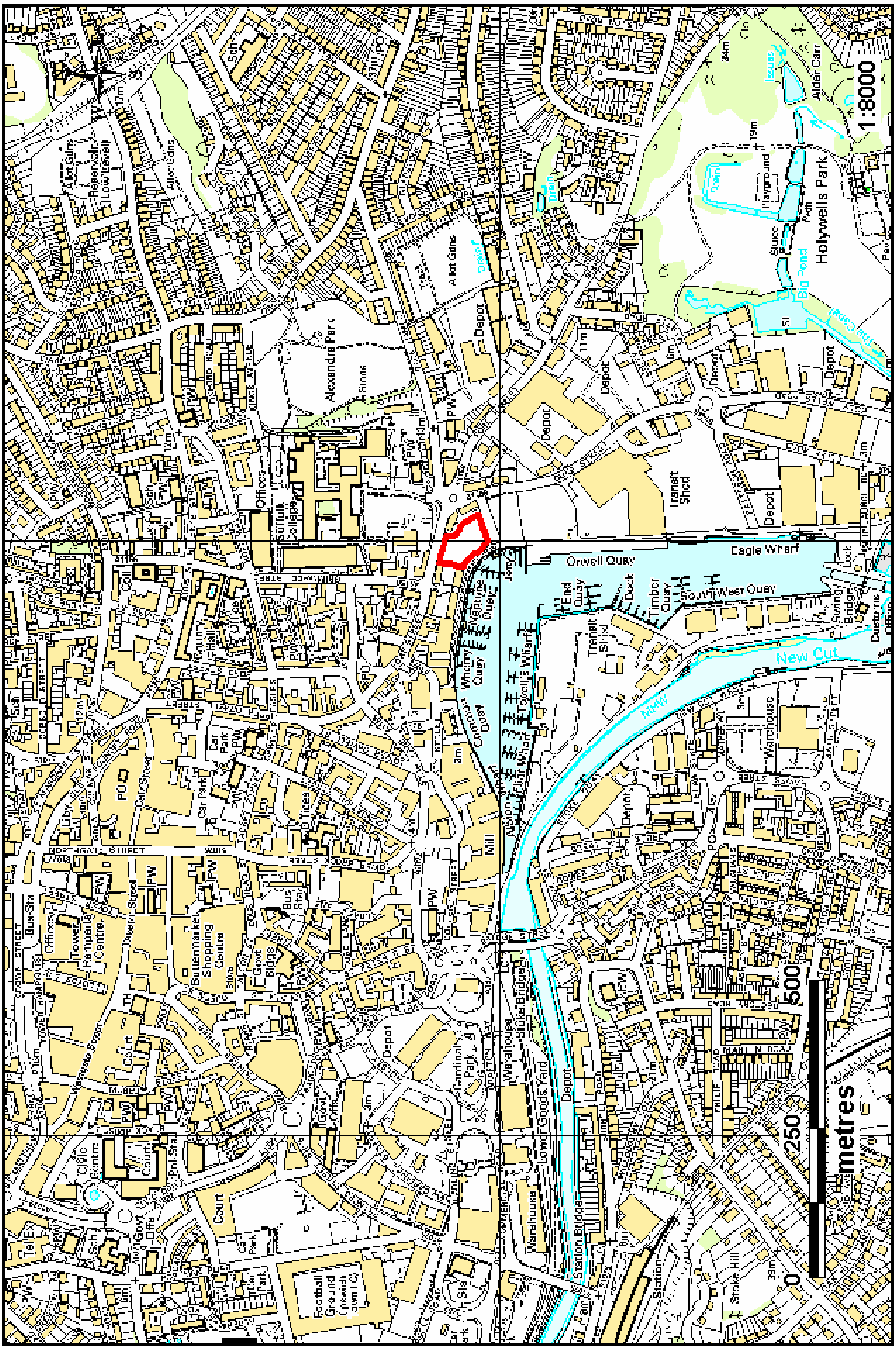


Figure 1: Location of University Site in Ipswich, highlighted in red

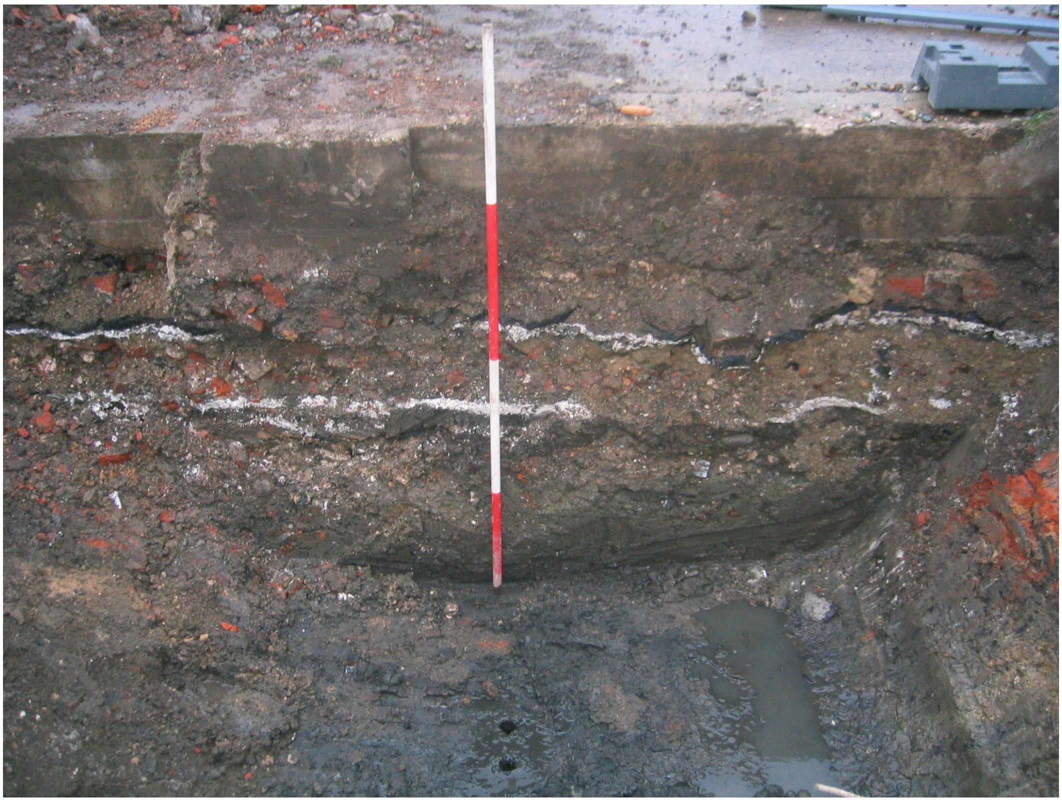


Figure 2: Photograph of Trench 1, facing east. Sample core taken from the centre of the trench

Figure 3: Photograph of Trench 2 facing north. Sample core taken from the centre of the trench

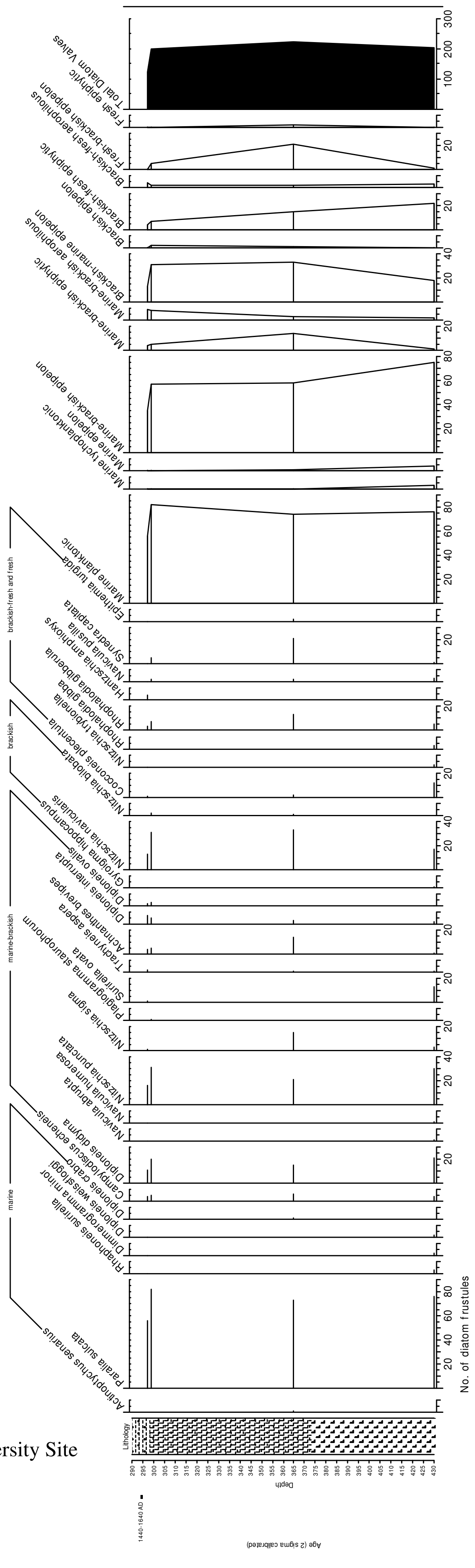


Figure 4: Diatom assemblages encountered within Core 1, University Site Ipswich

APPENDIX I

CORE STRATIGRAPHY

Core Stratigraphy

Troels-Smith (1955) sedimentary classification scheme used for stratigraphic descriptions. Refer to Table 1 for summary of classification scheme.

Core 1

Ground level: 3.35m O.D.

3.35m to 1.75m O.D.	MADE GROUND
1.75m to 0.37m O.D.	Da St El Dr UB 3 0 0 1 - Ga2, Sh1, Ggmin1, Ggmaj+, As+, Dh+, Dl+, Th+ *Dark brown organic sand with occasional gravel, shell fragments, oysters, bone, wood and pebbles (quartz, flint).* *Bone (Anser anser) at 0.41m O.D.*
0.37m to -038m O.D.	Da St El Dr UB 1+ 0 0 0 2 Ag3, As1, Sh+, Ggmin+, Th+, Dh+ *Light grey clayey silt with occasional pebbles ad organic mottling*
-0.38m to -0.96m O.D.	Da St El Dr UB 1+ 0 0 0 1 Ag2, As2, Sh+, Ggmin+, Dh+ *Light grey silty clay with organic mottling*
-0.96m to -1.01m O.D.	Da St El Dr UB 2 0 0 0 3 Ga4+, Ag+, Ggmin+ *Grey-brown sand*
Below -1.01m O.D	***Sands encountered but could not be extracted***

Core 2

Ground level: 3.34m O.D.

3.34m to 1.24m O.D.	MADE GROUND				
1.24m to 0.45m O.D.	Da	St	El	Dr	UB
	3	0	0	1	-
	Ga2, Ag1, Sh1, Dh+, Th+, Ggmin+, Ggmaj+				
	Dark brown organic silty sand with occasional gravel, shell fragments				
0.45m to -0.71m O.D.	Da	St	El	Dr	UB
	1+	0	0	1	1
	Ag2,As2, Ga+, Dh+				
	Light grey silty clay, with occasional plant remains and thin sand horizons				
-0.71m to-0.78m O.D.	Da	St	El	Dr	UB
	2	0	0	0	1
	Ga4, Ag+				
	Grey-brown sand				
Below -0.78m O.D.	***No sediment extracted, although sands encountered***				

APPENDIX II

BEETLE ASSEMBLAGE LIST

Sample depth	1.6-2.05m	2.05-2.50m	2.5-2.98m
Volume (l)			
Weight (kg)			
COLEOPTERA			
Hydrophilidae			
Cercyon spp.			*
Histeridae			
Acritus nigricornis (Hofm.)			**
Staphylinidae			
Oxytelus rugosus (F.)	**		**
Xantholinus spp.	*	*	
Aleocharinae gen. & spp. Indet.		**	
Lathridiidae			
Encimus minutus (L.)	**	**	*
Corticaria spp.		*	
Colydiidae			
Aglennus brunneus (Gyll)			**
Endomychidae			
Mycetaea hirta (Marsh.)			**
Anobiidae			
Anobium punctatum (Geer.)			**
Xyletinus spp.		**	*
Ptinidae			
Ptinus fur			**
Tenebrionidae			
Hypophloeus spp.		*	**
Scarabaeidae			
Oxyomus sylvestris		**	
Aphodius spp.	****		****
Chrysomelidae			
Phyllotraeta spp.			
Scolytidae			
Scolytus spp.	*		
Leperisinius spp.		*	
Curculionidae			
Sitona spp.			**

APPENDIX III

RADIOCARBON DATING CERTIFICATES

FROM: Darden Hood, Director (mailto:mailto:dhood@radiocarbon.com)

(This is a copy of the letter being mailed. Invoices/receipts follow only by mail.)

March 5, 2007

Mr. Thomas Hill
University of Birmingham
Birmingham Archaeology
Edgbaston
Birmingham B15 2TT, UK

RE: Radiocarbon Dating Results For Samples UNIIPS-1.65m, UNIIPS-2.94m

Dear Dr. Hill:

Enclosed are the radiocarbon dating results for two samples recently sent to us. They each provided plenty of carbon for accurate measurements and all the analyses proceeded normally. As usual, the method of analysis is listed on the report with the results and calibration data is provided where applicable.

As always, no students or intern researchers who would necessarily be distracted with other obligations and priorities were used in the analyses. We analyzed them with the combined attention of our entire professional staff.

If you have specific questions about the analyses, please contact us. We are always available to answer your questions.

The cost of the analysis was charged to the VISA card provided. A receipt is enclosed. Thank you. As always, if you have any questions or would like to discuss the results, don't hesitate to contact me.

Sincerely,

Darden Hood

Mr. Thomas Hill	Report Date: 3/5/2007
University of Birmingham	Material Received: 1/30/2007

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 226829 SAMPLE : UNIIPS-1.65m ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (wood): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1450 to 1650 (Cal BP 500 to 300)	360 +/- 40 BP	-25.9 o/oo	350 +/- 40 BP
Beta - 226830 SAMPLE : UNIIPS-2.94m ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (bone collagen): collagen extraction: with alkali 2 SIGMA CALIBRATION : Cal AD 1440 to 1640 (Cal BP 510 to 310)	320 +/- 40 BP	-22.1 o/oo	370 +/- 40 BP

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.9:lab. mult=1)

Laboratory number: **Beta-226829**

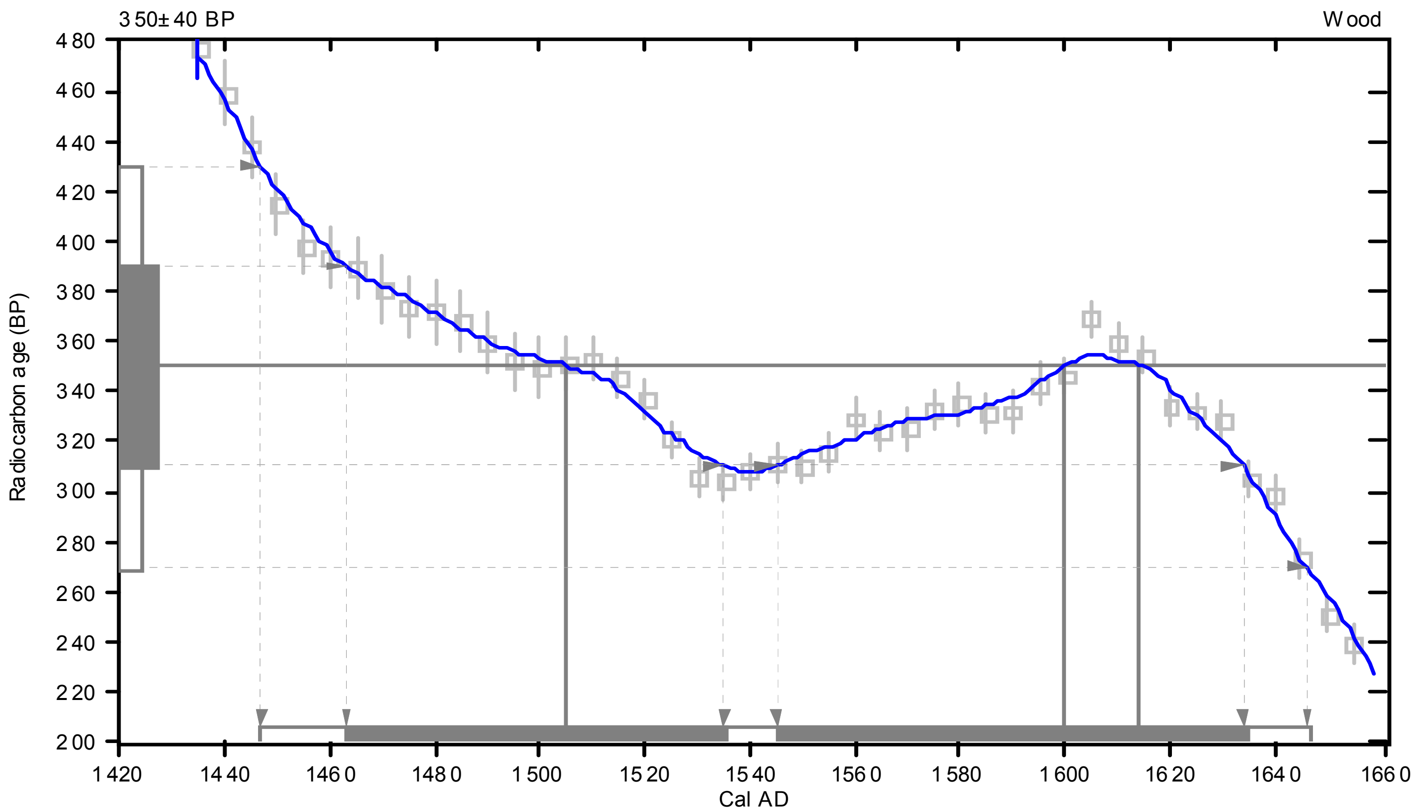
Conventional radiocarbon age: **350±40 BP**

2 Sigma calibrated result: (95% probability) **Cal AD 1450 to 1650 (Cal BP 500 to 300)**

Intercept data

Intercepts of radiocarbon age with calibration curve: Cal AD 1500 (Cal BP 440) and Cal AD 1600 (Cal BP 350) and Cal AD 1610 (Cal BP 340)

1 Sigma calibrated results: (68% probability) Cal AD 1460 to 1540 (Cal BP 490 to 420) and Cal AD 1540 to 1630 (Cal BP 400 to 320)



References:

Database used

INTCAL04

Calibration Database

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

Mathematics

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Beta Analytic Radiocarbon Dating Laboratory

4985 S.W. 74th Court, Miami, Florida 33155 • Tel: (305)667-5167 • Fax: (305)663-0964 • E-Mail: beta@radiocarbon.com

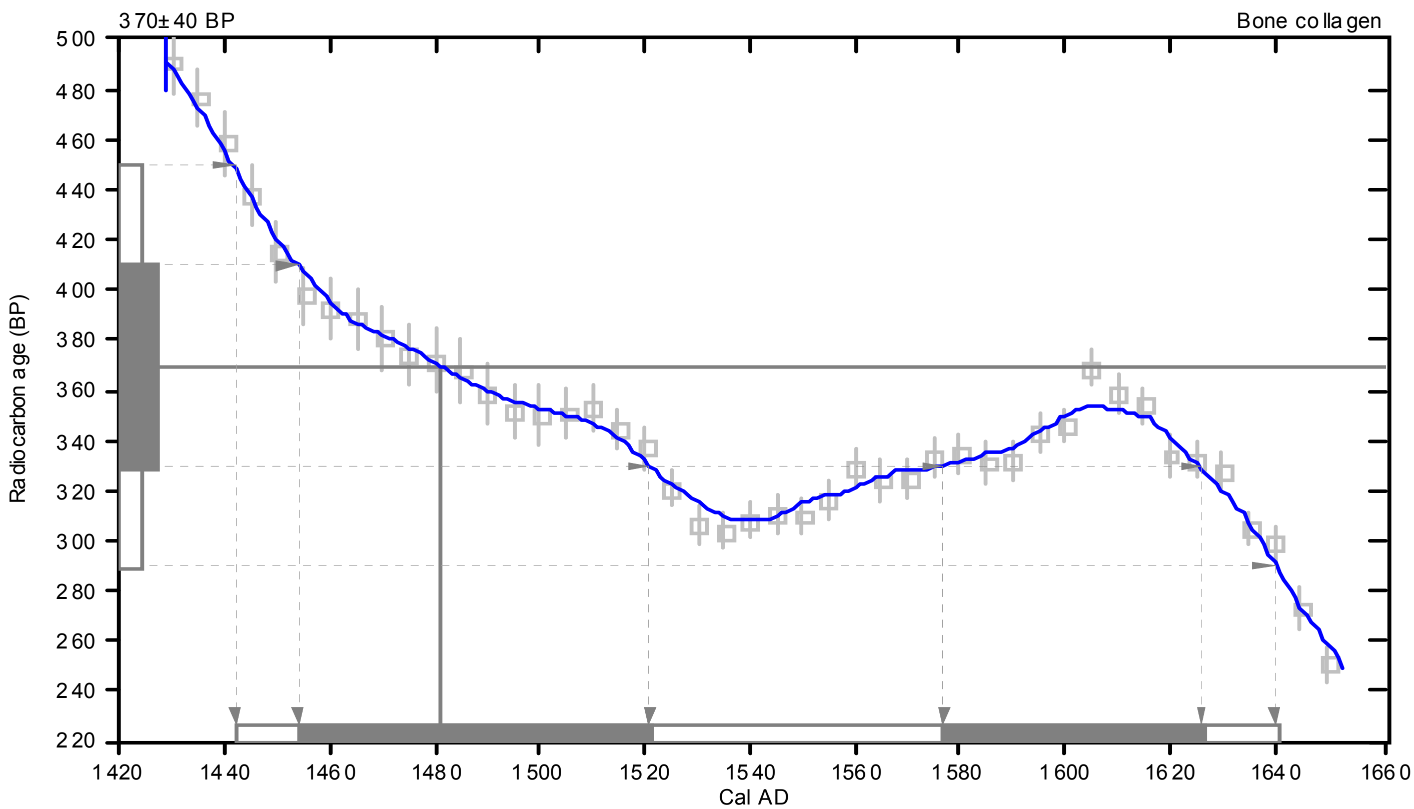
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-22.1:lab. mult=1)

Laboratory number:	**Beta-226830**
Conventional radiocarbon age:	**370±40 BP**
2 Sigma calibrated result: (95% probability)	**Cal AD 1440 to 1640 (Cal BP 510 to 310)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal AD 1480 (Cal BP 470)
1 Sigma calibrated results: (68% probability)	Cal AD 1450 to 1520 (Cal BP 500 to 430) and Cal AD 1580 to 1630 (Cal BP 370 to 320)



References:

Database used
INTCAL04

Calibration Database
INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

Mathematics
A Simplified Approach to Calibrating C14 Dates
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