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HOLOCENE PALAEOENVIRONMENT OF THE FENLANDS: SEA-LEVEL CHANGE AND SALTMARSH EVOLUTION AT FRISKNEY, LINCOLNSHIRE

Sally Derrett, Department of Archaeology, University of Sheffield. srderrett1@sheffield.ac.uk

Background and rationale

The low-lying Fenland basin (eastern UK) (Figure 1a) has been almost completely infilled with unconsolidated sediments following periods of marine and freshwater inundation throughout the Holocene. Stratigraphic palaeoenvironmental studies of the Holocene sediment sequences reveals a complex picture of environmental change (e.g. Brew *et al*., 2015; Smith *et al*., 2010; Godwin and Vishnu-Mittre, 1975). In order to develop a greater understanding of the long-term changes in relative sea-level (RSL), vegetation and the human relationship with the Fenland, a palaeoenvironmental investigation including pollen, foraminifera, loss-on-ignition (LOI) and particle size analysis (PSA) was carried out.

Friskney Decoy Wood is (Figure 1a) a nature reserve comprising of ~6 hectares of woodland. The digital surface model (Figure 1b) shows that the study site was once part of a vast tidal creek network, indicating the complex environmental history of the region. Palaeoenvironmental analyses were undertaken on a 5.4m sample borehole (hereafter referred to as FDWC1) which was obtained from the study site using a 46mm diameter percussion corer. The results of the LOI and PSA analyses are shown in Figure 2, alongside the results of the foraminifera analyses and a summary of the results of the pollen analysis. In order to provide a chronology for the palaeoenvironmental record, three sediment horizons of biostratigraphic/lithostratigraphic significance were identified for radiocarbon dating (Table 1). Three ~5g bulk sediment and peat samples were extracted and submitted for AMS dating to the ^{14}Chrono Laboratory (Queen's University, Belfast). All radiocarbon dates were calibrated using the CALIB REV8.2 programme with the intcal 20.14c radiocarbon data set for terrestrial samples (Stuiver and Reimer, 1993). The age–depth model was constructed using CLAM (linear interpolation) to provide interpolated ages for each sediment horizon not dated directly through radiocarbon dating (Blaaw, 2010).

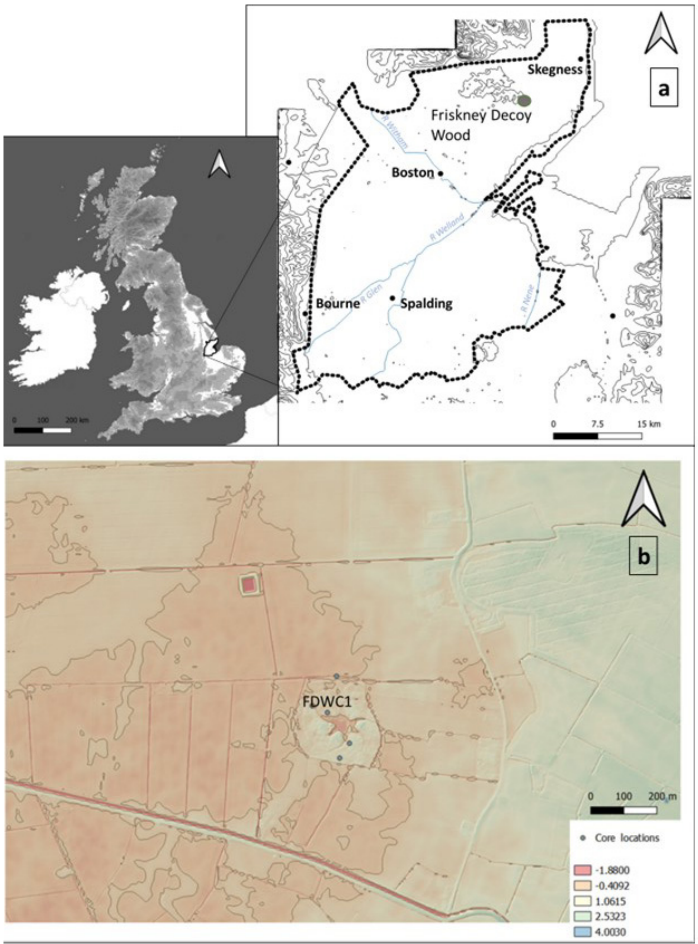

Figure 1. Map to show the location of the Lincolnshire Fenlands (a) and LiDAR images showing the location of the study site (Friskney Decoy Wood) and the location of the sample core taken (FDWC1) (b)

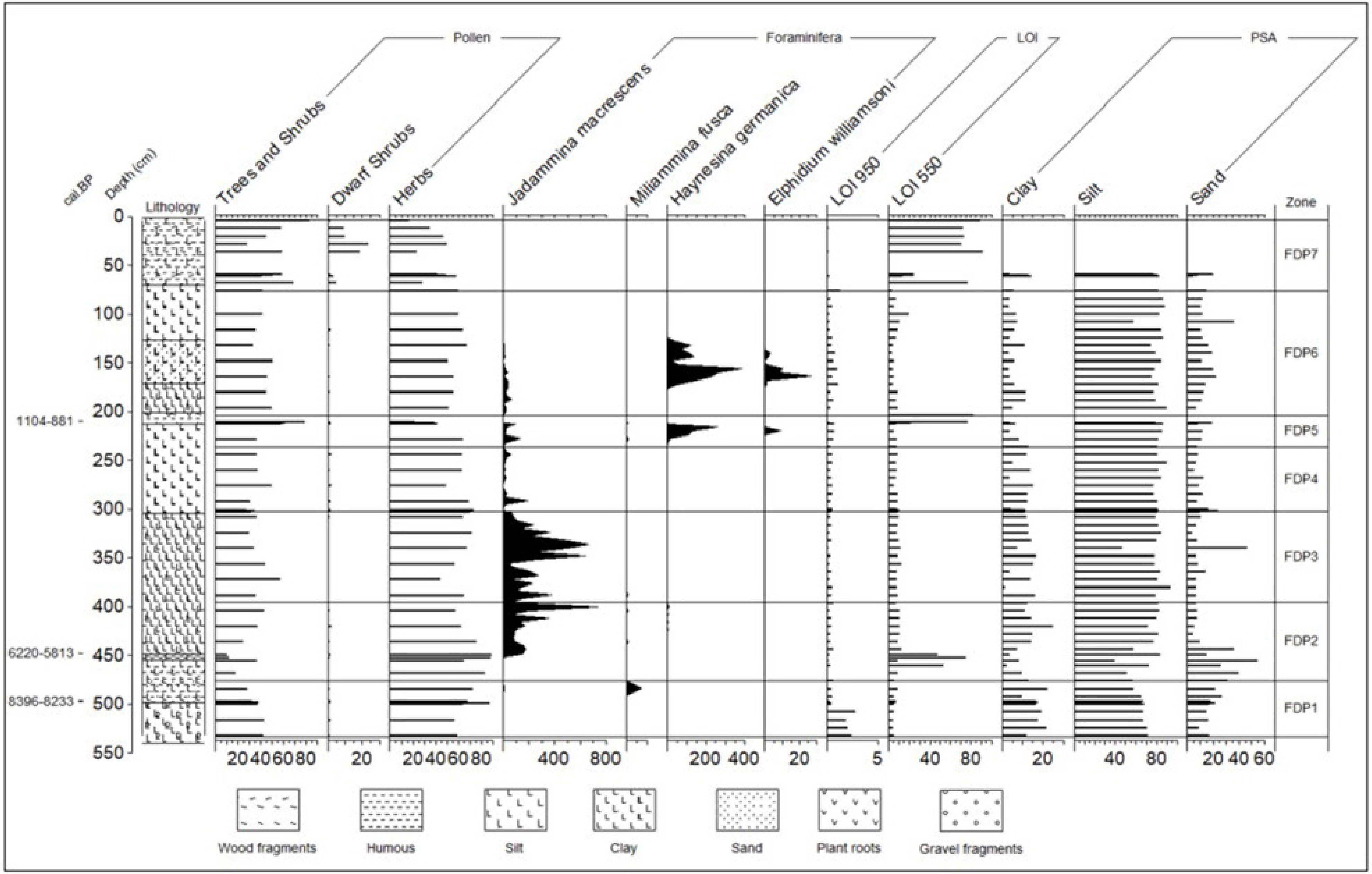

Figure 2. Summary percentage pollen frequency and foraminifera frequency (number per cm^3) shown alongside the results of the LOI and PSA analysis (%) the lithology of sample core FDWC1

Table 1. Justification for radiocarbon dating the selected lithostratigraphic and biostratigraphic alterations observed in FDWC1

Depth (cm)	m OD	Lab code	Reason for ^{14}C dating	Material dated
497-498	-4.41 to -4.42	FDW1	Transition from glacial till to organic sediments potentially indicating local water table level rise	Silt
449-450	-3.93 to -3.94	FDW2	Significant increase in *Jadammina macrescens* foraminifera and silt-clay sediments indicating the local development of a high saltmarsh environment as a result of an increase in the rate of RSL rise in the area	Peat
211-212	-1.55 to -1.56	FDW3	Significant decrease in *Jadammina macrescens* foraminifera alongside significant increases in Alnus and dwarf shrub pollen and organic sediments, indicating a fall in the rate of RSL rise in the area and the development of an alder carr environment	Peat

Results

The earliest radiocarbon date for core FDWC1 (Table 2) indicates that the palaeoenvironmental record begins before 8396-8233 cal.BP, with lithostratgraphic changes indicating increased water table levels and regional climate warming commencing after this date. Marine inundation of the study site and regional RSL rise is dated at 6220-5813 cal.BP. An episode of decreased RSL rise is dated at 1104-881 cal.BP. The age depth model (Figure 3) provides interpolated ages for two further episodes of RSL rise from ca. 1390 to 1104-881 cal.BP and ca. 772 to ca. 573 cal.BP. Interpolated dates for apparent phases of decreased RSL rise are at ca. 2487 to ca. 1390 cal.BP and 1104-881 to ca. 772 cal.BP. The age-depth model provides an interpolated age for the development of a more terrestrial environment at ca. 573 cal.BP as foraminifera disappear from the assemblage, and the development of raised peat bog at the study site from ca. 303 cal.BP.

Table 2. Radiocarbon dates obtained for core FDWC1

Depth (cm)	m OD	Lab code	^{14}C age BP 1σ	^{14}C age range cal.BP 2σ
497-498	-4.41 to -4.42	FDW1	7438±36	8396-8233
449-450	-3.93 to -3.94	FDW2	5187±42	6220-5813
211-212	-1.55 to -1.56	FDW3	1038±32	1104-881

Significance

The radiocarbon dates obtained from this research will be used to calculate sea-level index points for the area, thereby increasing the understanding of Holocene sea-level changes in the North Sea region and the position of the Fenland palaeo-coastline. The radiocarbon and interpolated dates for sea-level change events from this study highlight the complexity of environmental change in the region, showing some temporal variation when compared with the transgressive and regressive events recorded by Brew *et al.*, (2015). The diachronic approach adopted in this research also enhances knowledge of sea-level and vegetation changes into the late Holocene, for which there is little regional palaeoenvironmental data.

Further work

To increase the accuracy of the age-depth model and aid the calculation of sea-level index points, radiocarbon dates will be obtained at sample depths 172cm and 128cm. There may also be the potential to date the episode of decreased RSL rise at 284cm and the development of a raised peat bog environment at 60cm, where a prior hiatus in the sediment record is suspected.

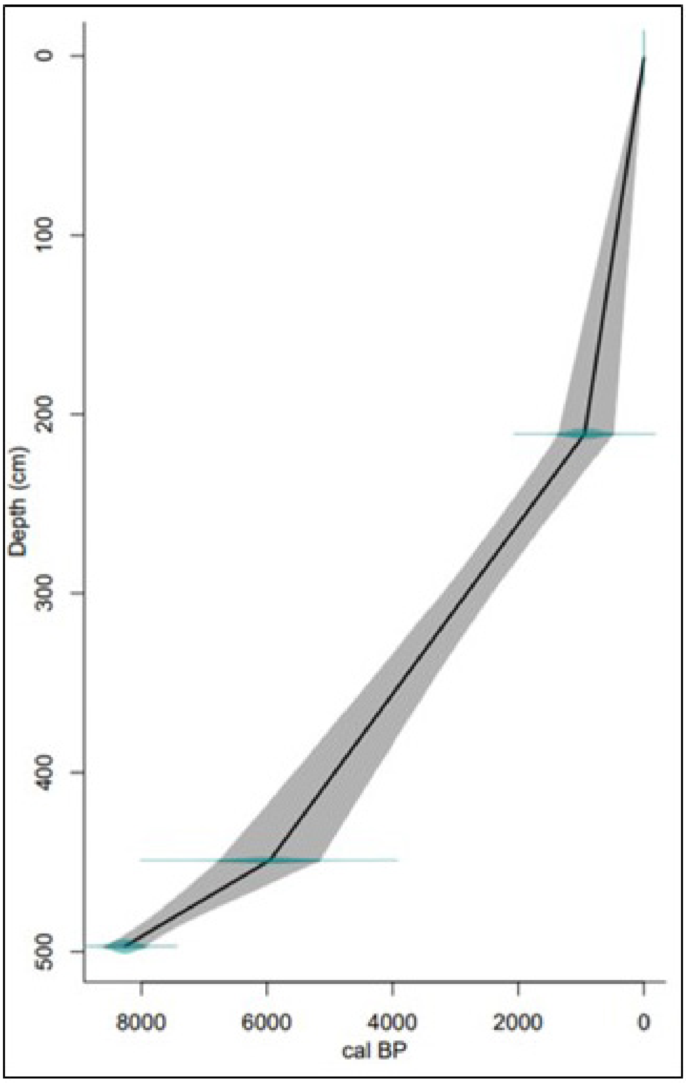

Figure 3. Age-depth model for core FDWC1

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