Hartlepool

[NZ 520 313]

A. Plater

Introduction

Hartlepool Bay lies to the north of the Tees Estuary and immediately south of Hartlepool Headland [NZ 520 313]. The foreshore contains the Hartlepool submerged forest, which is variably exposed along the coast between Seaton Carew and Hartlepool docks. Trechmann (1947) described the ancient forest or peat bed at Hartlepool as 'the most extensive and best known on the north-east coast of England', but marine erosion and engineering works have significantly altered the extent of peat exposure. The submerged forest is easily recognizable as a dark peaty outcrop that contains tree stumps and branches. In addition to its antiquarian interest, the peat bed forms part of a complex intercalated sequence of peats, estuarine and marine sediments, brackish and freshwater organic muds and glacial diamicton. Hence, the sedimentary sequence provides evidence of Holocene coastal change and relative sea-level trends in a crucial region between areas of crustal subsidence to the south and uplift to the north.

Description

The distribution of peat and associated minerogenic sediments at Hartlepool is both discontinuous and complex. Peat beds are exposed in a discontinuous belt from North Sands, Hartlepool, to the foreshore opposite Long Scar at West Hartlepool (Raistrick and Blackburn, 1932; Trechmann, 1936, 1947; Smith and Francis, 1967) (Figure 8.80). These previous studies noted that the peat was generally about 1 m in thickness, but reached a maximum thickness of approximately 5 m in the vicinity of Hartlepool dock. Indeed, excavations near The Slake in 1878 recorded peat up to 2.5 m thick with isolated horns of ruminants as well as tree trunks up to 6 m long and 1 m diameter (Cameron, 1878). Perhaps the best exposure today of the southern part of the submerged forest surveyed by Trechmann (1947) is in the middle part of the beach at Hartlepool Bay, where a depression in the pre-Holocene sediments contains freshwater organic deposits (Horton *et al.,* 1999c). Over 1 m metre of woody peat can be found in the centre of this depression beneath the present-day beach sand. From here, the surface of the underlying diamicton rises seawards, attenuating the peat until the beach sand directly overlies diamicton. Other thin woody peat beds, no greater than approximately 20–30 cm in thickness, are also found within confined basins within Hartlepool Bay, resting either on diamicton or a thin layer of micrite or *Chara* marl.

Although the depressions noted above contain only freshwater sediments, other relict channel features appear to have been open periodically to a marine influence during the Holocene Epoch. The peat beds here are made up of reed material, mainly *Phragmites,* with little wood. Some peaty units are clay-rich organic horizons rather than true peaty, and there are several distinct bands of silt and clay. Indeed, Trechmann (1947) noted the presence of an underlying blue-grey clay (of marine origin) that was penetrated by roots from the peat. At these sites, the extent of marine erosion has been considerable but earlier sea defence works afforded some protection; a high-level unit of grey silty clay is preserved as the uppermost sedimentary unit.

The results of micropalaeontological analyses on sediments from two channel fills are representative of the palaeoenvironmental data preserved at Hartlepool Bay (Innes *et al.,* 1993; Horton *et al.,* 1999c). A core from the lower part of the beach, WH19 [NZ 5209 3138] reveals an intercalated stratigraphy of organic muds and minerogenic units (Table 8.15). Selected pollen and summary diatom results, together with five radiocarbon dates, are given in (Figure 8.81). The lowest silty *limus* is a former land surface beneath a basal peat (*limus* with herbaceous roots). The sand and overlying silty *limus,* as well as the thick blue-grey silty clay (unit 7), are clearly marine deposits from their predominantly polyhalobous diatom assemblage. These were deposited around 6000 years BP and between approximately 5800 and 5500 years BP respectively. The upper part of the blue-grey silty clay preserves a change towards less saline conditions before the transition to the more brackish water conditions of the overlying fine *limus* with *Phragmites.* The silty *limus* between depths of 4 and 10 cm (unit 11) marks a return to marine clastic sedimentation with dominant poly- and mesohalobous diatom taxa. The pollen data (Figure 8.81) are indicative of deposition in an estuarine and saltmarsh environment under variable intertidal conditions. In addition, the radiocarbon dates are corroborated in the upper part of the coarse *limus* with *Phragmites* (unit 9) by a decline in *Ulmus* with other indicators of forest clearance, such as *Plantago lanceolata* and cereal pollen, and the temporary creation of more open vegetation and grassland.

(Table 8.15) Stratigraphy for WH19 (data from Horton *et al.,* 1999c)

Unit	**Depth (cm)**	**Description**
12	0–4	*Limus* with herbaceous roots
11	4–10	Silty *limos*
10	10–14	Fine *limus*
9	14–22	Coarse *limus* with *Phragmites*
8	22–24	Fine *limus* with *Phragmites*
7	24–51	Blue-grey silty clay
6	51–55	Coarse *limos*
5	55–58	Silty *limos*
4	58–59	Sand
3	59–63	*Limus* with herbaceous roots
2	63–75	Silty *limus*
1	75+	Stiff clay

Engineering works in the early 1990s enabled the excavation of wetland sediments preserved beneath the old sea wall, from which core HB4 was collected. The stratigraphy here also reveals an intercalated sequence of varying organic content (Table 8.16). A basal weathered diamicton is overlain by a former ground surface represented by an organic silty sand with rootlets (unit 3). A colluvial deposit with charcoal, plant remains and some flint artefacts (unit 4) overlies this ground surface, perhaps reflecting prehistoric clearance of the landscape in the vicinity. The pollen data (Figure 8.82) reveal that the former ground surface was dominated by *Alnus* with lesser amounts of *Ulmus, Quercus* and *Corylus.* This appears to date from the Elm Decline at about 5000 years BP and suggests that any clearance activity must have been early Neolithic. The pollen from the silty charcoal-rich colluvium are indicative of a strong local signal from alder can vegetation. Towards the top of this deposit, a reduction in tree pollen occurs, with the appearance of weeds indicating cleared, open ground. These indicators include *Plantago lanceolata, Taraxacum*-type and *Pteridium.* Evidence of local woodland destruction also is found in the lower part of the overlying organic sediments in the form of cereal pollen with *Pteridium.* Similar evidence of major Neolithic clearance activity also is present at other sites around Hartlepool Bay, e.g. char coal with weed and cereal pollen in peat from The Slake dated to 5240 ± 70 years BP (HV 3459) (Horton *et al.,* 1999c).

The organic sediments in HB4 are mainly organic muds with an increasing content of *Phragmites* reeds. The stratigraphy is indicative of a rise in the groundwater table and the consequent formation of freshwater ponds. These ponds contain a great deal of inwashed cultural debris, mainly from the Bronze Age, in association with butchered bones of domesticated animals, implements and evidence of construction. Hence, a settlement of some kind is inferred. A continued rise in water level led to the site becoming an area of marsh with ponds and reed beds. A peat with a high marine silt content is indicative of periodic flooding by the sea at this time. Indeed, the pollen contains saltmarsh indicators such as several Chenopodiaceae, *Armeria* and Aster-types. Saltmarsh and coastal pollen types, together with freshwater aquatics, increase abruptly at a date of 2865 ± 75 years BP before the deposition of the silty grey estuarine clay (unit 10).

In addition to the evidence for Holocene coastal and sea-level change preserved within the peats and associated minerogenic sediments, the submerged forest bed has been the subject of antiquarian interest for nearly 200 years (Sharp, 1816). A wealth of fossil information has been recovered, ranging from freshwater and estuarine Mollusca indicative of warmer climatic conditions (Trechmann, 1947) to vertebrate remains including cod, pochard, roe and red deer, aurochs, domesticated cow, pig and wild boar. A red deer antler from Trechmann's collection yielded ages from 8100 ± 180 ^{14}C years BP (BM-90) to 8700 ± 180 (BM-80) ^{14}C years BP (Barker and Mackey, 1961), confirming the cultural stage of the associated flint assemblage rather than the age of the peat. Most of the recognizable tree remains are oak wood and leaves, pine wood, birch bark and branches, hazel nuts and leaves, and alder leaves. Cultural remains from the early Mesolithic to the Romano-British periods have been reported as chance finds on the foreshore, but in-situ remains have been found within the peat beds themselves, including Mesolithic flint assemblages (Trechmann, 1936, 1947), Neolithic sherds, stone axes and worked wooden objects, and, more recently, an early Neolithic wattle panel (Annis, 1994). Perhaps the most significant archaeological discovery has been the Neolithic human skeleton from which bones were radiocarbon dated to 4680 ± 60 years BP (HV 5220). The skeleton was disarticulated, with the cranium upside-down (Tooley, 1978b), and was found in association with flints. From the injuries and the pathology this find appears to have been an in-situ wetland burial.

(Table 8.16) Stratigraphy for HB4 (data from Horton *et al.,* 1999c)

Unit	**Depth (cm)**	**Description**
10	0–17	Slightly organic clayey silt
9	17–40	Silty-clayey *limos* with some *Phragmites*
8	40–45	Laminated light grey-brown silty clay with some limus and *Phragmites*
7	*45–58*	Slightly clayey *limus* with herbaceous *detritus* and *Phragmites*
6	58–66	Woody detrital peat with *limus* and *Phragmites*
5	66–71	Dark brown *limus* with charcoal fragments and herbaceous *detritus*
4	71–76	Light grey, slightly organic silty clay with charcoal and some herbaceous *detritus*
3	76–79	Minero-organic sandy silt with plant rootlets and charcoal
2	79–82	Very sandy clay with some herbaceous rootlets
1	82+	Sandy blue clay with pebbles

Interpretation

The sediments from WH19 and HB4 are representative of those found across the foreshore at Hartlepool. The intercalated sequence of peats and organic muds with marine and estuarine clays and silts is indicative of a variable marine influence on sedimentation brought about by changing relative sea-level during the mid-Holocene. The blue-grey clays and silts containing marine diatoms and molluscs, such as *Scrobicularia plana* and *Cerastoderma edule,* were deposited during periods of relatively low energy, lower intertidal estuarine conditions (Horton *et al.,* 1999c). The organic deposits range from detrital muds deposited in shallow water to more terrestrial herbaceous and woody peats. These peats and many of the *limus* deposits represent periods when either upper saltmarsh conditions prevailed or freshwater swamps and fens became established on exposed older intertidal units.

The lowermost marine clay on Hartlepool foreshore is dated to shortly before 6000 years BP, and overlies a basal peat that appears from the pollen evidence to have started to accumulate at approximately 7000 years BP. As a result of a slight fall in relative sea-level, peat formation replaced the marine clay at about 5000 years BP. However, an increased marine influence soon after this time deposited a thin layer of marine sediments in restricted areas. In the region protected by the old sea defences, the sediments record two additional phases of sea-level rise, one depositing organic muds in the upper part of a peat bed around 3500 years BP and one that leavens the peat with a grey estuarine silty clay dating from around 2800 years BP.

In terms of the controls on sedimentation, the sequence observed is indicative of both groundwater movements and relative sea-level change. Changes in the groundwater level may, indeed, be linked to sea-level but also are a function of drainage efficiency as a consequence of coastal evolution and landscape changes in the adjacent catchments (Horton *et al.,* 1999c). The history of sea-level change in Hartlepool Bay has been reconstructed from these and other intercalated sequences by Tooley (1978b). The record shows almost no crustal movement in the region since about 5000 ^{14}C years BP, and only a small amount in the earlier Holocene (Shennan, 1989, 1992; Long and Shennan, 1993). Hence, the record from Hartlepool provides evidence of sea-level change for the period of approximately 7000 to 3000 ^{14}C years BP and reflects the combination of Holocene sea-level rise and site-specific factors such as changing catchment land use and sediment supply.

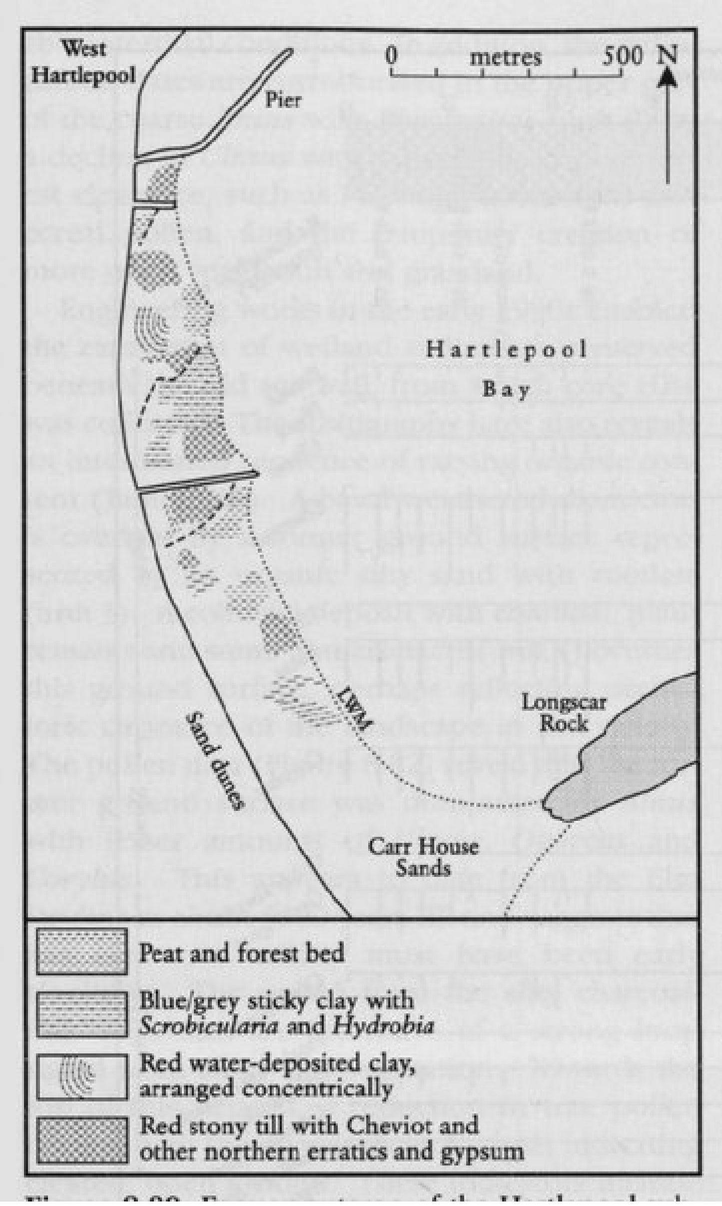
The concentrations of flints and artefacts, human remains and faunal evidence suggest that the wetlands in Hartlepool Bay were attractive to exploitation, especially by early farming communities of the Neolithic and Bronze Age. In addition, these people also may have influenced the nature of wetland sedimentation through clearance activity in the adjacent catchment, potentially altering sediment supply and drainage.

Conclusions

The submerged forest bed at Hartlepool is an important archaeological and geological resource. The wealth of Holocene palaeoenvironmental data obtained from the peats and intercalated tidal sediments includes evidence of past climate and sea-level change, as well as cultural remains from the early Mesolithic to the Romano-British periods.

The sedimentary record from Hartlepool foreshore is the product of considerable changes in land drainage brought about by a variable marine influence between approximately 7000 and 3000 years BP, phases of land clearance, and changes in sediment supply and coastal environment. The observed Holocene relative sea-level trend confirms the unique position of Hartlepool and the Tees estuary on the east coast of the UK as being located on the fulcrum between crustal uplift to the north and subsidence to the south.

References



(Figure 8.80) Former outcrop of the Hartlepool submerged forest bed between Hartlepool Headland and Long Scar. From Trechmann (1947).

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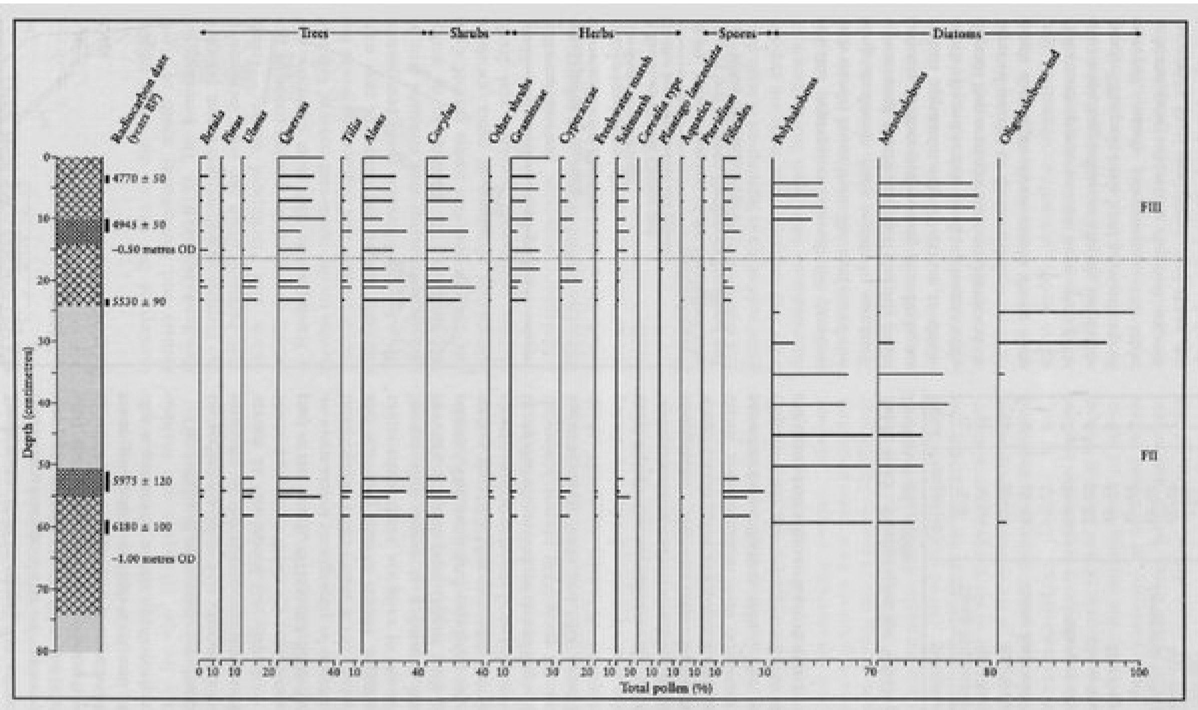
(Table 8.15) Stratigraphy for WH19 (data from Horton et al., 1999c)



(Figure 8.81) Summary stratigraphy, pollen, diatom and radiocarbon data for site WH19. After Horton et al. (1999c). See (Table 8.15) for a description of the stratigraphy.

Unit	Depth (cm)	Description
10	0–17	Slightly organic clayey silt
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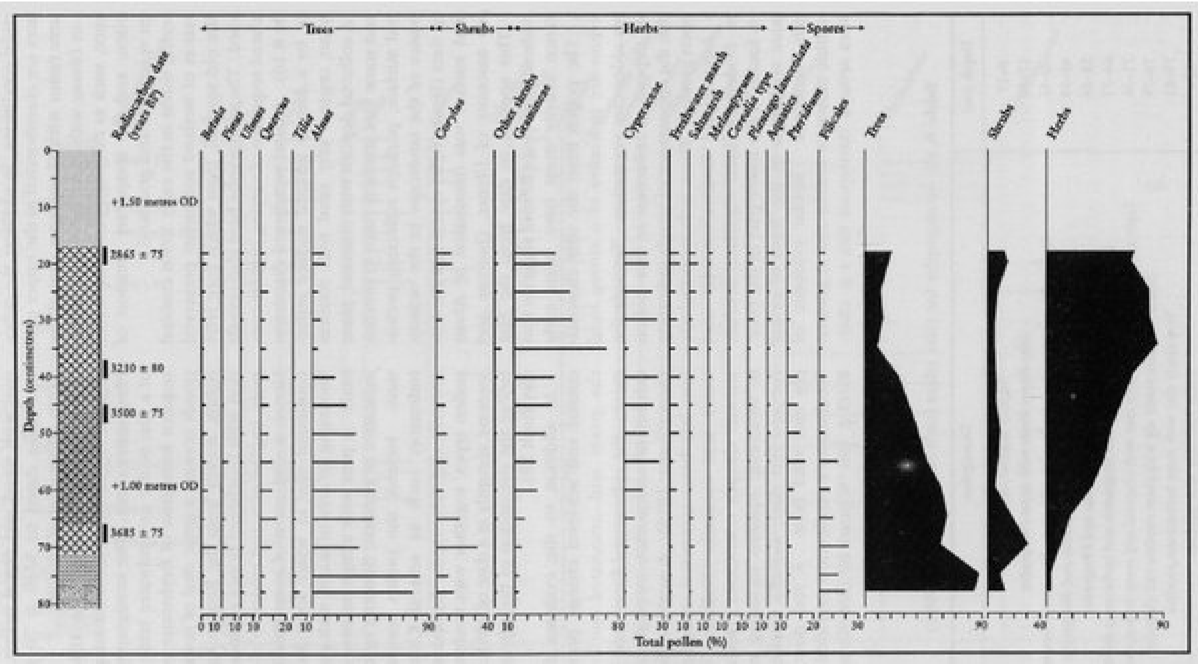
(Table 8.16) Stratigraphy for HB4 (data from Horton et al., 1999c)



(Figure 8.82) Summary stratigraphy, pollen and radiocarbon data for site HB4. After Horton et al., (1999c). See (Table 8.16) for a description of the stratigraphy.