Palaeoecology Research Services

Assessment of biological remains from core samples taken at the site of a proposed second crossing of the River Mersey, nr Widnes, Halton (site code: B4027A)

by

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Summary

A series of six cores were taken using a 75mm piston corer at locations in the vicinity of the site of a proposed second crossing of the River Mersey. The study area was of approximately 280 hectares and bounded by St Helens Canal to the north, Manchester Ship Canal to the south, Runcorn Jubilee Bridge to the west, and Hempstones Point to the east. Two cores from the site were selected for pollen and diatom assessment. In addition, single subsamples from each of these cores were taken for investigation of their content of plant and invertebrate macrofossils.

The diatom assessment showed that both sequences were dominated by euryhaline taxa, tolerant of wide variations in salinity and typical of an estuarine environment undergoing rapid fluctuations in salinity. The lack of a full marine, planktonic assemblage in either indicates a shallow-water environment throughout. With the possible exception of BH12 (pollen sample at 1.15m), the pollen concentrations in the samples were too low to permit anything other than tentative conclusions regarding the possible palaeovegetation. No invertebrate macrofossils were recovered from either of the examined subsamples. The extremely few plant macrofossils were of no great interpretative value, but were consistent with the evidence from the other classes of remains.

There is no potential for further diatom analyses on core BH17 due to poor preservation. A potentially significant change in the estuarine environment may be inferred for core BH12, however, which appears to relate to increased marine influence (high water levels) in the more recent past. There may therefore be potential at this coring site for a diatom-based study to detect natural or artificial changes in the level of high tide over time. However, in addition to diatom analysis, a sediment chronology would need to be established, which may be problematic given the core material available. Given the potential difficulty of deriving a chronology, it seems unlikely that further palynological work would be of value. No further investigation of the current material for plant and invertebrate macrofossils is warranted. If sequences of deposits with higher organic content are encountered by future sampling at the site, then a further assessment should be undertaken.

KEYWORDS: NEW MERSEY CROSSING; RIVER MERSEY; NR WIDNES; HALTON; WIDNES WARTH SALT MARSH; ASTMOOR SALT MARSH; ASSESSMENT; CORE SAMPLES; POLLEN; PLANT MACROFOSSILS; DIATOMS

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Introduction

A series of six cores were taken using a 75mm piston corer at locations in the vicinity of the site of a proposed second crossing of the River Mersey, nr Widnes, Halton. The study area was of approximately 280 hectares and bounded by St Helens Canal to the north, Manchester Ship Canal to the south, Runcorn Jubilee Bridge to the west, and Hempstones Point to the east.

Sections of the extruded cores were submitted to PRS for an assessment of their content of biological remains.

Two cores from the site were selected for pollen and diatom assessment: BH12 and BH17 located on the Widnes Warth (on the north bank of the river) and Astmoor (on the south bank) salt marshes, respectively. The cores consisted of fine sands, silts and clays, with some rare humified organic remains. Three samples for diatom assessment were prepared from each of the cores and two samples from each core for pollen assessment. In addition, single subsamples from each of these cores were taken for investigation of their content of plant and invertebrate macrofossils.

Methods

The diatom samples were prepared using standard techniques involving H_2O_2 and HCl to remove organics and carbonates. Diatom species were identified using Ricard (1975), Round *et al.* (1990) and Hartley (1996). Information on the life habit (planktonic versus benthic) and ecology of taxa were taken from a classification of diatoms of the Belgian coast made by Denys (1991).

For pollen analysis, one cm^3 samples were prepared using standard techniques (Moore *et al*. 1991) involving KOH digestion, treatment with HF to remove mineral matter and acetylation to remove cellulose. Counting was carried out using a Leica DMLB microscope at a magnification of x400. Pollen preservation was assessed on a four point scale: good (most grains well preserved), moderate (some poorly preserved grains), poor (most grains present damaged) and extremely poor (all grains damaged and many indeterminate).

Two sediment subsamples were taken (one from BH12 and one from BH17) for investigation of their macrofossil content ('GBA' samples *sensu* Dobney *et al*. 1992). Each subsample was taken to half the thickness of the core in order to preserve an unbroken sequence through the deposits. The lithologies of the subsamples were recorded using a standard *pro forma* prior to processing (following the methods of Kenward *et al.* 1980; 1986) for the recovery of plant and invertebrate macrofossils. In each case the residue resulting from processing was so small that separation of the components (e.g. by washing over of the lighter organic fraction or paraffin flotation) was not required. The residues were examined for plant and invertebrate macrofossils.

Results

Diatoms

Three diatom slides were prepared from each of two sediment cores: BH12: 1.15m, 2.02m and 2.14m and BH17: 2.12m, 2.40m and 2.70m. However, diatom preservation was very poor in core BH12 (Table 1), probably as a result of diatom valve fragmentation and dissolution under conditions of relatively high salinity

and turbidity. At 2.14m, preservation was restricted to occasional unidentifiable fragments and valves were rare in the uppermost two samples, prohibiting a full diatom count. The rare, identifiable intact valves at 1.15m and 2.02m were dominated by species including *Paralia sulcata* and *Aulacodiscus argus*, marine or marine-brackish shallow-water (tychoplanktonic or benthic) taxa typical of the marine littoral zone

Preservation was better in core BH17 although there was again evidence for fragmentation and dissolution but a meaningful full count would be possible. There is no evidence in the samples for a significant shift in the relative proportion of planktonic (deep water) to benthic (shallow water) taxa, the only true planktonic diatom, *Actinocyclus normannii* morph. *subsalsus*, being present in all three samples. The tychoplanktonic diatom, *Paralia sulcata*, which is typical of tidal flats (Denys, 1991) was common throughout, but there was also an increased proportion of benthic taxa at 2.4m. This was accompanied by taxa typical of freshwaters but which can tolerate low levels of salinity (*Cymbella sinuata*, *C. silesiaca*, *Navicula clementis*, *Fragilaria ulna*).

Pollen Analysis

Results of the pollen assessment are presented in Table 2 as raw counts since, with the exception of one sample(BH12: 1.15m), none of the samples produced sufficient pollen to merit a percentage calculation. Pollen nomenclature follows Bennett *et al*. (1994).

BH12: 1.15m

This sample contained a reasonable concentration of moderately preserved grains. A reasonably wide range of taxa were identified including trees *Betula* (birch), *Quercus* (oak) and *Alnus glutinosa* (alder), whilst the shrubs *Corylus avellana*-type and *Calluna vulgaris* are well represented. Herbaceous pollen in the form of Poaceae (grasses) and species of Lactuceae undiff. (dandelion) and *Plantago* spp. (plantain) were also present. *Pteridium* (bracken) and Pteropsida (monolete) indet. (ferns) spores were also recorded. The most abundant palynomorphs, however, were pre-Quaternary spores.

BH12: 2.02m

This sample contained very little pollen, and the preservation of those grains which were present was poor.

BH17: 2.4m

Fairly low concentrations of moderately preserved pollen present. The best represented tree and shrub taxa were *Quercus* (oak), *Corylus avellana*-type (hazel), and Poaceae (grasses). Other grains identified include: Lactuceae undiff. (dandelions), *Plantago lanceolata* (ribwort plantain), and Chenopodiaceae.

BH17: 2.7m

The pollen spectrum for this sample was very similar to that from BH12, 1.15m with *Betula*, *Quercus*, *Corylus avellana*-type and *Calluna vulgaris* the predominant tree and shrub taxa. Herb pollen included Poaceae, *Plantago lanceolata* and Lactuceae undiff. Pre-Quaternary spores were the most frequently recorded palynomorphs.

Macrofossil remains

No invertebrate remains were recovered from the macrofossil subsamples.

BH12: 2.12-2.19m (0.350 kg subsample processed to 300 microns)

Moist, light to mid grey-brown, stiff and slightly sticky (working soft), silty fine sand. There were no obvious inclusions in the sample.

The extremely small residue (much less than 1 cm^3) was mostly of sand grains with a trace of unidentifiable herbaceous detritus.

BH17: 2.39-2.50 m (0.676 kg subsample processed to 300 microns)

Moist, light to mid grey-brown, stiff (working soft), fine sand (with a little clay). There were no obvious inclusions in the sample.

The extremely small residue (of a few cm^3) amounted to only a little unidentifiable 'grassy' herbaceous detritus and some small mineralised root 'casts' or ‘moulds' - consistent with a natural deposit forming, for example, through alluviation (and subsequent development of grassland vegetation).

Discussion and statement of potential

The diatom assessment showed that both sequences were dominated by euryhaline taxa, tolerant of wide variations in salinity and typical of an estuarine environment undergoing rapid fluctuations in salinity. The lack of a full marine, planktonic assemblage in

either indicates a shallow-water environment throughout. The increased proportion of benthic taxa with depth in core BH17, which was accompanied by the presence of freshwater rather than marine-brackish taxa, indicates a trend above approximately 2.4m towards a shallower, upper estuarine environment with an increased marine influence.

With the possible exception of BH12 (1.15m), the pollen concentrations in the samples were too low to permit anything other than tentative conclusions regarding the possible palaeovegetation. Despite the alluvial depositional context, also reflected in the evidence for fluvial re-working and deposition from secondary contexts in the form of pre-Quaternary spores, many of the pollen grains were well preserved. This might suggest that the pollen derived from vegetation communities proximal to, and contemporary with, sediment deposition at the sampling site, rather than re-deposited from elsewhere. If this hypothesis is accepted, then the following comments may be cautiously made.

The spectrum from sample BH12 (1.15m) reflects a range of habitats including wood/scrubland with oak, hazel, alder and birch, heath/acid grassland vegetation with heather and perhaps bracken, coastal/salt marsh habitats, and open grassland communities with low growing herbs including dandelions and ribwort plantain. A single grain of cereal pollen indicated arable land. Given the nature of the sampling site, it is not possible to identify the possible location or extent of these vegetation communities in the landscape. In terms of a timeframe, the evidence for more open, possibly anthropogenically modified, habitats and the absence of woodland taxa (such as lime or elm) might suggest this sample dates to a post-prehistoric phase of landscape development.

The lower pollen counts from BH12 (2.7m) and BH17 (2.4m) were characterised by similar spectra to that from BH12 (1.15m). This might imply broadly similar vegetation communities over the period of accumulation of BH12 and possibly also suggests a temporal overlap between the two cores, although this is based on admittedly limited data.

No invertebrate macrofossils were recovered from either of the examined subsamples. The extremely few plant macrofossils were of no great interpretative value; those from BH17 (at 2.39-2.50m) were consistent with the evidence from the diatom and pollen samples at 2.4m, however.

Recommendations

There is no potential for further diatom analyses on core BH17 due to poor preservation. A potentially significant change in the estuarine environment may be inferred for core BH12, however, which appears to relate to increased marine influence (high water levels) in the more recent past. There may therefore be potential at this coring site for a diatom-based study to detect natural or artificial changes in the level of high tide over time. In addition to diatom analysis, a sediment chronology would need to be established, which may be problematic given the core material available.

Given the potential difficulty of deriving a chronology, it seems unlikely that further palynological work would be of value. However, should any further sequences be encountered, especially if of a higher organic content than BH12 or BH17, then an additional assessment should be considered.

No further investigation of the current material for plant and invertebrate macrofossils is warranted. However, as noted above, if sequences of deposits with higher organic content are encountered by future sampling at the site, then a further assessment should be undertaken.

Retention and disposal

The remaining sediment cores should be retained for the present.

Archive

All material is currently stored by Palaeoecology Research Services (Unit 8, Dabble Duck Industrial Estate, Shildon, County Durham), along with paper and electronic records pertaining to the work described here.

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Table 1: Results of diatom assessment of Cores BH12 and BH17. ***Key****: X = relatively more abundant than x. M = marine; MB = marine-brackish; B = brackish; BM = brackish-marine; FB = fresh-brackish; BF = brackish-fresh; occas = occasional; comm = common; eury = euryhaline (wide tolerance); med. tol. = medium tolerance; steno = stenohaline (narrow tolerance).*

Life form (Denys, 1991)	**Core**	**BH12**			**BH17**			***Ecology (Denys, 1991)***
	Depth-m	**1.15**	**2.02**	**2.14**	**2.12**	**2.42**	**2.70**	
	Diatom presence	*rare*	*rare*	*very rare*	*occas*	*occas*	*comm*	
	Species							
PLANKTONIC	*Actinocyclus normannii* morph. *subsalsus* (Juhlin-Dannfelt) Hust. ex Van Land.,	x			X	x	x	B, eury
TYCHO-PLANKTONIC	*Paralia sulcata* (Ehrenb.) Cleve	X			X	X	X	M-MB, eury
	Actinoptychus senarius (= *undulatus*) (Ehrenb.) Ehrenb.	x				x		MB, eury
	Aulacodiscus argus (Ehrenb.) A. Schmidt	x	X					M, med. tol.
	Thalassiosira pseudonana (Hust.) Hasle and Heimdal						x	
	Coscinodiscus sp.						x	
BENTHIC	*Naviculoid* centres indet	X	X		x			
	Diploneis centre (robust)	X	X					usually MB, eury
	Rhaphoneis amphiceros (Ehrenb.) Ehrenb.		X		X	X		MB, eury
	Rhaphoneis/Cocconeis sp.				X	X	X	
	Fragilaria virescens Ralfs				x		x	BF, eury
	Gyrosigma centres indet				x			usually B or BF, eury
	Navicula cincta (Ehrenb.) Ralfs in Pritch.				x		x	BF-FB, steno
	Achnanthes brevipes var. *intermedia* (Kutz.) Cleve				x			BM-B, eury
	Cymbella sinuata Greg.					X		FB, steno
	Cymbella silesiaca Bleisch in Rabenh.						x	FB, med. tol.
	Navicula clementis Grun.					x		BF-FB, eury
	Fragilaria ulna (Nitzsch.) Lange-Bertalot					x		FB, steno

Table 2: Results of pollen assessment of Cores BH12 and BH17, expressed as raw counts.

Core	**BH12**	**BH12**	**BH17**	**BH17**
Depth (m)	**1.15**	**2.02**	**2.40**	**2.70**
Pollen Taxa				
TREES				
Betula	7	-	4	6
Pinus sylvestris L.	8	1	-	3
Quercus	6	-	11	12
Tilia	1	-	-	-
Alnus glutinosa (L.) Gaertner	6	-	1	3
Fraxinus excelsior L.	-	-	-	1
SHRUBS				
Corylus avellana L.-type	19	1	8	-
Calluna vulgaris (L.) Hull	18	-	1	-
HERBS				
Poaceae	14	-	13	8
Cereal-type	1	-	1	1
Cyperaceae	3	-	2	1
Apiaceae	1	-	1	-
Chenopodiaceae	-	-	-	1
Achillea-type	-	-	1	-
Asteraceae (Lactuceae)	6	-	2	3
Asteraceae (Asteroideae)	3	-	-	1
Centaurea nigra L.	1	-	-	-
Plantago lanceolata L.	3	-	1	3
Plantago coronopus L.	1	-	-	-
Plantago major L./*P. media* L.	1	-	-	-
Plantago maritima L.	3	-	-	-
Plantaginaceae indet.	1	-	-	-
PTERIDOPHYTES				
Pteropsida (monolete) indet.	11	2	4	4
Polypodium	3	-	-	1
Pteridium aquilinum (L.) Kuhn	6	-	-	1
OTHERS				
Sphagnum	7	1	3	3
Unknown/indeterminable	17	2	4	3
Pre-Quaternary spores	35	9	7	17
Preservation	Moderate	Poor	Moderate	Moderate
Sum TLP	130	8	53	52