7

Conclusions

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In this chapter we summarise the main findings of this research and identify potential future research priorities for further work on the depositional complex. The focus of our work has been on the last 5000 years or so of landscape evolution, a time interval that encompasses the period of extensive peat formation across the back-barrier marshlands as Dungeness Foreland developed from its initial form. Therefore we start this chapter by summarising our main findings regarding the history of this important deposit of peat, paying particular attention to the evidence for late Holocene vegetation changes, the timing and causes of the end of peat accumulation and the deposition of the overlying minerogenic deposits (including the laminated sediments that infill the major tidal channels in the Rye area). Next we review our main conclusions regarding the evolution of Dungeness Foreland including our new age determinations for foreland evolution, the nature of the post-gravel minerogenic sediments and the depositional history of the limnic deposits preserved in the natural pits. Lastly, we summarise our new evolutionary model for the Romney Marsh/Dungeness Foreland depositional complex and highlight future research priorities.

7.1 Late Holocene vegetation history

Our work has generated significant new information regarding the late Holocene vegetation history of the former wetlands of the region, the High Weald and more widely southeast England. In particular, we argue that the data derived from the upper levels of the main marsh peat demonstrate a long history of woodland management and that the modern woodlands of the Weald are not, as popularly believed, a relict of a vast area of untouched woodland. The mid-Holocene *Tilia* (lime) dominated woodland of the Weald was subject to temporary clearance as early as the Neolithic. This woodland was more extensively exploited over a *c.* 700-year period from the beginning of the Bronze Age during which *Tilia* disappeared to be replaced by species indicative of secondary woodland. The main elements of the modern landscape (woodland, pasture and limited cultivation) can be traced back to a more intensive phase of human activity during the Late Bronze Age/Early Iron Age. This phase culminated during the Late Iron Age/Roman period, though importantly there is no evidence that the fuel demands of the early iron industry resulted in widespread woodland destruction. The early Anglo-Saxon period appears locally to have been one of continuity; though an increase in *Fagus sylvatica* (beech) pollen *c.* 700 cal. yrs AD is likely to reflect the development of wood-pastures in the wider Weald.

7.2 A chronology for the end of peat formation

Minerogenic sediments of marine/brackish origin replaced peat across the Rye area during the late Holocene, replicating a stratigraphic transition that is a defining characteristic of many coastal lowland areas bordering the southern North Sea at this time (Long *et al.* 2000). Radiocarbon dates are routinely used to provide a chronology for this change in environment. In the Rye area radiocarbon dates from the "main marsh peat", at locations where upper surface appears gradational, fall into four age clusters; *c.* 1400–800 cal. yrs BC, *c.* 800–400 cal. yrs BC, *c.* 100–400 cal. yrs AD and *c.* 700–900 cal. yrs AD. The hypothesis of multiple inundations is nevertheless rejected, primarily because of the absence of discrete post-peat bodies of marine/brackish sediment and because peat growth appears to have slowed-down or ceased at many sites in advance of tidal inundation. Additionally in the Rye area (and elsewhere across much of Walland and Romney Marshes), the upper contact of the peat is often sharp and associated pollen assemblages rarely indicate the occurrence of transitional plant communities.

The new dates from the Rye area suggest that peat formation ended locally as early as *c.* 1700 cal. yrs BC and at most sites ceased sometime before marine inundation. At the limited number of sites where there is evidence for transitional plant communities and saltmarsh development on top of the peat, the available dates suggest that tidal inundation occurred after *c.* 700 to 800 cal. yrs AD. This confirms the presence of a tidal inlet in the vicinity of Rye which later expanded during the extensive flooding that occurred during mid- to late-13th century AD (*e.g.* Eddison 1998).

Studies undertaken in Romney Marsh and other coastal lowland areas indicate multiple dating of the upper surface of late Holocene peat layers invariably produces diachronous results. As a consequence time-transgressive processes feature prominently as causal mechanisms underlying the shift from peat to minerogenic sediments. However, we believe that the dating difficulties recognised in the Rye area may well apply to many of these other regions and therefore argue that radiocarbon dates from the upper surface of late Holocene peat layers should, in most instances, only be regarded as limiting ages for the deposition of the overlying sediments. New chronologies for tidal inundation must now be constructed through the direct dating of the post-peat minerogenic sediments.

7.3 Driving mechanisms of coastal change associated with the end of peat formation

As noted above, the burial of peat by minerogenic sediment is a common feature of the late Holocene in many coastal lowlands areas bordering the southern North Sea (Section 3.3). Detailed stratigraphic and dating evidence (lithology, grain size, foraminiferal, pollen and radiocarbon dates) from a site in the Rye area (West Winchelsea) indicate gradual inundation after 640–690 cal. yrs AD and the establishment of a saltmarsh. Subsequently water depth increased and 4 m of laminated intertidal mudflat and tidal channel were deposited prior to site reclamation by 1460 AD. Grain size data and statistical analysis of sand and mud laminae thicknesses suggest the laminated sediments accumulated rapidly (*c.* 0.2 m per year) as heterolithic tidal rhythmites. Rapid compaction of the thick underlying peat bed provided the accommodation space for their deposition. This process began with the initial inundation of the site, but seems to have accelerated following the widening of the breach in the Rye barrier during the 13th century AD. Headward migration of tidal channels and creeks provided the mechanism by which the peat was dewatered and degraded. The ensuing compaction lowered the peat surface by at least 3 m. The West Winchelsea study demonstrates the powerful influence that compaction had on the evolution of the late Holocene landscape around Rye and, we believe, on many of the other coastal lowland areas which border the southern North Sea. We consider that this process is likely to have been a key driving mechanism behind rapid late Holocene coastal change, far exceeding the longer-term effects of either eustatic change or crustal uplift/subsidence.

7.4 Tidal channels and landscape evolution in the Rye area

Tidal channels in the Rye area can be reconstructed using stratigraphic, documentary and, from the 16th century AD onwards, cartographic evidence (Eddison 1998; Gardiner 1995). The precursors of these channels controlled the initial expansion of tidal waters and sediment across the back-barrier area (see above and Section 3.3). Once established, the channels provided the transportation links that allowed New Winchelsea and Rye to develop as major trading ports. Following their maximum expansion, probably in the late 13th century AD, these tidal channels were reduced in size by tidal sedimentation and the construction of sea walls.

Stratigraphic evidence (lithology, grain size and foraminifera) from West Winchelsea, White Fleet and the Lower Wainway record their infilling. The foraminiferal records during the period of channel conditions are similar at each site, with assemblages dominated by *Haynesina germanica* and *Gavelinopsis praegeri* a secondary dominant type. *Quinqueloculina* sp. and *Elphidium williamsoni* are also present in significant numbers. These taxa indicate channel conditions with a mixed assemblage of near-shore shelf and estuarine types. However, in the assemblages from the White Fleet and Lower Wainway there is little evidence for surrounding saltmarsh, suggesting these infills derive from final stages in the channels' histories. Detailed analysis of the laminated sediments preserved at these sites suggest they probably accumulated in association with the biannual equinoctial peak in tidal energy. Sedimentation rates vary between sites but all suggest rapid accumulation at rates of between *c.* 0.2 and 0.5 m/yr. The variability observed between sites (and over time) indicates the importance of localised and rapidly changing depositional palaeoenvironments driven by land-claim, together with changes in channel morphology that combine to influence the depositional record at each location.

7.5 A chronology for the formation of Dungeness Foreland

We have successfully dated the Holocene sands underlying the gravel beach ridges of Dungeness Foreland using optically stimulated luminescence (OSL) applied to coarse quartz grains. Thirty-nine sediment samples, derived from shoreface sands collected from 12 deep boreholes through the surface gravels, proved sufficiently sensitive and responsive to enable well-resolved dating using the Single Aliquot Regenerative dose (SAR) measurement protocol. The OSL chronology for the sub-gravel sands of the Dungeness Foreland places the early formation of the underlying shoreface at *c.* 3000 BC in the region of Broomhill, with ages decreasing progressively eastwards to *c.* 1600 AD under the present ness.

The uppermost OSL ages for the sub-gravel sand units, together with radiocarbon ages from a number of organic deposits on the gravel surface, provide bracketing ages for the deposition of the overlying gravel unit. Both sigmoidal isochrons constructed through the sub-gravel sand OSL ages across the Dungeness Foreland, and the consideration of down-core OSL ages, suggest that either an increase in rate of progradation or a change in direction of the foreland development took place after approximately *c.* 0 BC/AD, and again after *c.* 700 AD. From the observed orientation of successive gravel beach shorelines, a change in direction of foreland progradation is favoured, suggesting that the foreland has developed to the east of Lydd beach since the Roman era. Nonlinearity in coastal response is, therefore, expressed in the form of foreland geometry and directional extension rather than temporal changes in sedimentation rate. In addition, the short lag time between shoreface sand deposition and gravel ridge formation is indicative of a high degree of dependency of foreland progradation on the pre-existence of an emergent substrate.

7.6 Tidally laminated sediments across Dungeness Foreland and Denge Marsh

Tidally laminated sediments are common across parts of Dungeness Foreland where they accumulate on top of gravel and shoreface sands (*e.g.* The Wicks, The Midrips, South Brooks, Denge Marsh). Typically these sediments comprise a lower sand that grades up-core into a laminated sand-mud that, in turn, passes up into an iron-stained silty sand that extends to present surface. The traditional depositional model for tidal flat sedimentation in such sheltered back-barrier environments envisages their deposition as a gradual process characterised by the slow accretion of increasingly fine-grained sediments (up-core) with morphosedimentary responses to environmental change occurring over timescales of 10^0 to 10^3 years. However, the widespread occurrence of thick, up to several metres in places, laminated sands and muds in the late Holocene sediments of Dungeness Foreland indicate that a more rapid response to environmental change may have taken place here, driven by changes in the degree of protection offered by the Dungeness barrier.

Detailed lithological (grain size and laminae counts) from seven sites across the foreland enable the identification of cyclically varying tidal height, and hence depositional energy, encoded within the repetitive thickening and then thinning of sand layers of the laminated sediments. Cycles within the layer thickness cover periods ranging from fortnightly neap-spring, to annual, and can be correlated directly with the pattern of variations in highest tides from the Dungeness tide station data. A depositional model based on sedimentation occurring primarily around the lower energy threshold for distinctive rhythmite preservation is proposed and this fits well with the conclusion that sedimentation was concentrated around the period of higher equinoctial tides which occurs twice every twelve months. Deposition rates derived from these bi-annual peaks in layer thickness indicate that sedimentation across wide areas of the marsh during the late Holocene took place at rates of 0.3 m/yr.

The response to changing barrier morphology was initially rapid with metres of sediment accumulating in just a few years prior to a period of more typically gradual sedimentation as the surface elevation moved up the tidal frame to the point where tidal flooding was no longer sufficiently frequent or energetic to enable discernable rhythmite deposition. A short section of core recovered from below the gravel, also laminated, indicates that this mode of deposition may have been important at times during the build up of the lower intertidal to subtidal shoreface on which the gravel was subsequently deposited.

7.7 The natural pits on Dungeness Foreland

We studied three natural waterlogged depressions on the surface of Dungeness Foreland (Wickmaryholm, Muddymore and Open Pit 1) to assist in developing a radiocarbon chronology for the foreland and to provide information on vegetation history; namely the hydroseral development of the pits, shingle vegetation succession and changes in the regional vegetation.

Both bulk and plant macrofossil samples were used in a radiocarbon dating programme for each pit. The humin and humic acid fractions from the former provided consistent results but differ from those obtained from the macrofossils, being *c.* 400–500 cal. yrs older where material was taken from the same stratigraphic position. Macrofossil dates from the base of Wickmaryholm Pit suggest deposition by at least 240–305 cal. yrs AD (24% probability) or 210–410 cal. yrs AD (61% probability). At Muddymore Pit the sediments are younger and date from the 11th to 12th century AD. These determinations are consistent with the OSL data and demonstrate that Dungeness Foreland grew between these sites, a distance of *c.* 2 km, in about 1000 years. Wickmaryholm Pit remained a relatively stable freshwater depositional environment until about 400–600 cal. yrs AD after which saline water began to flood the pit. This culminated several hundred years later (*c.* 860–1020 cal. yrs AD) by the replacement of an organic mud by clastic sedimentation. These changes are evidence for erosion of the south coast of Dungeness Foreland, initially leading to the seepage of saline water into the pit, and relate to larger scale barrier changes associated with the expansion of the Rye tidal inlet at this time. At Muddymore Pit brackish conditions returned during the late medieval period, though this switch is likely to be linked to the construction of the Dengemarsh Sewer. At Open Pit 1 the radiocarbon dates indicate that the organic sequence sampled here did not begin to accumulate until recently, probably after 1950 AD.

The pollen assemblages from the organic mud at Muddymore are remarkable for their high *Cannabis sativa* (hemp) values which indicate the use of the site as a hemp-retting pit. The pollen record for *Cannabis* here corresponds with a period during which the nearby town of Lydd reached the height of its prosperity and importance as one of the lesser haven of the 'Cinque Ports' confederation and hemp would have been required for products such as rope (for rigging) and cloth (for sails).

Each of the pits investigated records the early development of fringing reedswamp. At Wickmaryholm and Muddymore there is no pollen or macrofossil evidence for the widespread development of the later hydroseral stages (carr or oligotrophic communities) which are present in some of the pits today, though the Open Pit 1 assemblage suggests the former is likely to be heavily under-represented in the pollen records from the pits. Elements of the pioneering *Rumex-Glaucium* and shingle heath communities are consistently recorded, though clear temporal trends in the development of the shingle vegetation are hard to identify, probably due to the ease of pollen dispersal across the foreland. Nevertheless, the scarcity of pollen of taxa such *Prunus* (blackthorn), *Taxus baccata* (yew) and *Sambucus nigra* (elder) from the pits, until the recent past, argues against the extensive development of late successional scrub on the foreland.

The arboreal pollen in the pits is likely to be derived from a large source area. The Wickmaryholm Pit assemblages suggest (in contrast to the pollen records from the Rye area) that *Fagus sylvatica* (beech) was a major woodland component during the late Roman period, possibly more abundant than *Quercus* (oak) and that *Carpinus betulus* (hornbeam) has been a component of the woods of south-east England since at least the late-Roman period. Higher *Corylus avellana*-type (hazel) values provide some evidence for large-scale vegetation changes, possibly a decline in woodland management, around the time of the demise of the Roman iron industry. Open Pit 1 indicates a change in the regional pollen rain occurred in the late 1950s/early 1960s. *Quercus* values decline and there are increases in *Betula* (birch) *Alnus glutinosa* (alder), *Fagus sylvatica* and *Pinus sylvestris* (pine) pollen. These trends are consistent with the increase in the planting of conifers in the late 20th century AD and the spread of secondary woodland.

7.8 The late Holocene evolution of the Romney Marsh/Dungeness depositional complex

The data collected as part of the Rye area and Dungeness Foreland projects enable us to develop a new model for the evolution of the depositional complex. An initial, probably sand-dominated drift-aligned structure, extended northeast from Fairlight Head reaching Broomhill Level by *c.* 3000 cal. yrs BC. For the next 2000 years, the barrier remained a largely stable form, building to the east and fed increasingly with sediment cannibalised from up-drift sources. Peat formation was widespread across the back-barrier area. Marine conditions returned to Romney Marsh proper *c.* 0 cal. yrs BC/AD, although this phase of tidal flooding has yet to be conclusively dated.

Between *c.* 700 to 1700 cal. yrs AD, the evolution of Dungeness Foreland was linked to the opening and subsequent contraction/closure of tidal inlets at Romney and Rye. For a period of time the two inlets appear to have been open simultaneously. Closure of the Romney inlet was helped by reclamation that reduced the back-barrier tidal prism and diminished the size of the ebb-tidal delta. An initially small inlet at Rye was widened in the 13th century AD causing extensive erosion of the back-barrier sediments and the collapse of the main marsh peat. There followed a brief phase of renewed flooding of Walland Marsh after which the main tidal channels began infilling. By *c.* 1500 AD the inlet was sufficiently full of sediment to provide a platform upon which gravel beaches could develop and the beach complex at Rye Harbour accreted with gravel derived from up-drift sources.

The integration of records from the Rye area and elsewhere across Walland and Romney Marshes, together with our new observations from Dungeness Foreland, confirm the strong interdependence that has characterised the depositional history of these related landform types. Without the shingle barrier system it is unlikely that conditions would have be suitable for the accumulation of fine-grained minerogenic and organic sediments, especially given the exposed nature of this part of the eastern English Channel. Moreover, without the deposition of the fine-grained sands and muds that comprise the shoreface platform and back-barrier sand and mudflats, there would not have been a sedimentary platform on top of which the gravels of Dungeness Foreland could have accumulated.

This independence is further illustrated by a consideration of the tidal inlets that periodically traversed the sand and gravel beaches of the depositional complex. When open, they not only reduced the 'connectivity' of alongshore sediment transport but also served as conduits for water and sediment to be exchanged from the English Channel to the back-barrier areas. Given the volume material and rapidity of deposition of the late Holocene minerogenic sediments, we believe that there was a strong net flux of sediment from the English Channel into the back-barrier area. Cartographic evidence from Rye (*e.g.* Symondson's map of 1594) shows the presence of shoals both immediately offshore and inside the Rye inlet and these are probably the ebb and flood tidal deltas respectively. As this inlet, and potentially also that at Romney and Hythe closed, so the ebb delta sediments would have been reworked and transported landward to form the coastal dunefields observed at Camber, Littlestone and perhaps also at Sandtun.

We consider a strength of our palaeogeographic reconstructions to be the integration of dating evidence from a variety of sources. For the first time we are able to present a robust chronology for the pre-gravel shoreface sands based on absolute dating using OSL techniques. In addition, post-gravel minerogenic and organic sediments provide complementary dating control that adds to the confidence of our interpretations. The model for foreland evolution can also be linked to the evolution of the back-barrier, especially during the initial period of barrier formation and establishment. Moreover, our efforts to resolve the age of the end of peat formation now indicate that this change in environment was more complex than thought previously (*e.g.* Long, A. J. *et al.* 1998) and probably strongly influenced by human activities.

It is evident from both the OSL chronology and the analysis of tidal rhythmite data from the Rye area and Dungeness Foreland, as well as from our analyses of the peat and post-peat sediments, that the Romney Marsh/ Dungeness Foreland depositional complex has undergone periods of protracted stability punctuated by episodes of very rapid change. During the mid-Holocene, the expansion of mudflat, saltmarsh and then freshwater peat-forming communities across Walland and Romney Marshes heralded a period of time, lasting several thousand years, when the landform was relatively stable. The foreland continued to prograde in an easterly manner and the changes recorded in the back-barrier complex, a slow-down or cessation in organic accumulation in many areas after *c.* 1500 cal. yrs BC and the establishment of a raised bog across the southwestern part of Walland Marsh *c.* 750 cal yrs BC, reflect the continued stability of the barrier system. However, after about 0 cal. yrs BC/AD, following an increase in the rate of progradation or a change in direction of the foreland development, the back-barrier area experienced rapid and radical change. One example of such change is the expansion of the Rye tidal inlet in the 13th century AD which over a few centuries resulted in the destruction or deep burial of the main marsh peat across the Rye area. Another example is the very rapid sedimentation in tidal channels in response to changing coastal morphology, as evidenced by the tidal rhythmite data. This suggests that in tidal channels across Walland Marsh and on Dungeness Foreland, decimetre thick units of minerogenic sediment were deposited in a year or less. These periods of rapid sedimentation were interspersed by phases of non-deposition or erosion, but nevertheless, and particularly in the latter phases of tidal channel infilling, they promoted abrupt changes in the intertidal landscape.

7.9 Future research directions

The research undertaken as part of the Rye area and Dungeness Foreland projects has generated a series of new research questions. We briefly outline below some of the more pressing areas of research that we believe would assist in furthering our understanding of the history of the depositional complex, as well as of coastal evolution in the late Holocene more widely.

7.9.1 Basement topography and early Holocene sedimentary environments

Despite recent advances in the Rye area (Long *et al.* 1996; Waller & Kirby 2002) little is known about the bedrock topography and the early Holocene depositional history of the wider marshland. A program of deep drilling, ideally in transects across Walland and Romney Marshes and potentially supplemented by boat-based seismic investigations in the many gravel pits of the study area, would help us address a number of research questions. Knowledge of the basement topography would enable us to link the topography of the western valleys with the palaeovalley network known to be present offshore (Greensmith & Gutmanis 1990; Dix *et al.* 1998), with bedrock topography being likely to have exerted a strong influence on the early Holocene evolution of the region in determining coastal configuration before the development of the sand and gravel barrier system *c.* 2000 cal. yrs BC. Such a programme of research would also enable us to determine the nature of the sedimentary environments present during early Holocene, the volume of sediment that accumulated in the pre-peat period, and how the region responded to the major changes in tidal regime and sediment supply that must have accompanied opening of the Strait of Dover.

7.9.2 A compaction-free relative sea-level curve

Almost all of the sea-level index points from the study area have been lowered from their original elevation as a result of sediment compaction. Illustrated most clearly at West Winchelsea, this process adds considerable complexity when attempting to resolve the role played by relative sea-level change in the evolution of the depositional complex. This problem is especially acute in the late Holocene as the upper levels of the peat have been most severely affected by this process and because much of the organic sediment which has accumulated above the gravel beaches originated in former waterlogged depressions and therefore provide equivocal data for reconstructing age/altitude trends in relative sea-level. One approach to addressing this question would be to develop a basal peat sea-level curve by targeting thin organogenic deposits where they overlie the bedrock (*cf.* Gehrels 1999) or substantial thickness of buried gravel (as observed on Broomhill Level, Scotney Marsh and Allens Bank). The progressive expansion of peat forming communities in an easterly direction during the mid-Holocene might be profitably exploited through a series of sampling sites stretching across the northern edge of Walland and Romney Marshes.

7.9.3 The nature of the early barrier

We have largely repeated pre-existing models for the initial origin of Dungeness Foreland by invoking an early drift-aligned barrier extending from Fairlight Head towards Hythe. Nevertheless, the composition, configuration and date by which any such barrier developed remain uncertain. Although Green (1968) suggested that the Midley Sand might record the remnants of this early barrier, stratigraphic investigations at the Midley Church Bank demonstrate that the surface outcrop of sand here post-dates the main marsh peat and is one of the youngest elements of the marshland stratigraphy (Long & Innes 1993). However, a sandy shoreface is a necessary precursor to gravel deposition and it is interesting to note that Midley Sand is also mapped by Green (1968) as a buried deposit in several locations, including across parts of Broomhill Level. Further investigation of these deposits, again including seismic and resistivity profiling, could potentially yield information on the form of the early barrier system.

7.9.4 OSL dating of the "younger alluvium" and earthworks

We have demonstrated that at several sites radiocarbon dating is a blunt tool for resolving the age of minerogenic sediments that overlie the main marsh peat. OSL dating has, in contrast, provided a powerful technique for determining the age of the shoreface sands beneath Dungeness Foreland. Elsewhere, OSL dating of saltmarsh deposits has proved successful (*e.g.* Bungenstock *et al.* 2004) and it is possible that such an approach would provide reliable dates for the development of the Hythe, Romney and Rye inlets. Such a technique also has potential to resolve the age of successive land-surfaces that surely exist within the "young alluvium", including the substrate upon which many of reclamation/sea defence walls were constructed. Establishing the age of the Rumensea Wall, which may have been constructed as early as *c.* 700 AD as a sea defence for Romney Marsh proper, is an urgent research priority that this approach could resolve.

7.9.5 The Hythe and Romney inlets

Our focus in this study has been on the Rye inlet, yet the Hythe and Romney inlets remain relatively poorly understood. In particular, we know little of the early history of the former, including its configuration during the period of peat formation and subsequent inundation. The gravel beaches in the Hythe area have yet to be dated. A series of deep cores from Romney Marsh proper would yield interesting evidence regarding the process of infilling of the back-barrier area as Walland Marsh developed into a freshwater wetland. Likewise, detailed stratigraphic data from the Romney inlet is lacking and we know nothing of the deeper stratigraphy in this area, despite its importance to models of coastal evolution. If our palaeogeographic reconstructions are correct, the tidal inlet here should have once been connected to the Rye inlet.

7.9.6 The Walland Marsh raised bog

We studied the Walland Marsh raised bog as part of the Rye project to provide a regional pollen signal. However, our palaeogeographic reconstructions suggest the significance of this feature has been under-estimated. The upstanding area of raised bog was one of the last parts of the marshland to be inundated (existing until at least *c.* 1000 cal. yrs AD) and is likely to have been an important resource for fuel and as grazing land into the medieval period; and may even have been important in determining the pattern of early land-claim (Allen 1996; Waller 2002). The sediments of the bog provide an opportunity to investigate past climate change, using techniques such as the determination of peat humification and testate amoebae and plant macrofossil analyses (Chambers & Charman 2004) and may also contain micro-tephras (Hall & Pilcher 2002) that would assist on correlating the sequence here with sites elsewhere. Further coring around the margins of the complex would help delimit its extent, especially along its southern edge where it may have abutted against the sand and gravel barrier.

7.9.7 Land-ocean interactions

The relative contributions of the Wealden catchments, material reworked from offshore and from updrift sources, to the finer minerogenic sediments that have accumulated in the complex during the Holocene remains unclear. Wider application of techniques such as sediment geochemistry, clay and heavy mineralogy, the use of which to date have largely been confined to the marshland/foreland interface environments where sediment source is difficult to resolve due to diagenesis (see Chapter 5), could provide new information on sediment provenance (*e.g.* Ridgway *et al.* 2000; Plater *et al.* 2000); particularly in helping to separate inputs from the geologically distinct updrift sources from sediment that ultimately derives from the Weald. There is also potential for using organic biomarkers and isotopic signatures for sediment provenance work, particularly with respect to resolving fluvial and marine sources (*e.g.* Lamb *et al.* 2006). The thick alluvial sequences in the upper Wealden valleys (Burrin 1988) have the potential to provide information on the timing and the processes (*e.g.* land-use change, climate change, industrial activity, sediment storage/release) causing the release of sediment from the catchment. With current chronologies in the upper valleys based on palynological data there is again the opportunity to apply new dating techniques (*e.g.* OSL). Considerable scope also lies in the numerical modelling of sediment delivery to the coast from the Wealden catchment as a function of climate and land-use change (*e.g.* Coulthard & Macklin 2001). Our understanding of regional vegetation history (which includes not only the pollen data but recent unpublished investigations of microscopic charcoal from the Rye sites, Grant *pers. comm.*) offers well resolved input data with which to explore the impacts of increased runoff and/or land clearance (at a range of spatial scales and locations) on soil erosion and sediment supply to the back-barrier marshland.

7.9.8 Patterns of coastal evolution in the eastern English Channel

At several points in this research we have discussed the potential sources (offshore, alongshore and catchment) for the sands and gravel that comprise Dungeness Foreland. However, little is known as to the relative significance of these sources and how they may have varied in importance through time. Jennings & Smyth (1990) argue that only during certain periods would gravel have been able to drift along the Sussex coast and into the Romney Marsh/Dungeness Foreland depositional complex, due to the presence of large open tidal inlets at locations such as Pevensey Levels for much of the Holocene. Until the stratigraphies of the valleys and coastal lowland areas along the Sussex coast are better understood, testing competing models of drift cell operation is likely to prove difficult. A particular challenge here are the problems we have identified in interpreting the dates obtained for the end of peat formation as we believe these are likely apply to other parts of the Sussex coast.