Heritage Management and the North Sea Palaeolandscapes Project

Simon Fitch, Vincent Gaffney and Ken Thomson

Abstract
This paper presents the larger heritage context of the North Sea Palaeolandscapes Project (NSPP). It outlines associated archaeological issues and a methodology for implementing an historic landscape characterisation programme within an inaccessible environment associated with hunter-gatherer communities. The latter part of the paper then provides the data relating to the archaeological potential of the interpreted landscape as well as an uncertainty/ threat assessment derived from available data. The paper concludes by outlining the potential of the region for further archaeological research.

Key Words
Mesolithic archaeology, heritage management, historic landscape characterisation, threat assessment, archaeological potential, southern North Sea

Introduction
The data generated as part of this project for the southern North represents one of the largest samples of a, potentially, well preserved early Holocene landscape surviving in Europe. Prior to discussing the significance of the mapped remains in heritage terms some review of current knowledge is required. The period under study, the Mesolithic, essentially incorporates the period 10 Ka BP to 5.5 Ka BP. This episode is, in many ways, a time of transition, and tremendous environmental change is the background to cultural events throughout this period. Sea level rise, associated with climate change, resulted in the loss of more than 30,000km2 of habitable landscape across the area Southern North Sea basin alone during the Mesolithic and the inundation of this immense area has left us with a 'black hole' in the archaeological record for north western Europe as a whole. The few finds from this region rarely possess accurate provenance or context (Koojimans 1971; Verhart 2004).

Whilst the Early Mesolithic (10 ka BP to 8.5 ka BP) record from this region is, essentially, a blank, the terrestrial record does provide some insight into what may be expected within the area of the southern North Sea ((Jacobi 1973; Wymer 1991). The early stages of the English Mesolithic are best represented by a small number of sites including Star Carr, Thatcham, Broxbourne or Horsham (Clark 1972, Healy et al. 1992, Warren et al. 1934, Jacobi 1978). . These sites do show some variation in culture indicative of different social groupings (Reyner 1998), and in the past there has been a trend to group British types with that of the Maglemosian of Denmark, and frequently to see parallels with the "Duvensee" culture (Clark 1975). However, there are difficulties with such comparison and they add little to our understanding of the archaeology of the North Sea region as it stands.

In general term, all of these early sites demonstrate utilisation of a range of resources, primarily focused upon game animals and plant resources. The early Mesolithic in England does not yet record substantive evidence of the use of marine resources. However, given the emerging knowledge of coastal change it is likely that most of the areas that might record such economic practises are actually submerged. Evidence from Scandinavia where substantial areas of early coastline survive, suggest that these resources would not have been ignored (Norqvist 1995). Conventionally, the Early Mesolithic has been seen as period where populations moved between base camps on the coastline moving inland to forage (Clark 1972, Smith 1992, Fischer et al. 2004). This interpretation suggests that the emergent

landscape of the Southern North Sea may possess seasonally visited base camps during the Early Mesolithic. However, information from Scandinavian suggests a contrasting lifestyle utilising only resources within a maritime zone (Indrelid 1978:169-70, Nygaard 1990:232), and it is possible that the contemporary occupants of the "Doggerland" coastline followed a similar lifestyle. If this comparison is correct it would contrast with conventional models of Mesolithic movement (Darvill 1995, figure 20; Smith 1992). Indeed, whilst it must be acknowledged that previous models have rarely had access to data from the original coastlines, recent discoveries at sites including Howick in Northumberland suggest that we might expect significantly more complexity and diversity in economic and social practise than previously imagined (Waddington et al. 2003). Any enhancement of our knowledge derived from the submerged landscape of the North Sea is therefore likely to provide information that will significantly refine our appreciation of the Early Mesolithic within the larger region.

The Later Mesolithic (8.5 ka BP to 5.5 ka BP) in Britain has often been interpreted as a time of increasing divergence from cultural developments in Europe and one of economic change (Jacobi 1973; Wymer 1991).. Jacobi (1976) for example, proposed that any discrepancy was related to the submergence of parts of the North Sea and the increased difficulty of maintaining connections between Europe and Britain. Certainly, the effect of the final inundation of the North Sea emergent landscape during the Later Mesolithic would have been significant to the many groups who must have lived in or adjacent to the North Sea plain. As the historic landscape was lost to the sea it would have fragmented into islands. Whilst some of these isolated areas, at least, would have continued to be populated as marine transgression progressed, habitation of this region would have become increasingly tenuous and migration from the region must have occurred (Coles 1999). The consequences for the groups who moved, or for those who lived in the areas into which they migrated, are, at present, simply unknown. Whilst some consideration of migrations from the region to areas including Norway and Scotland have been considered for the earlier period of inundation (Nummedal 1924, Bjerk, 1995; Fuglestvedt 2003) and Scotland (Warren 2005, 37), the significance of population movement during the final periods of flooding is only rarely considered (Coles 1999, 54).

The isolation that is assumed to have derived from these changes is often stressed in the literature. The absence of formal burial in the English archaeological record, for instance, is notable and suggests a cultural difference. It may be that there were separate customs regarding burial in Britain but it is equally possible that formal burial sites do exist and that these may have been located near the coast, in areas which have now been lost to the sea (Barton and Roberts 2004, Chatterton 2005, 108). However, as Funnell (1995) and Coles (1998) observe Britain did not become an island until c7000 BP and the actual effect of the North Sea as a barrier to cultural contacts must be open to question. The use of major river systems for communication seems uncontroversial (Roberts 1987, Reyneir 1998), and it is not inconceivable that the shallow marine areas of the North Sea could have been traversed and contact with European groups maintained (e.g. Coles 1998, 76). One might even suggest that the potential for communication by boat, via such shallows, might have actually enhanced the potential for contact rather than acted as a barrier. Consequently, whilst the overall picture provided by the available evidence for the Late Mesolithic within Britain suggests a mosaic of localised groupings we should be cautious when assuming that this reflects enforced isolation (Morrison 1980),.

Another traditional characteristic associated with the transition from the Early to Late Mesolithic, and often assumed to be a consequence of the change in sea level, is the assertion that there is an increasing focus upon coastal resources (Rowley Conwy 1983). This shift has been interpreted as a response to higher population levels or mobility caused by sea level rise (Mithen 1999). However, this period is characterised by an increasing visibility of activity in landscapes that had previously been underrepresented in the archaeological record, eg estuaries which had previously lain beyond the contemporary coastal margins. These areas provided a diverse range of resources that were unlikely to be ignored during any period of human occupation (Allen 1997, Clarke 1978). Once again, we should be cautious about the extent or significance of such change (Milner 2004). The current picture may well be the result of increased visibility of coastal resource utilisation rather than substantive economic change. The provision of information that permits adequate comparison or assessment of development during this period is again predicated on the availability of representative data for the period overall. On that basis, the potential for the North Sea to provide critical information for such an assessment seems clear.

The nature and significance of data provided by the North Sea Palaeolandscapes Project

The probable significance of the results derived from the NSPP mapping of the Holocene surfaces should be clear from the previous discussion. It is essentially true that our current interpretative position for settlement of the maritime regions of north western Europe stand largely as a consequence of the lack of information from the North Sea, and that this could be challenged if the position changed. The ability to identify significanct landscape features or information that can support directed exploration, or data gathering, is therefore a considerable opportunity for academics but a serious challenge for the heritage communities within all the countries that bound the North Sea basin (Maarleveld and Peeters 2004). The nature of this challenge can now be assessed initially by considering the potential of the new mapping for assessing the nature of the archaeological record and, in particular, the potential survival of archaeological or palaeoenvironmental data. Following this one can assess how current management options may be changed or adapted to use the new data and, finally, it will be necessary to discuss the potential of the data to plan research strategies that may begin to answer some of the research questions outlined in the previous section.

The primary quality of the North Sea archaeological resource, in management terms, is the general inaccessibility of the presumed resource and the associated uncertainty surrounding the nature, or even location, of any archaeological remains. This contrasts sharply with intertidal or shallow marine zones where there is usually some potential to physically record, known sites, to analyse their distributions and therefore to provide some degree of protection or management. The depth of deposits, or water column, overlying the presumed North Sea landscape has generally ensured that the presence of archaeological deposits could only be inferred on the basis of contemporary correlates from terrestrial or shallow water contexts (Fleming 200X). Paradoxically, whilst there is a general assumption that the depth of water and overlying deposits might mask substantial, preserved archaeological deposits, the archaeological material trawled from the area, which is generally our only guide to the distribution of deposits, presumably suggests continuing damage to extant deposits. Unfortunately, whilst acting as an important proxy for direct examination, this material also has a low locational or interpretative value.

Management of such a resource, essentially indefinable or without adequate positional information, is an unenviable challenge but one that cannot be avoided (Roberts and Trow

2002; Oxley and O'Regan 2001). There are a number of legal or treaty obligations that govern regional and national responsibilities for marine heritage. Wickham Jones and Dawson (2007, 7-14) and Fleming (2005, 3-10) provide substantive reviews of national legislation and international obligations that apply or impact upon British maritime territory (Wenban-Smith, 2002). What need be stressed here is that whilst English Heritage's direct responsibility for Marine Heritage only carries to the 12 mile limit around the coast many government agencies retain a wider interest in the marine heritage (Oxley nd). Moreover, the nation, through treaty or international obligation, is often required to consider marine heritage issues across territorial waters. It is also true, following the extensive recent activity related to marine archaeology (frequently related to ALSF funding), that agency interests in the wider issues of the North Sea are becoming more explicit (Oxley nd). This is clear in published reviews of the potential of the marine resource (eg Dix et al. 2004), or projects with applied methodological value (Bates et al. nd). A number of ALSF projects have covered specific heritage management issues including the provision of codes of practise for reporting marine finds and investigating the application of historic landscape characterisation programmes to marine seascapes (Wessex Archaeology 2003; 2005). The establishment of the North Sea Prehistory Newsletter by Pete Murphy is also worth stressing here as this indicates the emergence of an international group with explicit interests in policy issues related to the prehistory of the entire North Sea and its coasts. In support of such initatives, the overt inclusion of marine issues in the emerging Palaeolithic Research Framework may also prove significant over the longer term (http://www.iceage.org.uk/Framework.html).

Despite this larger context, it is clear that the extent and detail of information for the Holocene land surfaces of the North Sea provided through this project is currently unique and tasks heritage agencies with providing an appropriate management response. Within England at least there are some basic guidelines to guide action, Robert and Trow's (2002) publication "Taking to the Water: English Heritage's Initial Policy for the management of Maritime Archaeology in England" sets out the general principals that the marine resource "and terrestrial archaeological remains provide a seamless physical and intellectual continuum" and that maritime heritage should "enjoy parity of esteem and treatment with their terrestrial counterparts" (Robert and Trow 2002, 4). Of particular importance is the requirement to consider the marine environment as an historic landscape stressed within this document and, given the scale of the North Sea study area, this is clearly a premise from which we can begin to provide a management response (Oxley and O'Regan 2001).

With this in mind, and given the available data provided through the project, there are three heritage products that one might anticipate from this study

- A general characterisation and interpretation of the available data in landscape terms
- An assessment for the likely potential of the available data in respect of archaeological research
- An assessment of the reliability of the interpretation and its value for mitigation mapping

The general process by which this work was carried out is provided in figure 1.

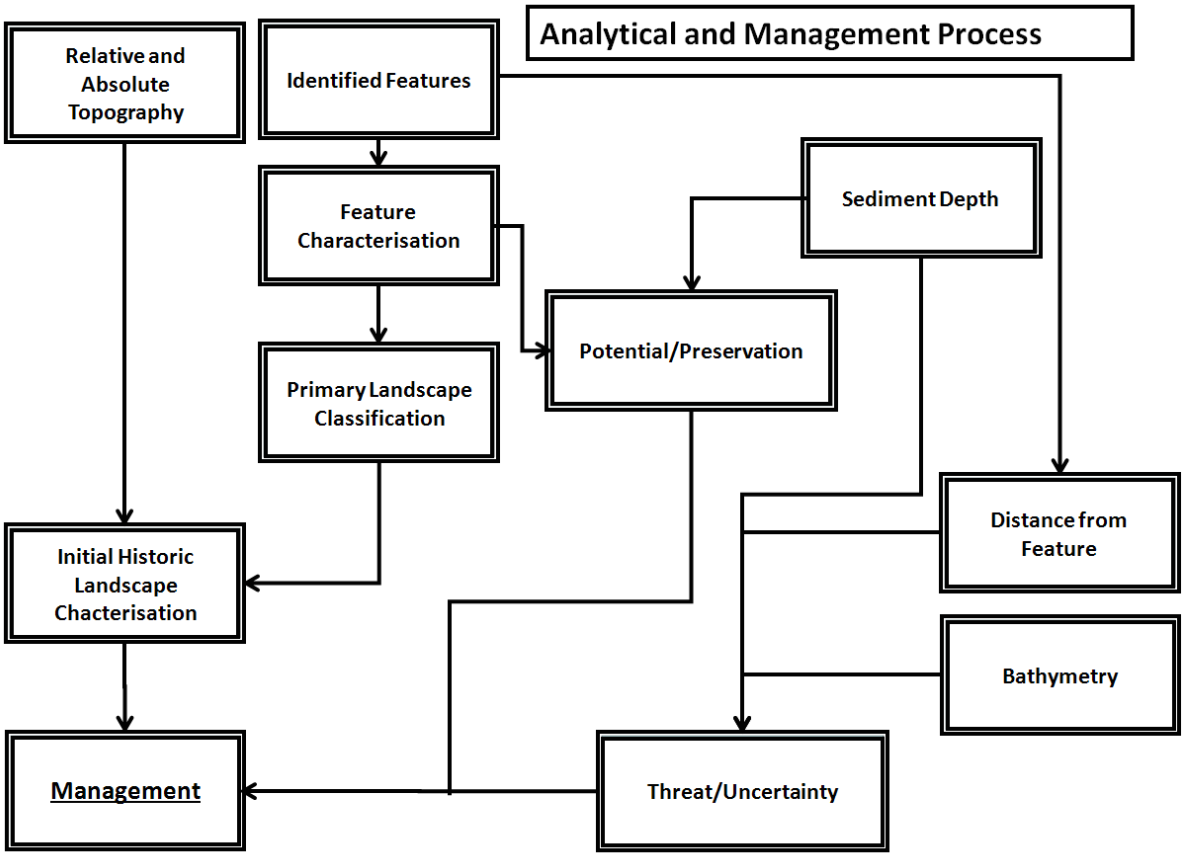

Figure 1 The Analytical Procedure

Landscape Characterisation

For the past 16 years landscape heritage management within much of the United Kingdom has been concerned with historic landscape characterisation (HLC). HLC, in its current form, derives from the recognition that there is a requirement to provide a comprehensive characterisation of entire landscapes as a management tool (Aldred and Fairclough 2002, Fairclough and Rippon 2002). Previous heritage strategies were flawed by their emphasis on those known archaeological sites deemed worthy of separate treatment and which, unintentionally, tended to privilege isolated areas of landscape to the detriment of areas excluded from such classifications. In contrast HLC sought to appreciate the overall importance of the landscape itself. No specific part of any landscape is deemed as more valuable than another within an HLC programme, and all aspects of a landscape are available for classification and therefore management. Landscape is treated as a contemporary and dynamic entity incorporating past activity as one contributing factor to the final interpretation. All HLC projects seek to assess every significant land parcel of a study area, assigning it to the type which best represents its predominant landscape character, as far as this is determinable. Once detailed HLC types have been defined, simplified and interpreted cultural landscape zones can be derived. This approach enables general patterns of the landscape to be discerned, while providing a basis for more detailed, localised work if necessary. The primary output from a traditional HLC programme is therefore a broad-brush interpretation of landscape character that supports the management of change across an entire landscape by providing a continuous assessment of the whole area (Fairclough 2006)

Heritage practitioners have not ignored the potential value of HLC within the context of maritime archaeology and a number of initiatives, including English Heritage's historic

seascapes programme, have attempted to implement the broad concepts of historic landscape characterisation in a number of marine environments (Wessex Archaeology 2005; Hill et al. 2001). At the time of writing few of these projects had reached fruition, but informal discussion with other project staff indicted that there were significant difficulties in applying HLC in areas where early features were obscured by sedimentation and bathymetry was a poor guide to precursor land surfaces. In contrast, the scale at which the North Sea project has operated and the extensive topographic data generated has a clear HLC application. There are, however, also significant differences. In the first instance the available mapped data is not consistent across the whole of the study area. Seismic response is variable, particularly in the southern and western sectors of the study area where the water column is relatively shallow and the response less good as a consequence. The resolution of the mapped data from the North Sea also falls well below that expected by terrestrial HLC project, which commonly use 1:1250-1:10,000 map scales according to the context of the project (Aldred and Fairclough 2002, 26). However, the poor resolution of the data may be offset by the nature of the landscape under study. The North Sea data effectively represents a partially mapped Mesolithic landscape in topographic terms, and the notional resolution of the data, c. 12.5 metres (thomson this volume), supports mapping of generalised economic/landscape units which may, ultimately, reflect broad land use patterns within a Mesolithic economy. Whilst unencumbered by later cultural development the landscape's post-depositional taphonomy should also be considered part of the landscape's character. In this sense, the data seems, *a priori*, to possess the potential for an HLC implementation.

On that basis, a strategy was designed to provide basic HLC data using the available data. Initially, the landscape was classified into a series of broad areas based upon their depositional history, and major historic landscape features. At the outset an attempt was made to automate this process by treating the data as a hyperpectral image following a procedure designed to categorise poorly mapped landscapes at Fort Hood, in Central Texas (Barratt et al 2007; White and Ray 2000). This approach, however, failed at an early stage due to the mosaic nature of the seismic images. The landscape characterisation was therefore performed manually using the available mapping, and was primarily guided by geomorphological and hydrological characteristics to provide broad landscape zones. On this basis, the entire area was classified into the areas detailed in Table 1, and the description added to the polygon layer as an attribute to provide graphical display. The dividing lines for many of the landscape zones observed coincided broadly with known watersheds between observed fluvial features. .

Class	Area (Km2)	Speculative Area (Km2)	Classification	Description	General Marine Areas
1	1872.33	261.63	Early Mesolithic Seaway,	Similar in Style to Severn Estuary, base shows tidal scour marks & presence of abandoned bedforms	The Outer Silver Pit
2	2872.34	0	Dominated by Geology with Fluvial Systems	Area is typified by thin deposits and near surface solid geology, which illustrate modern erosion, a few fragmentary fluvial systems present	Offshore Lincolnshire
3	3154.09	932.17	Dominated by Geology with some fluvial systems	Area of very strong solid geology response with large salt structures. It is likely that these formed regional features within the landscape	Spurn, Sole Pit Region and Easternmost Rough
4	412.55	157.45	Inlet Area - Partial Scour	The inlet of the Outer Silver Pit Area. The area only shows partial scouring, and possesses a channel that may have drained the lake which once existed in the Outer Silver Pit.	Outer Silver Pit
6	4390.82	124.84	Landscape influenced by underlying glacial deposit	An area of structures where the fluvial channels appear to be influenced by the nature of the underlying glacial deposits	Offshore Norfolk, South Central Dogger Bank, Outer Well bank
7	3760.9	0	Area of Smaller holocene Channels	This area contains many smaller channels, only visible in part, but appear to have extended across the whole of this area	Swarte Bank, Indefatigable Bank
8	823.52	0	Area Surrounding large Lacustrine feature	Drainage in this region appears to have been dominated by the Markhams Hole Lacustrine System	South Botney Cut, South East Outer Silver Pit
9	2762.3	65.54	Low lying areas with soft coastline	Lower lying areas of the Doggerbank region which possess extensive fluvial systems which extend into soft coastline areas.	Southern Doggerbank, South West Patch & South West Spit
10	1626.13	0	Area of Reuse of Late Pleistocene features	This area is dominated by two major fluvial systems which appear to be vitilising existing Late Pleistocene courses	South Eastern Outer Silver Pit, Well Hole
11	146.37	0	Lacustrine Feature	Area which would have formed Lakes/Wetlands during the Early Mesolithic	Sole Pit, Silver Pit, Well Hole and Markhams Hole
12	1033.29	0	Doggerbank Fluvial Systems Area -	This area holds the clearest and best preserved of the fluvial systems in the region, the data in these regions suggest that the landscape is completely in-situ	Dogger bank, Eastermost Shoal
13	535.23	0	Areas with Clear indication of Marine transgression	These are a variety of areas which clearly show evidence of being altered by Marine incursion	Botney Cut Region, Cleaver Bank, South Rough, Eastermost Shoa
14	293.23	42.67	Early Holocene Coastline	The coastline of the Early Mesolithic which covers this area.	Outer Silver Pit, North East Doggerbank
Total	23683.1	1584.3			

Table 1. Primary landscape characterisation zones

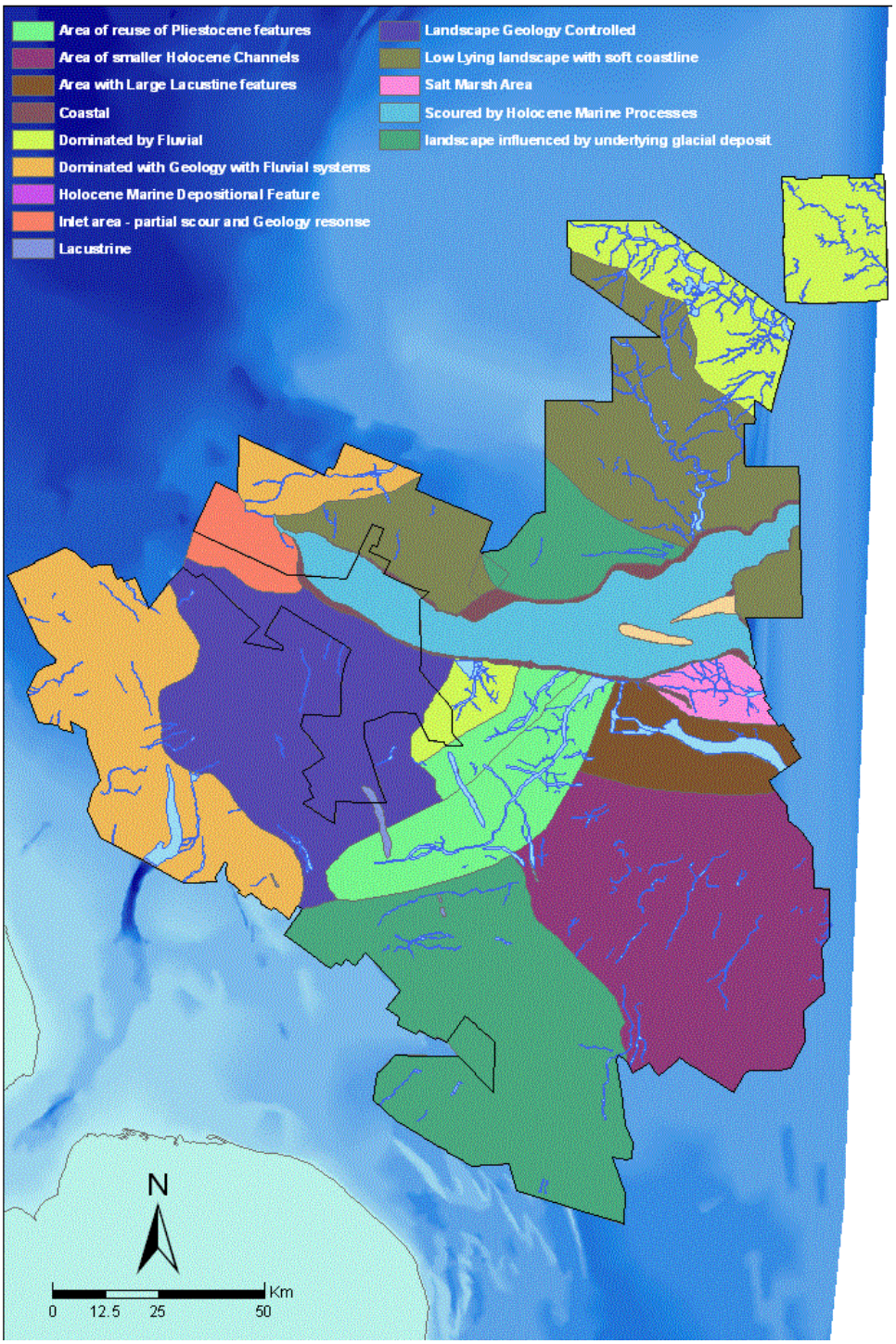

Figure 1 Broad Landscape Character Zones

However, the broad topographic variation of the landscape, picked from the Holocene land surfaces, permitted refinement by cross-tabulating the primary topographic variation of the Mesolithic landscape with the primary landscape zones defined from the initial characterisation phase. A total of 80 separate land classes were generated through this process and these are shown in figure 2. This data is interesting as it probably represents the best general zonation, in terms of probable Holocene land use, currently achievable using the available data and, to the extent that it may correlate with broad economic activity, may carry considerable potential to act as the basis for more detailed behavioural modelling.

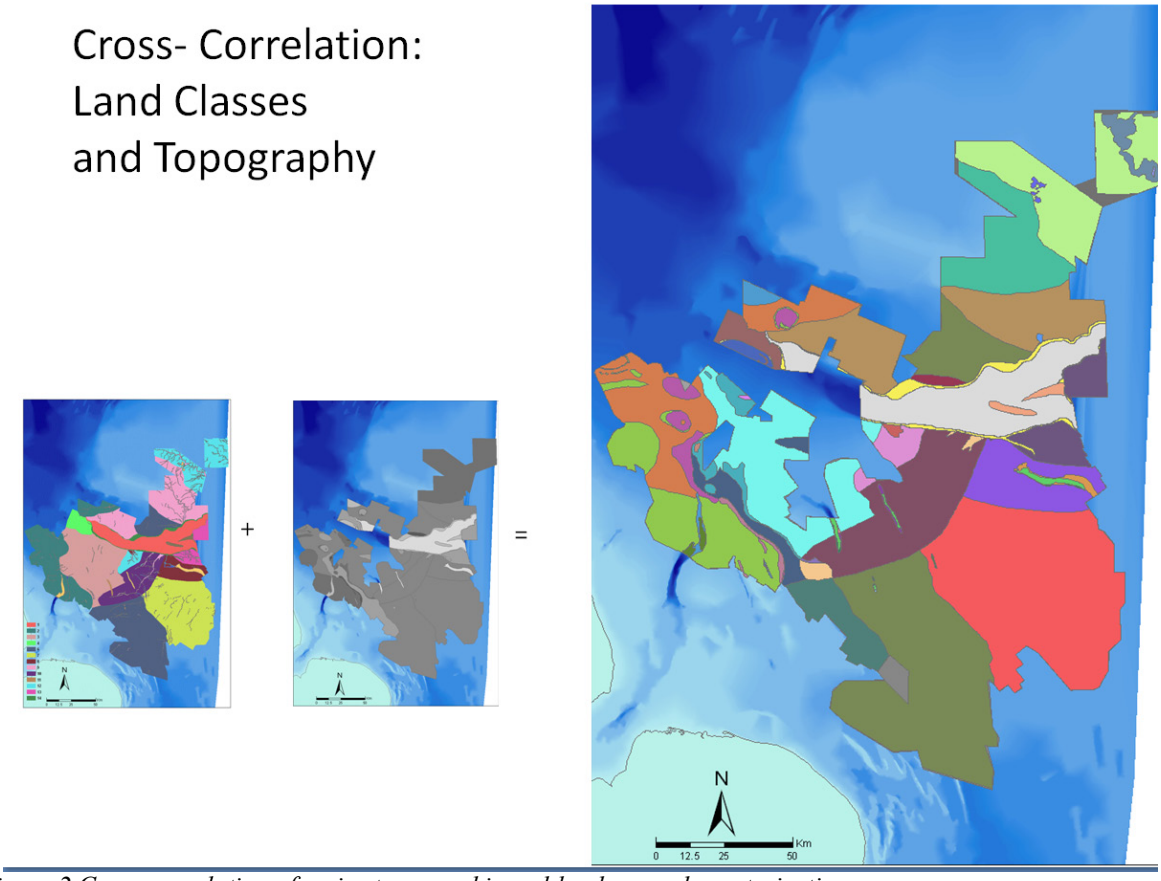

Figure 2 Cross correlation of major topographic and landscape characterisation zones

It should be acknowledged that the data presented here does not currently represent a full HLC product as it does not truly incorporate contemporary landscape features. In fact a further stage characterisation of the HLC classes was generated incorporating a zoned bathymetry layer. This produced an excessively complex image that, although potentially of use in management, is not presented here and is retained in archive.

Threat mapping

Whilst the HLC data are significant in their own right they are probably not, in themselves, an adequate basis for a larger management strategy for the southern North Sea. In particular, this requires an assessment of the potential of the area under study for preservation of archaeological materials. This may be provided by the multiplication of two normalised data sets for the interpreted archaeological potential of identified landscape features and the depth of overlying sediments derived from published sources including BGS mapping. The relative values for landscape feature potential, prior to normalisation, are provided in table 2. Following this process, areas with a lack of known features and an absence of significant sedimentation score low, whilst probable scoured areas, including the Outer silver Pit, produce a value of 0. Areas with probable archaeological potential and with significant overlying deposits score high. The mapped data is provided in figure 3.

River potential 0 = Absent 1 = Low 4 = high (Ranking based on a modified Strahler stream ordering)	Lakes 0 = Absent 4 = present	Marsh/Wetlands 0 = Absent 4 = present	Coastlines 0 = Absent 4 = Present	Deadzones Scoured = 0 Landscape present = 1

Table 2 Ranking of features by archaeological potential

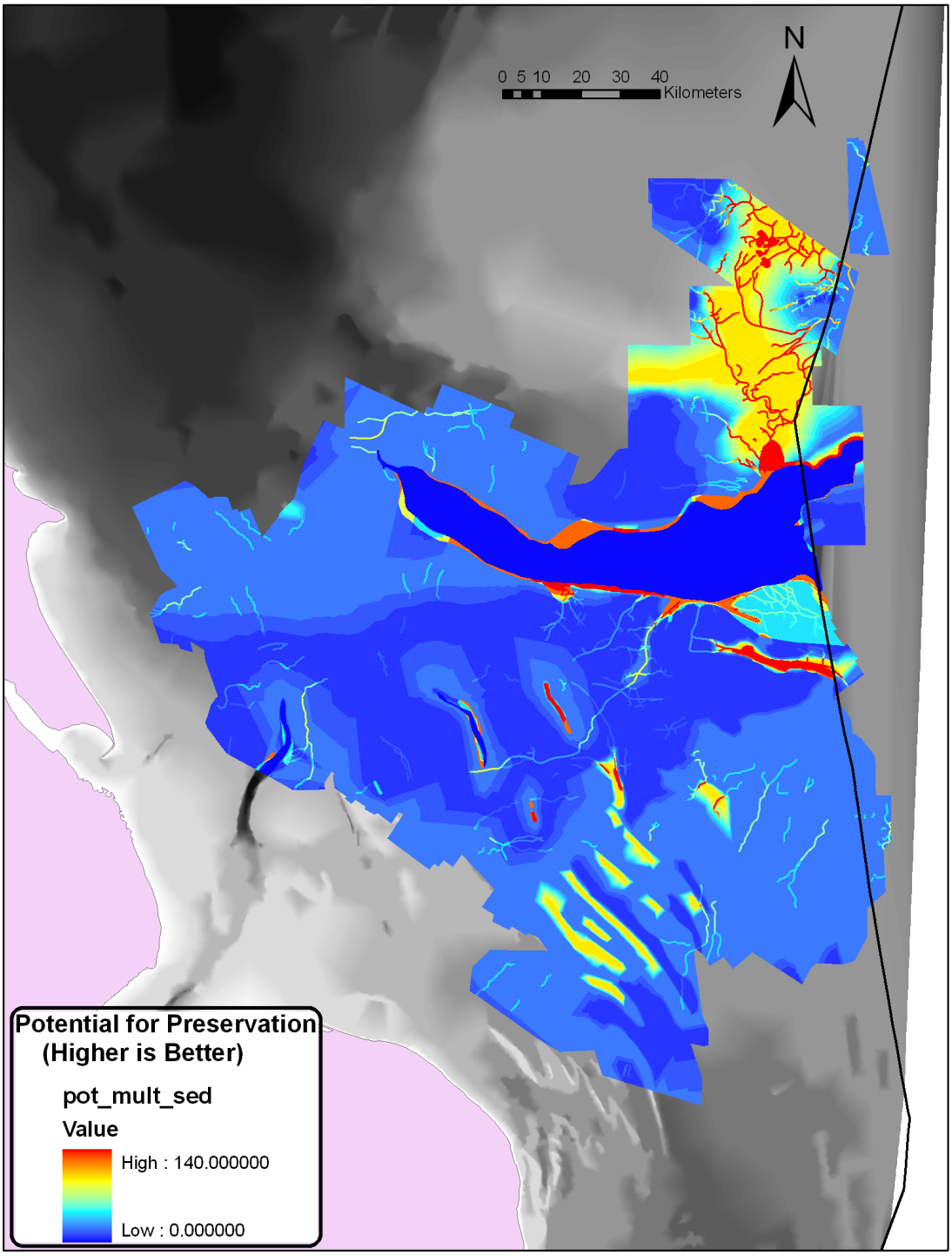

Figure 3 Potential for Preservation

Not surprisingly, figure 3 emphasises areas which are likely to be of prime archaeological interest; most notably lacustrine environments, marsh areas and coasts. However, the area around the large river systems to the north of the Outer Silver Pit are emphasised overall: a consequence of the association of a dense network of major channels and protective sediments. The apparent potential associated with the large sand bank systems in the south east of the southern area may be misleading as this reflects depth of sediment associated with highly mobile features.

Threat and Uncertainty Mapping

The data provided in figure 3 is useful in assessing the overall significance of features identified through the seismic analysis. However, the mapping does not provide substantial guidance in areas where features have not been identified. Hence the extensive areas which are suggested as having a relatively low potential may be misleading. Earlier papers in this volume have noted that our ability to identify Holocene structures is limited in a number of areas, notably those associated with a shallow water column. Consequently, a primary concern, after direct identification of Holocene features, must be to identify areas that may contain features and might also be under threat. Such zones may be chosen for further prospection or development plans may be modified in the light of the potential of such areas to contain undiscovered features.

It seems reasonable to suggest that the further we are from identifiable structures the more likely it is that other factors may be preventing discovery. Following such an argument, a separate map was prepared representing threat and uncertainty as a single measure linked to distance from feature and accessibility (ranked according to depth of sediment and water column). These three factors were normalised added to provide a single value and the data is presented in figure 4. This map provides a continuous assessment across the study area in which areas of high threat and low uncertainty (shallow water column or sediments proximate to identified features) grade into areas with low threat and high uncertainty (greater water column or sediments at an increasing distance from known features).

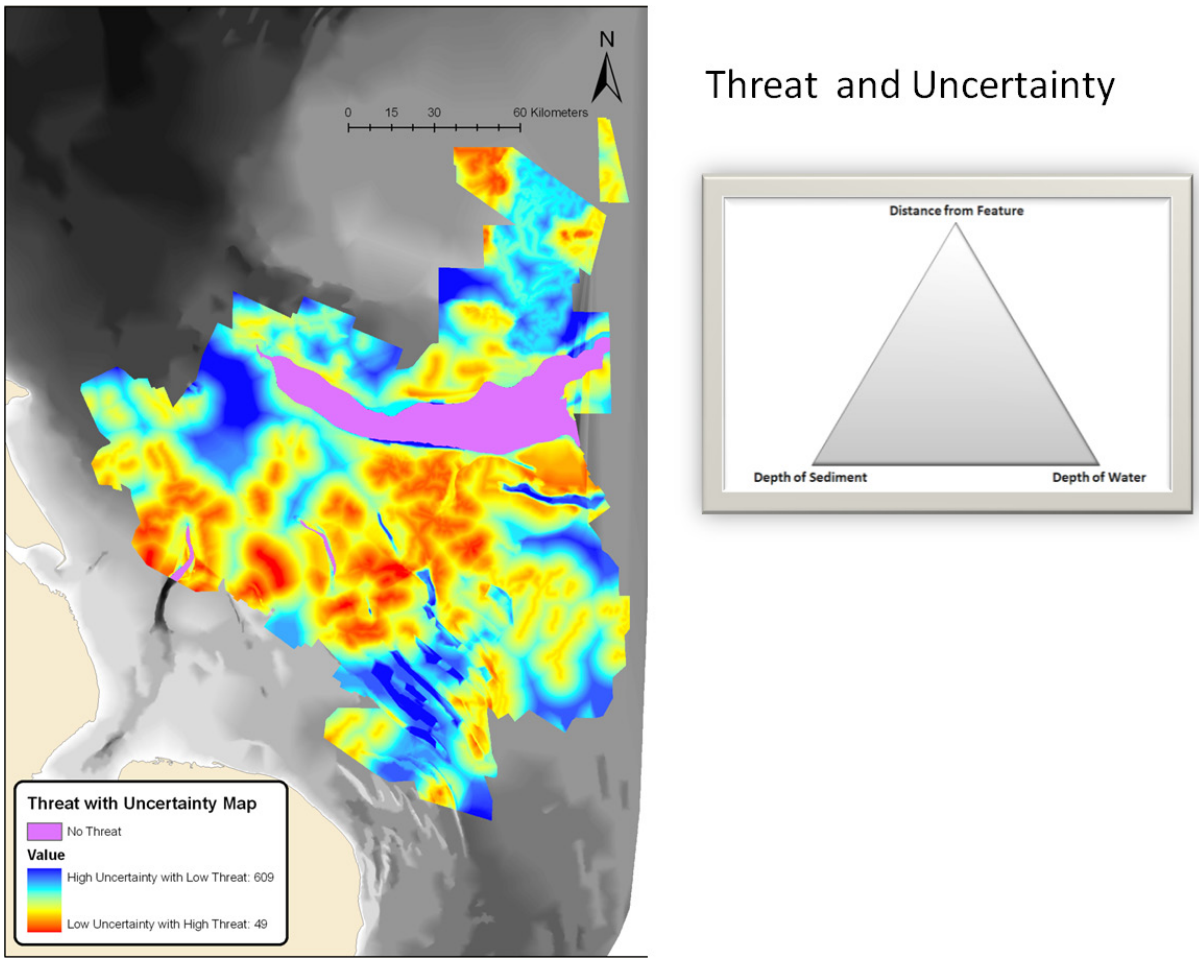

Figure 4 Red Flag Mapping. This figure combines threat and uncertainty data based on distance to feature and depth of overlying sediment. The lack of sediment cover and direct association with identified features

with archaeological potential rate as high threats with little uncertainty. Deep overlying deposits lying further from recorded features rank as low threat areas but with significant levels of uncertainty.

This provides a simple but highly effective form of "red flag" mapping that can be usefully compared to figure 3, which primarily reflects probable archaeological potential. Setting aside areas which well be scoured (the Outer and Inner Silver Pits), this measure highlights significant areas in the southern and western parts of the study area as zones which might contain features, which are not amenable to current mapping technologies but which may be more prone to development threat.

Future Research

It is incontrovertible that the data presented as part of this project has demonstrated the potential of marine, remote sensed data for the exploration and management of the inundated Holocene land surfaces of the North Sea. In comparison to the situation described by Fleming, a mere 3 years ago, the North Sea is no longer terra incognita (Fleming 2004). It is, of course, acknowledged that the current product still represents a limited interpretation and could be substantially refined by the integration of further data sets, including high-resolution 2D seismic surveys. However, the resolution and detail of the derived landscape can provide a substantive basis for further prospection or exploration of this unique landscape. In particular the need, outlined in the paper by Hill et al. above, for further coring to support palaeoenvironmental research is substantially supported by our ability to identify and map deposits with enhanced environmental potential. Given our potential to identify areas or specific features of interest, expensive fieldwork may now be planned with some confidence. We may be freed, to some extent, from our current reliance on serendipitous finds with poor contextual value. the result of such work will be detailed palaeoecological studies of the type now being carried out on terrestrial landscapes around the North Sea basin (Peeters 2006)

We should also note the potential of the data for providing the basis for novel and exciting behavioural models with real archaeological potential (Ch'ng et al 2004). The Holocene landscapes of the North Sea were never an abstract concept. This land was both habitable and inhabited, and the landscape data we possess, or can now acquire, offers us the opportunity to explore archaeological predictive modelling that can, in turn, be used to refine our concepts of land use and enhance the potential of directed, invasive exploration to answer archaeological questions. Other research programmes have already begun to generate such models and some, including the "Danish Fishing Model", are reported to be very successful; (Fischer 1995, 375). Most of these have used localised bathymetry as a topographic proxy but this is inevitably less successful in deeper water where burial of the landscape has occurred (Fisher 1995, 377). The utilisation of information from seismic data should help improve modelling strategies and the exploration of predictive models using the North Sea seismic data is part of research currently being carried out at Birmingham (Fitch et al forthcoming IA).

Despite the apparent success of the NSPP it should not be presumed that the current work represents a final product either in spatial or chronological terms. This area studied here does not represent the whole, or even the available, extent of land surfaces that could be investigated. The shoreline of the great North Sea Holocene plain would have extended north along the current shoreline of northern England and further to the east of the present study area (Boomer et al. 2007; Coles 1998). Equally significantly, similar studies are limited by the extent of available seismic data. There is a significant gap in the availability of 3D seismic data in the marine areas associated with Northern England. There is also an

attenuation of response to 3D seismic survey in shallow waters. Consequently, there exists a "white band" which surrounds the modern coast and within which our knowledge of the palaeotopography and, by inference, the archaeology of the area, is severely limited. Our ability to tie together the data from the southern North Sea with terrestrial archaeology in a seamless manner, although desireable, is therefore limited. In the deeper marine areas there will be a reliance upon 2D seismics to fill this gap, with a concomitant loss of the extensive detail associated with 3D data sets. In shallow waters traditional methods of marine prospection may be employed to effect (diving, high resolution seismic survey etc.): although the resolution of such data is a limiting factor when considering heritage requirements to manage the resource. There is, therefore, an urgent need to collect new data sets to fill these gaps or to investigate methods to integrate other data sets in a more imaginative and productive manner.

There is another point to be made in relation to the remaining archaeological potential of the North Sea. There is increasing evidence that we should expect, at least, low-level occupation in areas north of the study area during the later Palaeolithic. Wickham-Jones and Dawson (2006, 19) suggest that the melting of the Devensian ice sheet north of Scotland would have been rapidly followed by marine inundation and that the areas to the north and west would not have been available for occupation. However, whilst excluding consideration of even earlier periods, the spatial extent of surviving late Palaeolithic land surfaces, that have a potential for preserving traces of human occupation, is actually bounded by the Norwegian Trough and encompasses the Viking Bergen Hills. Not surprisingly, traces of occupation in these areas are few and the context of a single worked lithic, recovered from a vibrocore at a depth of 143 metres off the Viking Bank, remains uncertain (Long et al. 1986). However, Wickham-Jones and Dawson conclude that current absence of evidence for Late Palaeolithic habitation in Scotland should not be regarded as evidence of absence and that "the submerged landscape of the Scottish shelf is thus the most likely location for the preservation of traces of early settlement" (2006, 34). The significance of 3D seismic data sets from northern waters can be demonstrated and the result of analysis of one small area, not far from the Viking bank find indicates that new insights are possible for early landscapes in the deeper waters to the north (figure 5).

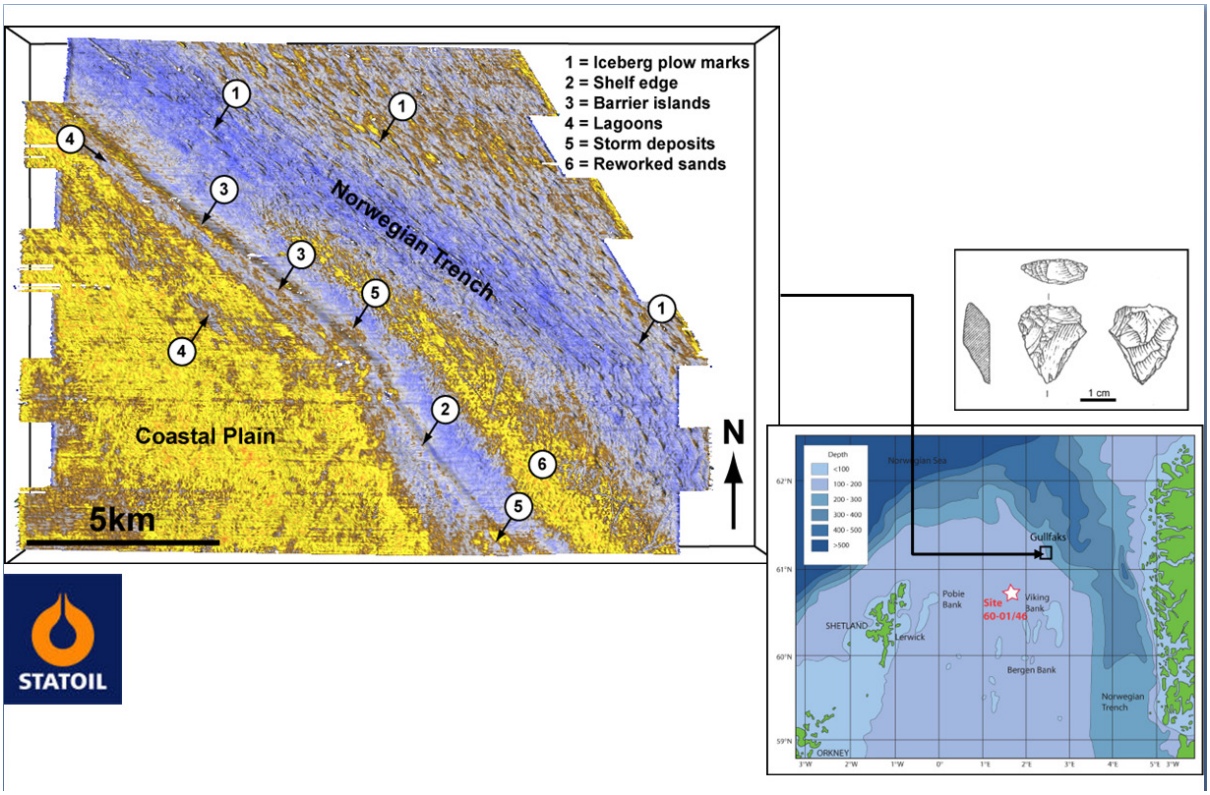

Figure 5 Sample seismic data illustrating probable late Palaeolithic land surfaces adjacent to the Norwegian trench. The Viking flint is illustrated in the inset (Long et al. 1986).

Such observations are also significant for this study. Whilst not consistently mapped as part of this project, the results indicate that Late Palaeolithic surfaces are also amenable to study (figure 6 and atlas section). One must assume that the potentially, well preserved Late Palaeolithic deposits that underlie the current study area, and stretch fare to the north, must rate as priorities for research and heritage management.

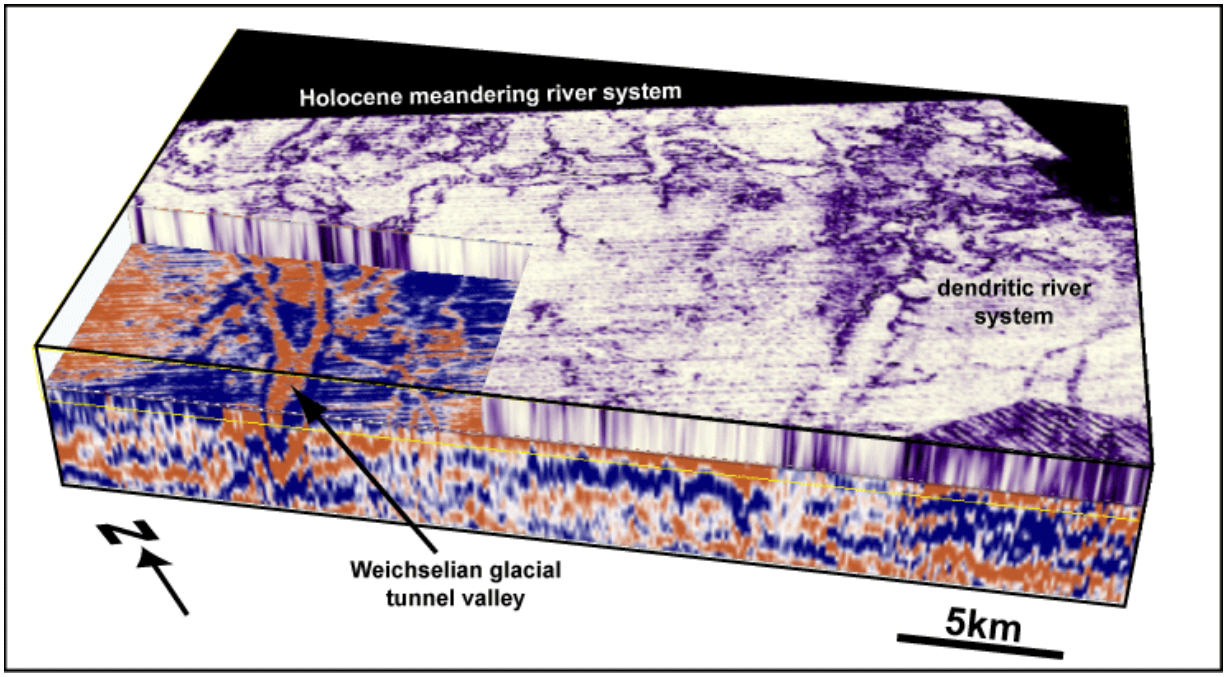

Figure 6 *Seismic data cube illustrating chronostratigraphic relationship between Holocene and earlier features*

Final Observations

The North Sea Palaeolandscapes Project mapped more than 23,000 square kilometres of Holocene land surfaces and presented these for publication in slightly over 18 months. The product of this work is one of the largest analyses of remote sensed data ever attempted for archaeological purposes and this has brought to the attention of the archaeological and heritage communities one of the most extensive and best preserved prehistoric landscapes in the Europe at least. The methodologies demonstrated here have wide application in similar landscapes elsewhere, when appropriate remote sensed data is available. Whilst technically appealing, we should not lose sight of the fact that its fundamental importance of this work relates to its potential to inform research into the Early Holocene communities of north western Europe. Reynier (2005, 1) recently described research into the early Mesolithic as currently "listless", perhaps due to the difficulties presented by the archaeological record. In part this may be a consequence of our lack of knowledge of the prehistoric archaeology of the North Sea. Currently, the Holocene archaeology of the North Sea is infrequently considered within the literature. The lack of available evidence is tacitly presented as an absence of evidence and, consequently, the area appears to occupy a proximal role in the literature and our interpretative position. It remains true, however, that only a few sites are actually available to support our current models (Milner and Woodman 2004, 5), and fewer have provided adequate environmental evidence for this period (Whitehouse and Smith 2004). This is a parlous position and we should be assured that the apparent density of sites that have been identified or explored in Europe, most notably in Denmark, will not actually fill this gap (Fischer 2004). Few of these sites are located further than 5km from the coast and, whilst useful for comparison, these can never truly be used as a proxy for settlement more than 120km away, in the centre of the Great North Sea plain. The results of this work should be taken as a wake up call. The landscapes mapped here represent areas that could have been prime habitable zones linking and explaining much of the archaeological variation we see around the North Sea basin (Figure 7). The present terrestrial archaeological record, in much of Britain at least, may well represent areas that were peripheral locations for the Mesolithic occupants of the North Sea basin (Morrison 1980).

Never previously available for location or study, the landscape detail generated by this project is beginning to discriminate between environmental zones, characterise areas of archaeological potential and identify regions that may be explored with some likelihood of success. The scale of the work, equivalent to the exploration of an entirely new European country, whose landscape and archaeology are almost untouched by modern anthropogenic practices, offers the prospect of revisiting and possibly entirely revising many of our current perceptions and models for the Mesolithic and a unique opportunity to re-invigorate research into the Mesolithic and later Palaeolithic occupation of north western Europe overall.

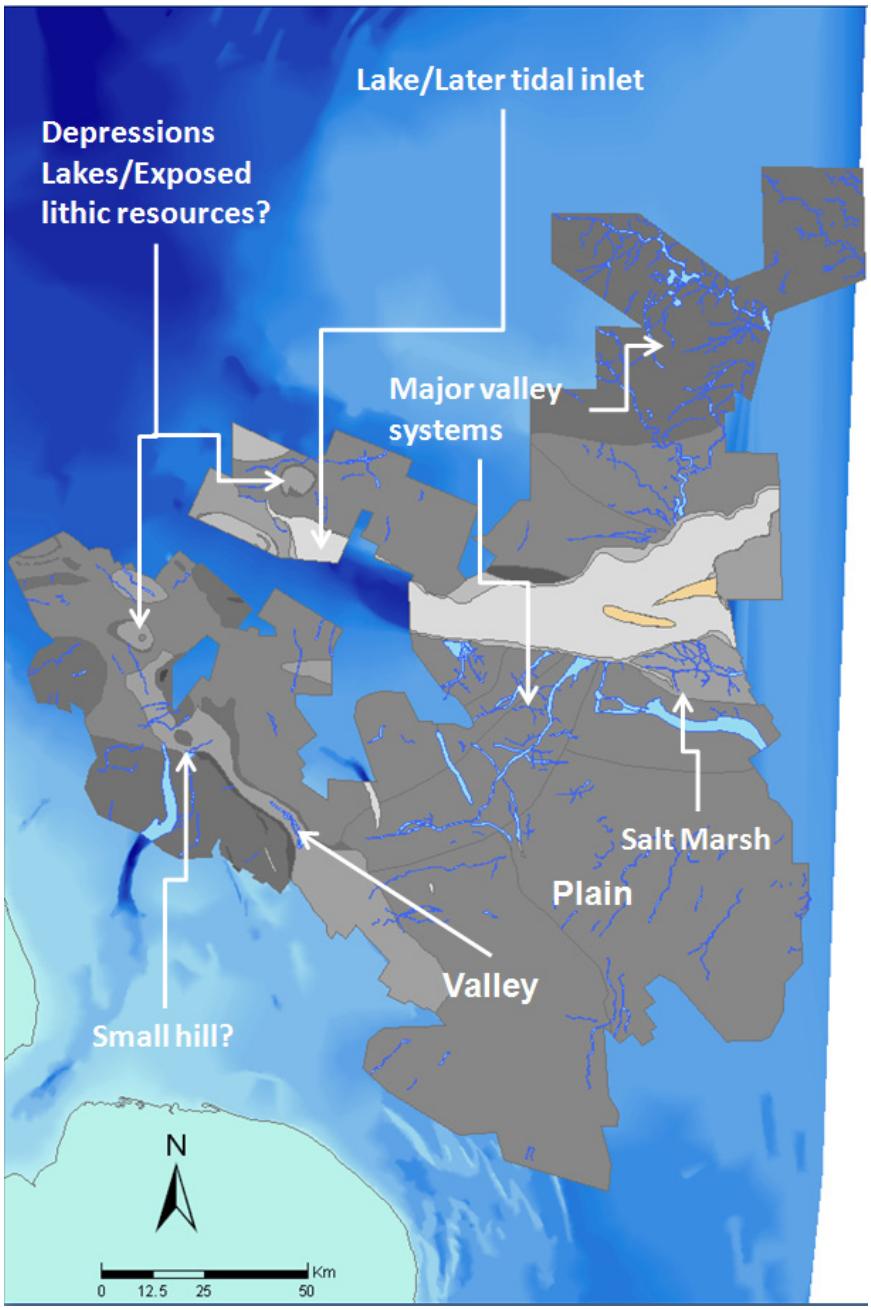

Figure 7 major or significant topgraphic features in the study area

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