

Claimed by the Sea: **Salcombe, Langdon Bay,** **and other marine finds** **of the Bronze Age**



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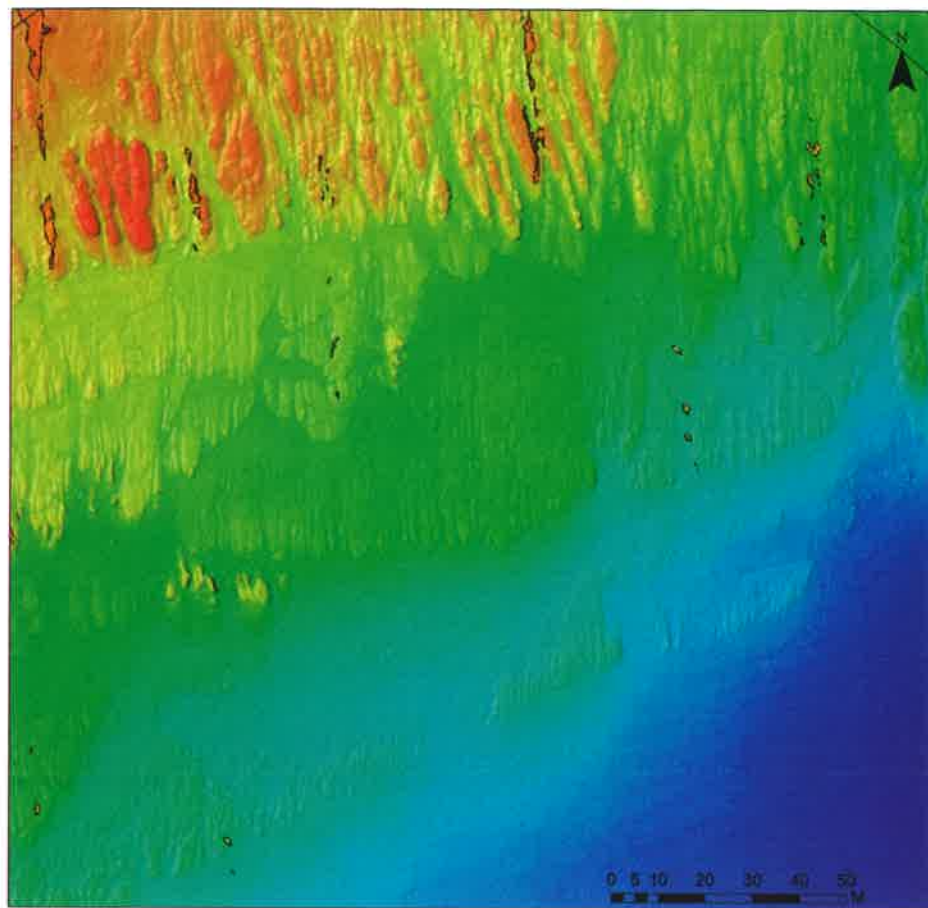


Fig 2.13 Detailed bathymetry of the study area, showing the incised nature of the rock-cut platform

ancy. A change in the chart datum (from OSGB36 to WGS84) on UKHO Chart Number 1698 may have also exacerbated the problem.

Coastal erosion and landscape change by Martin Bates

The Langdon Bay 'wreck' was found (Coombs 1976; Muckelroy 1981) on a gently sloping eroded chalk rock platform at a depth of 7–13m below sea level, some 500m offshore of the adjoining cliff line cut through the chalk of the North Downs (Fig 2.13). Today the white cliffs form a historically important feature of the British landscape, the permanency and longevity of which few question. Indeed, the cliffs, and an estuary penetrating inland along the course of the modern Dour valley (Fig 2.14), appear to have been major features of the landscape by the time of Julius Caesar's expedition to Britain in 55 BC. In the 'Commentaries of Julius Caesar' he describes a place thought to be the mouth of the Dour estuary thus: 'The nature of the place was this: The sea was confined by mountains so close to it that a dart could be thrown from their summit upon the shore' (*De Bello Gallico*, Book 4, para 23).

However, today it is recognised that this landscape is an ever-changing one; and, with increasing

concerns over global warming, sea-level rise, and the impact of change on the coastline, attention is turning to attempting to understand the nature of coastal change and its history in order to derive predications for rates of coastal change and retreat (Dornbusch 2005a and b). This interest may also be extrapolated to the past and, as a result of the discovery of the Dover Bronze Age boat over a decade ago (Clark 2004a), the local context and geomorphological setting of the Langdon Bay Bronze Age finds now requires clarification (Bates *et al* 2011).

Background

The creation of the English Channel and the modification of the Strait of Dover from the Middle Pleistocene onwards has been the source of debate for a number of years (Gibbard 1995; Gupta *et al* 2005), and current work in the southern North Sea as well as the Channel region may soon provide new information on the evolution of this important sea passage. However, because of the nature of the processes operating within the vicinity of the Strait, erosion predominates at the expense of deposition and little evidence exists on, or beneath, the seabed to help calibrate and contextualise these changes. Consequently, it is difficult to ascertain the local

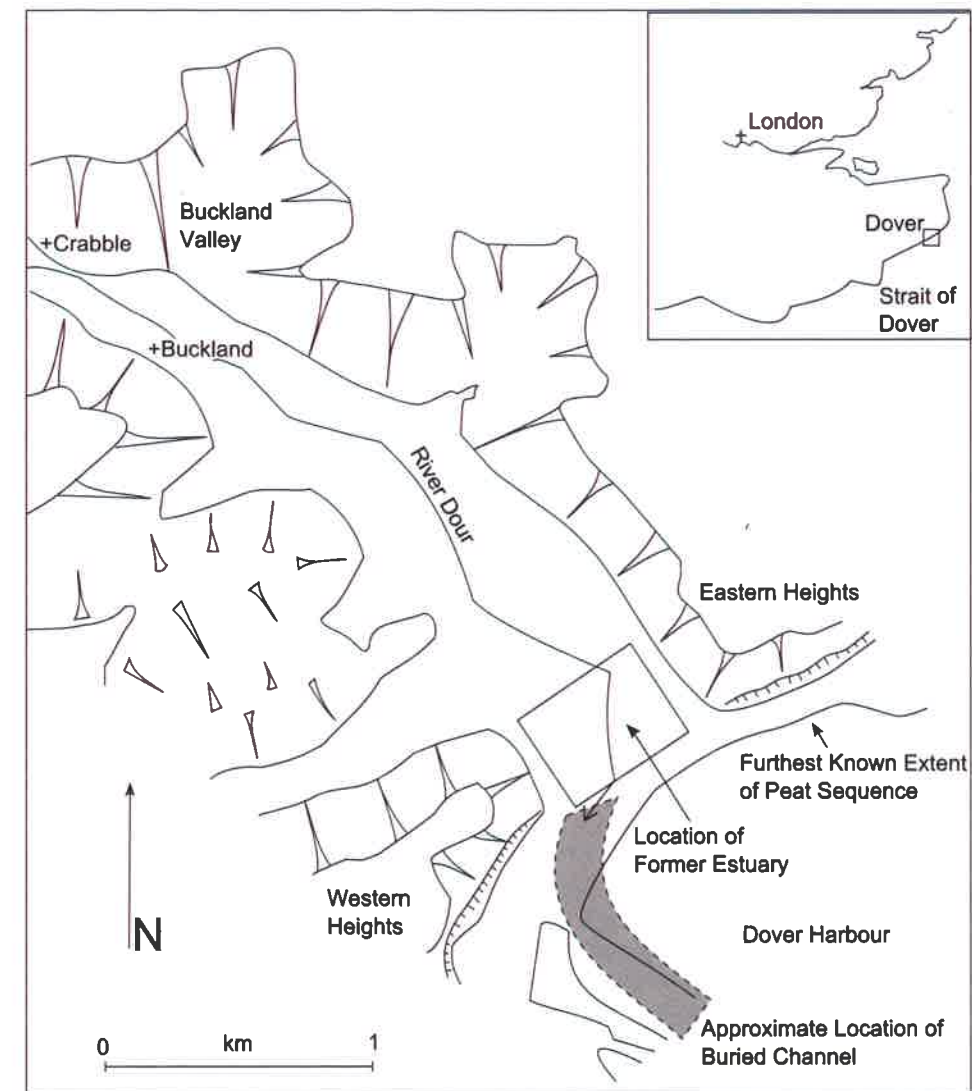


Fig 2.14 Lower Dour valley, showing position of former estuary and distribution of gravels lying within buried channel

palaeogeography of the coastal zones within the area during the later parts of the Pleistocene and much of the Holocene.

This section examines the context and geomorphological situation of the Langdon Bay metal assemblage with a view to understanding the original nature of the site as well as something of the nature of the processes likely to have been operating at the site following discard/loss. Consequently, a number of scenarios may be articulated that require examination and testing:

- The assemblage represents a cargo from a true maritime wreck resting on the seabed, lost during transport across/along the Channel margins in a situation very similar to the modern one.
- The assemblage represents a boat lost in a marine marginal situation within a topographic context different from that of the present-day open coastline.
- The assemblage represents material lost or deposited in a terrestrial context prior to erosion

and landward migration of the shore zone across the depositional site.

In order to address these three differing scenarios, two major strands of evidence may be utilised. The first comes from studies of coastal chalk cliff instability and patterns of coastal erosion in the Channel region, and the second from local geomorphological evolution and palaeoenvironmental sequences associated with the mouth of the river Dour. Evidence from these diverse sources will be articulated and discussed first so that the competing lines of evidence can be evaluated and assessed.

Bedrock geology, geomorphology, and coastal erosion

Bedrock geology

The bedrock exposed in the cliffs backing Langdon Bay consists of up to 100m of chalk exposing both

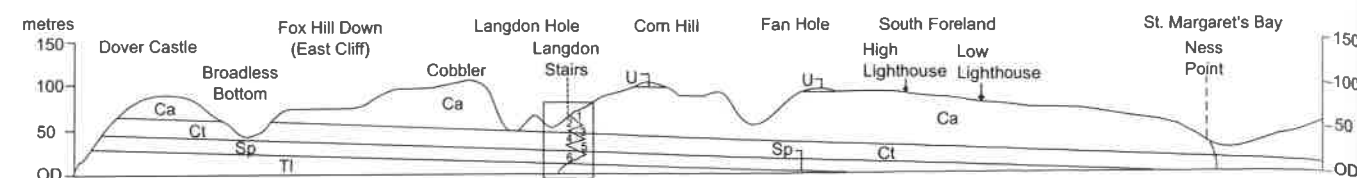


Fig 2.15 Sketch section of the cliffs between Dover and St Margaret's Bay, showing the northerly dip of the beds. Tl: *Terebratulina lata* (Middle Chalk). Sp: *Sternotaxis planus*. Ct: *Micraster cortestudinarium*. Ca: *Micraster coranguinum* (from Shephard-Thorn 1988)

Table 2.4 Chalk strata characteristics from the Landon Bay area (derived from Shephard-Thorn 1988)

Macrofossil zone	Stage	Traditional scheme	Thickness	Characteristics
<i>Micraster coranguinum</i>	Coniacian/Santonian		c 65m	Blocky white chalk with evenly spaced bands of nodular flints
<i>Micraster cortestudinarium</i>	Coniacian	Upper Chalk	c 20m	Shelly chalk with courses of flint nodules
<i>Sternotaxis planus</i>			15m	Hard nodular chalks, marl seams and large flint nodules at base overlain by soft white chalk. Nodular chalk at top
<i>Terebratulina lata</i>	Turonian	Middle Chalk	54m	Massive, soft white chalk with marl seams

Middle and Upper Chalk strata (Fig 2.15). The base of the cliff lies within the upper beds of the *Terebratulina lata* zone and the sequence upwards runs through the succeeding *Sternotaxis planus*, *Micraster cortestudinarium* and *Micraster coranguinum* zones (Shephard-Thorn 1988) (Table 2.4). These strata have been variously grouped into the Dover Chalk Formation, the Ramsgate Chalk Formation (Robinson 1986), and, more recently, into the New Chalk Pit, Chalk Rock, Lewes Nodular Chalk, and Seaford Chalk Member (Bristow *et al* 1997). Structurally, the chalk exposed in the cliff sections between Dover and Walmer exhibits a gentle dip in a NNE direction (Fig 2.15), thereby bringing successively more recent strata close to beach level in a northerly direction along the coast. Although no data is available to the author for the area immediately offshore from the cliffs, the nature of the strata and their dip would suggest that the seabed in Langdon Bay would be dominated by Middle Chalk of the *Terebratulina lata* zone.

Local geomorphology

Today, the local area is dominated by the Middle and Upper Chalk (Shephard-Thorn 1988) of the North Downs backing the modern beach. The North Downs form the northern limb of the Wealden anticline, with a steep scarp face to the south at Folkestone and a gentle, north-dipping dip slope extending through the study area towards Sandwich. West of Langdon Bay, the modern town and port of Dover encom-

passes the mouth of the Dour valley. The alignment of the valley (north-west-south-east) contrasts with the predominate drainage pattern in the area, in which currently dry valleys trend in a south-west-north-east direction at 90° to the strike of the modern lower and middle Dour Valley (Barham and Bates 1990). This pattern may be a relic inherited from an older drainage network of early Pleistocene or pre-Pleistocene age. For example, the strike of the modern valley may be fault guided (Shephard-Thorn 1988), with incision being initiated during the Pleistocene (the presence of a major fault in the area may influence both possible earthquake history and impact on local tectonic features dictating local subsidence rates). The nature and evolution of the valley have important implications for coastal changes in the vicinity of Langdon Bay.

Sediments infilling the Dour valley have been mapped by the British Geological Survey (BGS) and comprise alluvium, estuarine alluvium, and dry valley and nailbourne deposits in the valley bottom. Head and head brickearth along with clay-with-flints cap the adjacent downland plateaux and dry valley bases (Shephard-Thorn 1988). Within the lower Dour Valley, recent work (Barham and Bates 1990; Bates *et al* 2011) has demonstrated that the nature and patterns of sediment distribution in the area are more complex than previously documented.

Today, the cliffs at Langdon Bay rise to nearly 100m either side of a central low known as Langdon Hole (see Fig 2.1). Although no sediments survive (or are mapped) at the base of the hollow, it is probable that head deposits may once have existed

Table 2.5 Some cliff collapse events recorded for the Dover area (predominantly 19th century). Unless otherwise stated all events are recorded in a diary held in Dover Museum written by a Mr Pattenden

Date	Event type
c 1300 AD	Sea wall breached, harbour choked with pebbles (Stratham 1899)
6/4/1580	Earthquake. Cliff collapsed and outer walls of harbour came down (Stratham 1899; Batchellor 1828)
1612	Wall of the Great Pent (the Henry VIII coastal defences and harbour) breached during a storm (Stratham 1899)
1772	Several falls of the cliff caused great alarm (Stratham 1899)
14/12/1810	Seven members of family killed in cliff collapse at East Cliff. Pig buried in cliff cave after fall, dug out alive after 160 days
12/11/1844	Fall of cliff, 2 children killed
18/2/1847	40,000 tons of cliff fall from Shakespeare Cliff
21/1/1849	100,000 tons of cliff fall from Shakespeare Cliff
20/1/1853	100,000 tons of cliff fall of chalk in Limekiln Street
26/2/1853	Several thousand tons of chalk fall at Cobblers Rock, East Cliff
5/4/1859	2 men killed by fall at Snargate Street
12/5/1868	Great fall of cliff below Adrian Street
15/11/1872	Cliff collapse near castle destroys 2 houses
12/1/1877	S E Railway blocked for 2 months by fall of chalk cliff
13/3/1881	S E Railway blocked by cliff fall at Abbots Cliff

there. Little information is currently available on the origin of the hollow, but formation as a result of solifluction processes during the late Pleistocene is a possibility (Ballantyne and Harris 1994). Alternatively, the feature may be a truncated solution hollow now sectioned by the coastline. Either option would indicate probable weakness in the chalk associated with the base of the hollow.

Coastal processes

Coastal processes operating in the North Downs coastal zone are linked to meso- to macrotidal ranges. Present-day sediment dynamics are directly linked to nearshore tidal currents and are subject to a trend in longshore drift from west to east as a result of the prevailing westerly winds, which drive waves eastwards up the Channel. However, those beaches sheltered from the south-west winds may be exposed to easterly gales and local reversals of pattern can be seen, resulting in westerly drift.

Previous reports indicate that the seabed in the vicinity of the find was heavily pitted and fissured (a feature that is clear in the seabed bathymetry surrounding the site). The bathymetric map (see Fig 2.13) shows that the eroded chalk surface is progressively overlain by mobile sediment towards the southern end of the site study area. Muckelroy (1981) also noted that some gullies contained stable black-grey clays as well as the more mobile light silts. Unfortunately, the relationship of the sediments to the bronzes was not fully established.

Coastal erosion along the chalk cliff lines of Kent and Sussex is well established (eg McDakin 1900;

May 1971; May and Heeps 1985; Dornbusch 2005a) and a considerable effort is currently being made to understand the factors controlling erosion along these populated coastlines (see the 'Beaches at Risk' programme). While cliff-line erosion has been assumed to have occurred throughout the historic and prehistoric periods, little information is currently available to calibrate such processes. Erosion processes operating on a coastal cliff line are primarily influenced at a regional scale by rock type (Carter 1988), but, at smaller scales, variations in erosion rate are a function of a number of other factors (McDakin 1900; Dornbusch 2005a), including: the rock structure; water saturation; the presence/state of aquifers; precipitation; marine processes; the configuration and aspect of the coastline; the height of the cliff; the width of the shore platform; the nature of the beach; the topography of the shore platform; sea level; the presence of cliff-top superficial deposits; and human activity. Consequently, calculating retreat rates for coastal cliff erosion is notoriously difficult.

It is, however, well documented in historical literature that cliff collapse was a common feature of the Dover area (Table 2.5). The earliest attempt to calculate erosion rates was made in the late 19th century, when stakes were driven into the cliffs of the North Downs (McDakin 1900). Reported rates over a four-year period were, according to McDakin, 'unexpectedly small, only amounting to half an inch in a year'. May and Heeps (1985) suggest a mean rate for cliff-top retreat for the North Downs sector as a whole of 0.12m per year, ten times greater than McDakin's estimate. More recent calculations as part of the Beaches at Risk programme have used historical records covering the last 100 years or so

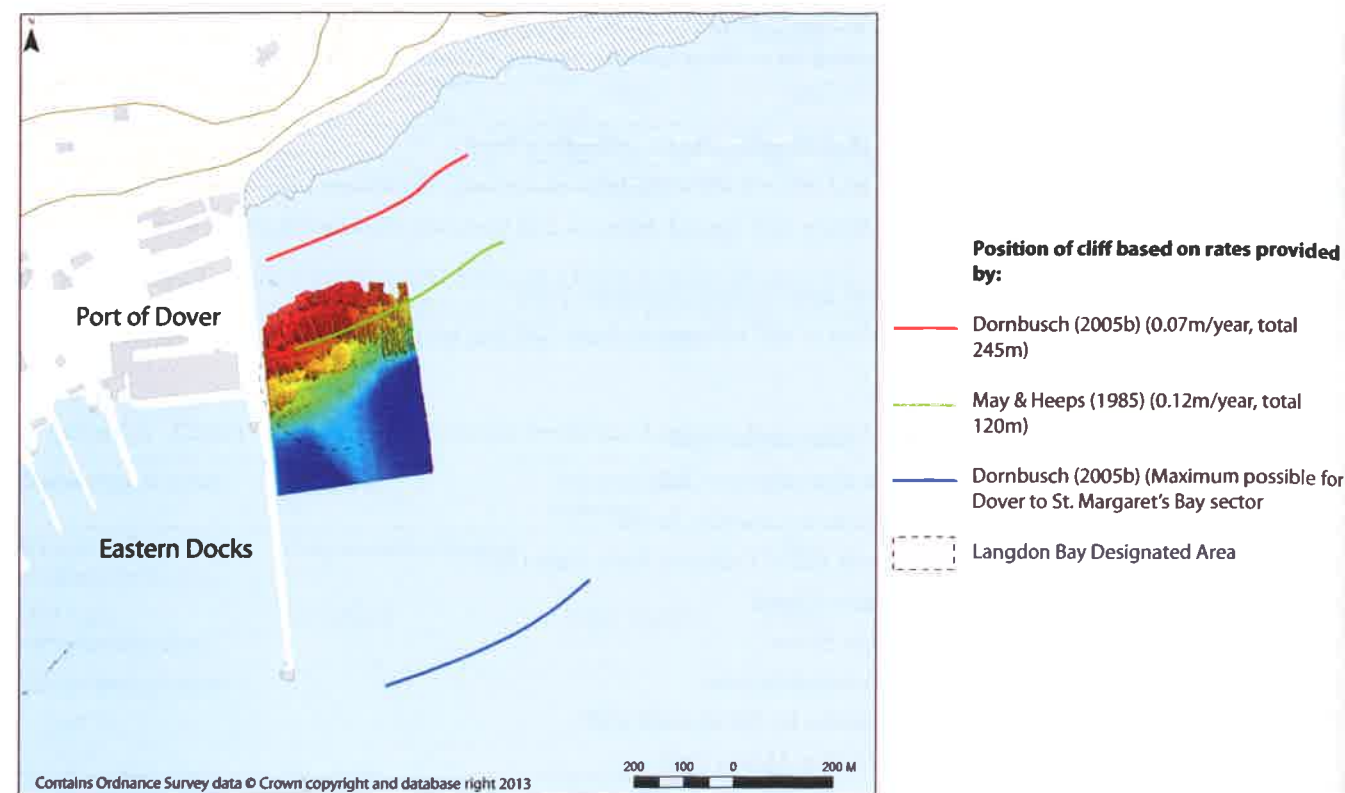


Fig 2.16 Postulated position of cliffs c 3500 BP, based on linear extrapolation of cliff retreat rates for study region

to suggest somewhat lower average rates of cliff recession of 0.07m per year for Kentish Chalk cliffs, contrasting with higher rates for the Sussex Chalk cliffs of 0.27m per year (Dornbusch 2005a). However, locally, significant portions of the Kent coast show almost no retreat at all. It should be remembered that, because these records only cover the past 100 years, any or all of these estimates may be widely inaccurate when extrapolated over longer time spans into the historic and prehistoric past. The difference in rates between Kent and Sussex may, in part, be a result of the differing aspect of the cliffs. Furthermore, Costa *et al* (2004) suggest that cliffs of Cenomanian, Turonian and Coniacian Chalk retreat less quickly than cliffs formed of Santonian and Campanian chalk. They also suggest that the latter are often subjected to frequent, but less voluminous, falls. Thus, although Kentish cliff-line retreat rates appear to be lower than those of the Sussex coastline, Kent is characterised by low frequency but high magnitude cliff-fall events (Dornbusch 2005b). Such was the collapse of January 2001, when a large piece of chalk, estimated at over 100,000 tonnes, collapsed from the cliff north of Dover.

Using the average rates of cliff-top erosion, 0.12m per year, provided by May and Heaps (1985), a total of some 390m of coastal erosion would have occurred since the deposition of the Bronze Age material (Fig 2.16). Using the alternative rates provided by Dornbusch (2005b) – 0.07m per year – projected retreat rates over 3250 years would be of the order

of 227m. However, as Dornbusch shows (2005b), the calculated rates of coastal erosion for the Langdon Stairs to St Margaret's section of the coast actually vary from less than 0.1m per year to in excess of 0.3m per year. Using these figures, retreat distances of up to 975m over a 3250-year time span might be anticipated in certain situations (Fig 2.16).

When attempting to retrodict cliff erosion rates into the prehistoric past, other factors also need to be taken into account. For example, Duperret *et al* (2004) suggest that rainfall patterns and associated ground saturation are important triggers to cliff collapse, while Mortimore *et al* (2004) suggest that further influences include storms and frost. These sorts of climatic impacts have important implications when considered in conjunction with potential phases of climate change in the past. For example, the well-known cold period of the Little Ice Age in the 17th century (Grove 2002) or the Late Bronze Age climatic deterioration noted by van Geel and Renssen (1998) are likely to have enhanced cliff erosion rates in the area. It is also noteworthy that superficial sediments present could influence the depth of weathering and consequent instability of the cliff (Mortimore *et al* 2004). Finally, patterns of marine erosion and tidal effects are also important factors (Duperret *et al* 2004; Mortimore *et al* 2004). It is interesting to note, although within a totally different system, Allen's (2002) observations of the degree of erosion on the Severn Levels over the last 1000 years, where significant variations in

long-, medium-, and short-term erosion rates can be postulated. These variations are a function of an assortment of factors operating at local and regional levels and similar differences in erosion rates through time are likely for the Channel coast.

Another factor to consider as potentially influencing erosion at the coast is the influence of earthquakes, although Duperret *et al* (2004) concluded that seismic activity over recent periods is not applicable. However, significant earthquakes have been known to hit the Channel region in the past, perhaps the most famous being the Dover Strait earthquake of 1580, along with an earlier one in 1380 (perhaps associated with the fault thought to run along the length of the Dour valley discussed earlier). The former earthquake was estimated to have had a magnitude of between 5.3 and 5.9 (Harris *et al* 1996) and caused cliff collapse at Dover as well as the destruction of houses. Musson *et al* (1984) also record other earthquakes in 1776 and 1950 and have suggested that this seismic activity may be evidence for periodic earthquakes in the Channel region approximately every 200 years. Evidence of tsunamis in the Channel has also been recorded. Another factor to consider today is the impact of harbour construction at Dover and, in particular, the large building programmes resulting in the creation of the major east and west breakwaters. This construction activity is likely to have influenced longshore drift across the mouth of the Dour valley and potentially starved the Langdon Bay area of sediment from the Roman period onwards, thereby reducing the potential erosion of the cliff.

Finally, shore platform erosion also needs to be taken into account. Over time, both lowering of the coastal platform and consequent landward migration of the low water line (LWL) have occurred along the Channel coast (Dornbusch 2005b). While it is difficult to assess accurately the degree of change, an average horizontal retreat of the LWL of 68m between 1870 and the 1990s was calculated, with significant estimates for the lowering of the coastal platform. Today's platform width between low and high tide within the Langdon Bay area varies between about 50m and in excess of 100m depending on location within the bay. Similar values may also have been experienced in the past.

Summary

Coastal erosion will have taken place in the past. Erosion rates are difficult to define, but total retreat values from less than 227m to greater than 975m may be retrodicted from recent erosion rates. Changes in coastal erosion rates are likely to have occurred as a function of a variety of factors, including climatic change in the past. Accelerated erosion rates within the central portion of Langdon Bay may be expected owing to the presence of enhanced weathering zones in the bay's central region (Langdon Hole).

Humans, landscape change, and geomorphological evolution at the mouth of the Dour valley

The river Dour has been central to Dover's very existence since at least the Bronze Age (Clark 2004; Parfitt and Champion 2004; Bates *et al* 2011). By Roman times the lower part of the valley had flooded, but this did not impede the siting of a major Roman fort there (Rigold 1969; Philp 1981; Barham and Bates 1990). The estuary, however, has long since disappeared as a result of infilling with silt and shingle, and much of modern Dover is built across deep layers of natural and artificial sediment which infill the site of the ancient haven (Bates *et al* 2011).

Evidence for the earliest significant human activity at the mouth of the Dour is the presence of a Bronze Age boat of 1575–1520 cal BC, discovered during roadworks in 1992 in the Bench Street underpass excavations in the town centre (Parfitt 1993; Clark 2004). This discovery was associated with peat and tufa sequences (B in Fig 2.17) which have been traced elsewhere through the town centre and lower Dour area (Fig 2.17) and are of particular importance in the history of landscape change locally. Underlying all sequences recorded below the boat were angular flint and chalk gravels (A in Fig 2.17), a deposit first described by McDakin (1900) as a fan of gravel up to 18 feet (c 5.5m) thick. Geotechnical borehole records gathered by the author indicate that similar sediments can be traced from the town centre upstream to Crabble Mill and westwards to the Western Docks Train Ferry Terminal (Figs 2.17 and 2.18). The poorly sorted, sub-angular nature of the gravels, together with the discovery of mammoth teeth in Market Square and around Admiralty Pier, suggests that these gravels were laid down during cold climate conditions in the late Pleistocene. The distribution of the gravels can be used to infer the position and shape of the valley during this period (prior to 10,000 BP) of lowered sea levels (Fig 2.19).

Overlying the gravels and associated with the Bronze Age boat is a thick sequence of tufa, peats, and silts (see Fig 2.17 B and 2.20 A and B) documenting environmental change in the valley mouth in the later prehistoric period (Keeley *et al* 2004; Bates *et al* 2011). The sequence consists of interbedded tufa and compact, firm, humified peats being replaced upwards by minerogenic silts. These deposits appear to have commenced formation in a carbonate-rich flood plain or channel-margin environment that does not exist in the Dour valley today (Bates *et al* 2011) and which contains no evidence for marine or brackish water conditions (Keeley *et al* 2004). The tufa associations appear similar to those described by Pedley (1990) as forming braided fluvial systems and suggest the presence of shallow, clear-moving water bodies. The peats may have formed in areas of damp ground and contain evidence for wetland, grassland, and wooded situations. Anecdotal evidence suggests that similar

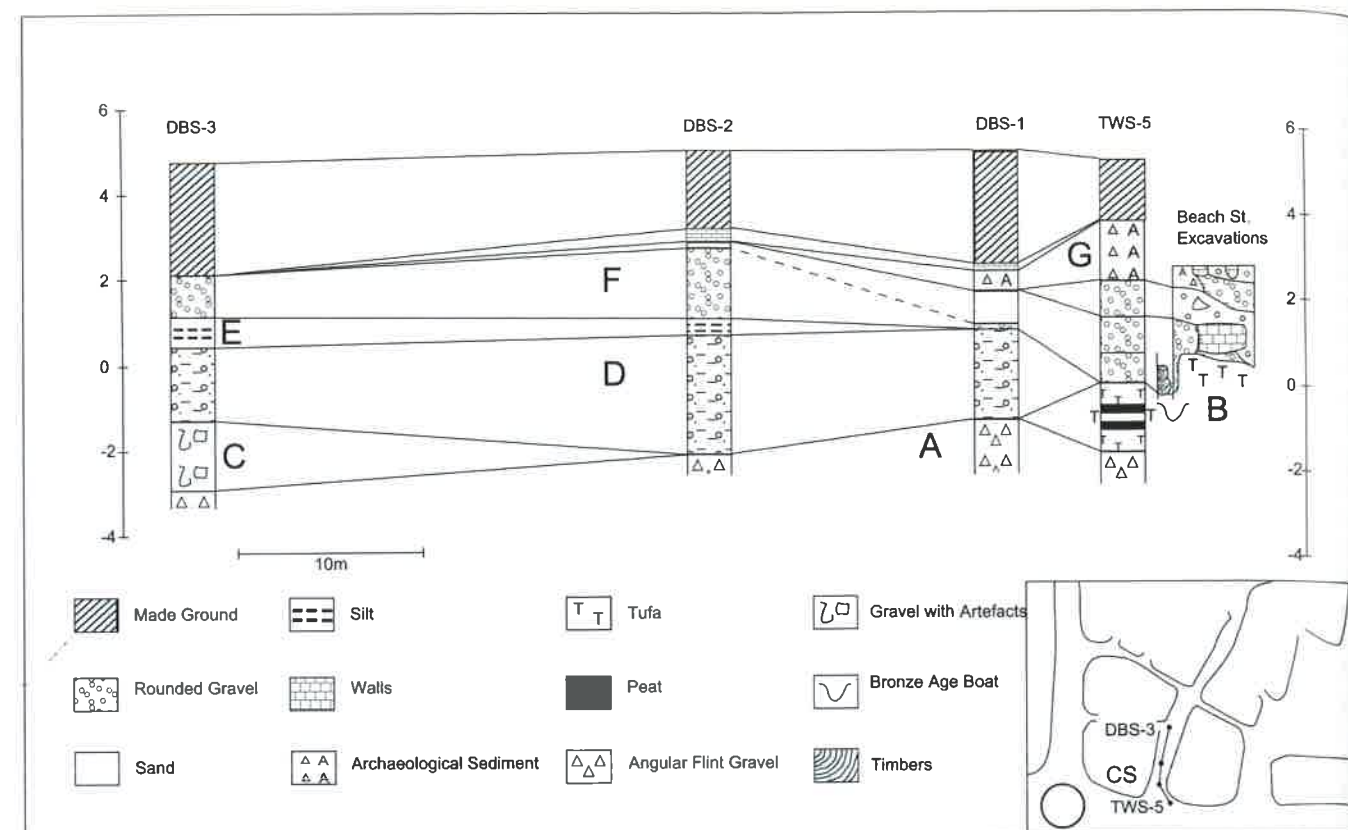


Fig 2.17 Stratigraphic profile through town centre area, showing main units. A: Late Pleistocene gravels. B: Tufa, peat, and silt associations. C: Gravels with pottery. D: Sands and silts (brackish). E: Freshwater silts. F: Marine gravels and sands. G: Archaeological horizons (medieval). CS: Crypt site

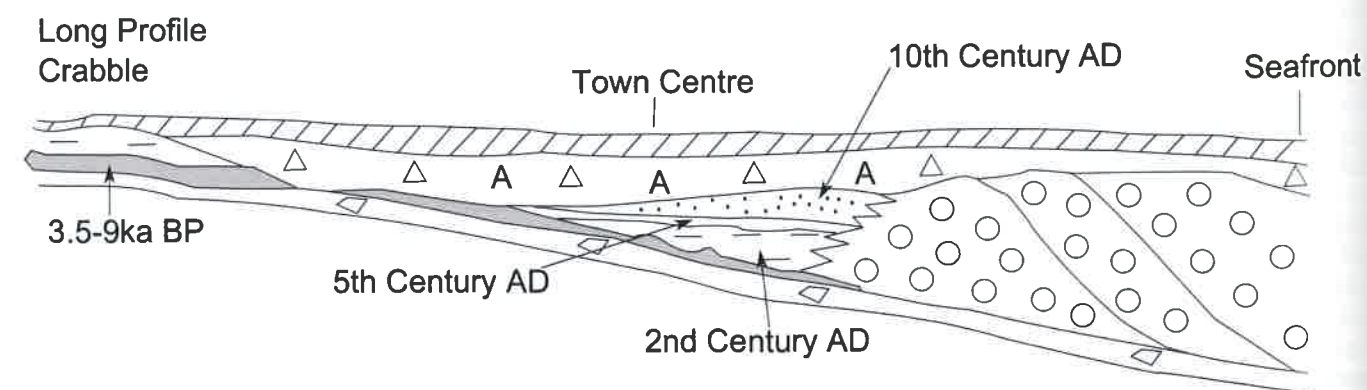


Fig 2.18 Schematic profile through Lower Dour valley (see Fig 2.17 for key)

sediments once occurred on the foreshore within Dover harbour, and recent borehole records along Waterloo Crescent and Marine Parade support this notion (see Fig 2.14). It is only in the deposits that consist of bedded, sometimes carbonate-rich silts that replace the peat and tufa upwards that pollen and diatoms, which suggest increasingly maritime conditions, start to appear. Age estimates on these sediment bodies indicate tufa/peat accumulation beginning in the valley by 9400 BP (Bates and Barham 1993a; Bates *et al.* 2011) and ceasing some

time after the abandonment of the boat (post 3250 BP/1500 BC).

Evidence for true marine conditions within the area is provided by the organic sands and silts found in the vicinity of the Bench Street-Market Square area (see Fig 2.17 C, D, and F). These deposits vary from poorly to well-bedded sands and silts with a variable organic content that includes plants/wood, forams, ostracods, diatoms, and pollen (Bates *et al.* 2011). These sediments infill a basin-like depression that corresponds approximately to Rigold's Outer

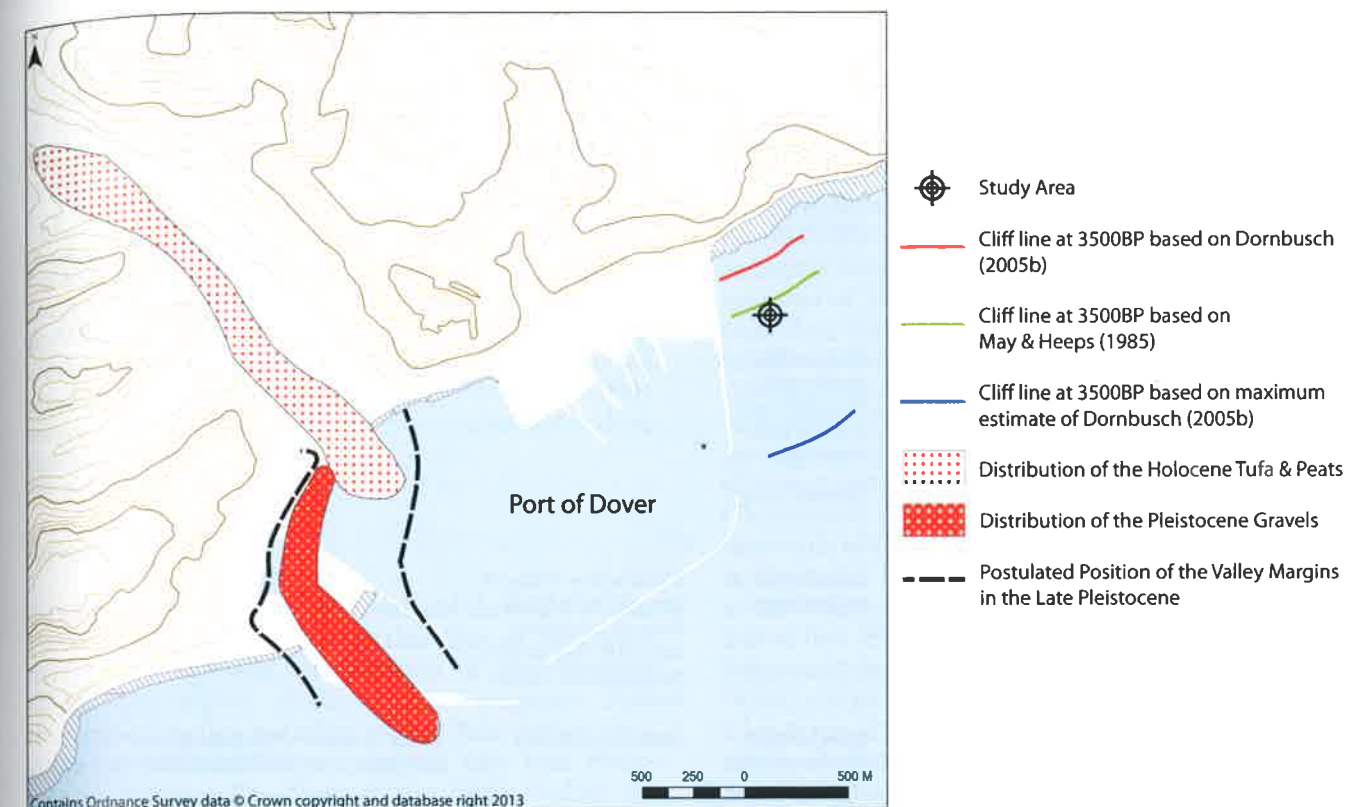


Fig 2.19 Map of the study area, showing main features relevant to the topographic history of the Lower Dour valley and Langdon Bay

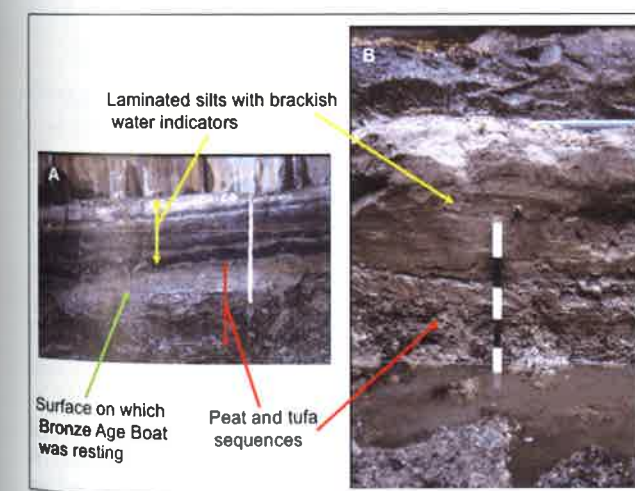


Fig 2.20 A: Sequence of tufa/peat overlain by minerogenic sediments adjacent to Dover Bronze Age Boat. B: Detailed view of minerogenic sediments containing brackish water indicators

Harbour (Rigold 1969) and diatom floras indicate deposition in sub-tidal or inter-tidal situations in a brackish or saline environment (N Cameron [UCL], pers comm). Occasional pot, tile, and concrete fragments recovered from boreholes (Bates and Barham 1993b), as well as excavation records of major Roman structures (Elsted 1856; Threipland

and Steer 1951; Rahtz 1958; Rigold 1969), suggest flooding of the mouth of the Dour by the Roman period. Indeed, a major Roman harbour at the mouth of the Dour had long been assumed (Rigold 1969), but it was only excavations in the 1970s and 1980s that gave definitive proof of the existence, under the modern town, of an almost unique 2nd-century Roman naval fort (*Classis Britannica* fort) in addition to the remains of a late Roman Saxon Shore fort. Various other buildings and harbour installations (Rigold 1969; Philp 1981; 1989) have been found surrounding the harbour basin.

The geoarchaeological information allows the sequence of events associated with landscape change in the vicinity of the modern mouth of the Dour to be outlined and placed within a timeframe based on both archaeological and non-archaeological criteria (see Figs 2.18 and 2.19; Table 2.6).

The earliest sequences identified within the town centre/port area date to the late Pleistocene (post Last Glacial Maximum) and include the angular flint and chalk gravels of the valley bottom and sides described above (see Fig 2.18). The pattern of distribution of these deposits and the topography created by their deposition define the shape of the Holocene valley (ie the topographic template *sensu* Bates 1998; Bates and Whittaker 2004). This topographic template suggests that the late Pleistocene/early Holocene valley extended south-westwards along the line of Snargate Street and then south-eastwards

Table 2.6 Stratigraphic units, age ascriptions, and inferred palaeoenvironmental and geographical changes in the Lower Dour valley

Stratigraphic group	Bench Street boreholes	Crypt site	Bench Street Excavations, TWS - 5	Age ascriptions	Inferred palaeoenvironmental conditions
Made ground, anthropogenic sediments (G) and rounded flint gravels (F)	Rounded gravels and waterlogged organic silts (Norman)	Stratified cultural sediments (medieval)	Well-rounded flint gravels (medieval)	Medieval to post-medieval	Storm beach established parallel to modern coast, final infilling of valley with organic sediments in low-lying areas, colluvial deposition on valley sides and establishment of modern town geography
Sands and rounded flint gravels (F)		Well-bedded sands and rounded flint gravels (late Saxon pot)		Late Saxon	Littoral and aeolian sand infilling former Roman harbour basin
Freshwater silts (E)	Organic silts 1545±65BP 1670±65BP	Organic silts			
		Late Roman to early Saxon	Freshwater wetland growth on infilled Roman harbour, colluvial deposition continues on valley sides		
Gravel with pottery and organic sands and silts (C/D)	Interbedded sands and silts with gravel at base (with Roman pot)	Interbedded sands and silts (with Roman pot)	Roman structure	Early to late Roman	Sub-tidal to intertidal infilling of harbour basin
Bedded silts (B upper)			Bedded silts	?Iron Age	Fluvial systems rich in silt, overbank flooding with colluvial deposition on valley sides. Unstable system approach of brackish water systems, removal of barrier to marine conditions
Tufa/peat units (B lower)		Tufa and peat	Tufa and peat containing boat 4340±85BP 6315±85BP 8380±110BP	<3300 BP >9240 BP	Carbonate-rich fluvial systems with damp ground, open and closed vegetation. Stable system. Occupy valley floor in freshwater conditions, marine influence excluded
Angular flint and chalk gravels (A)	Angular flint gravels	Angular flint gravels	Angular flint gravels	>10,000 BP	Periglacial, braided channel systems, valley extended seawards via Western Docks

beneath the Western Docks (see Figs 2.14 and 2.19), implying the presence of an east bank and valley side extending across the harbour area during this period.

A shift in the nature of sedimentation followed the onset of temperate conditions in the Holocene, and tufa/peat sediments were deposited along the valley floor from Crabble Mill (Bates *et al* 2008) to the modern coast in the vicinity of the foreshore (see Fig 2.18). This alteration was followed, probably in the Late Bronze Age, by a shift towards minerogenic sedimentation and increasing evidence of brackish conditions in the valley. The relationship of these deposits to contemporary coastal geographies is of particular relevance to ascertaining the nature of the coast during the period of interest to this study. Sea-level rise during the Holocene in the Channel

region has been considered by Waller and Long (2003; 2011); however, they point out that only a limited number of sites have been investigated in the area (the closest dataset is derived from Romney Marsh). Significantly, the early Holocene is characterised by rapid sea level rise until approximately 4850 cal BC. After this time, the rate of sea-level rise slowed and is often associated with extensive peat growth. Finally, after about 1750 cal BC there was a further decline in the rate of sea-level rise, although many coastal sites in the eastern Channel were inundated by marine waters during this period. The sea level around 1300 cal BC, the period of the Langdon Bay bronze finds, is estimated by Waller and Long (2003) to be somewhere between -2 and -4m OD, just below the recorded levels for the Bronze Age boat (c 1500 BC), but the boat in its

final resting place was certainly within reach of storm surges and floods. Consequently, the presence of the peat/tufa associations and the absence of any indication of marine influence until at least 1500 BC suggest that a substantial barrier existed to the penetration of sea waters into the valley. This hypothesis might suggest that the eastern bank of the Dour was still a major barrier until after c 1500 BC and that the contemporary mouth of the Dour with the sea was still a considerable distance downstream. Therefore, it is possible that significant quantities of coastal erosion have occurred since this time, trimming back the eastern valley side and exposing the valley floor to coastal flooding during the Iron Age.

Summary

A major channel of the Dour existed during the late Pleistocene, draining along the line of Snargate Street and beneath the position of the Western Docks. The aspect of the channel suggests that the eastern valley margins of the Dour valley once extended seawards, accompanying this late Pleistocene channel. Flooding of the lower valley by marine waters did not occur until sometime after c 1500 BC, implying a barrier to the penetration of the sea in the vicinity of the modern beach area within the harbour. Breaching of the eastern flank of the Dour valley appears to have fully occurred only during the Late Bronze Age or Iron Age.

Discussion

The evidence presented in previous sections indicates that significant local and regional changes in the topography of the channel region, and, by implication, the Langdon Bay area adjacent to the Dour valley, are likely to have occurred during, and since, prehistoric times. Therefore, the context of the bronzes recovered from the seabed requires close evaluation.

Although it will never be possible to define the precise location of the cliffs at any particular point in the past, the evidence gained from the study of recent cliff recession rates suggests that significant erosion of the chalk cliffs at Langdon Bay is likely to have occurred during the last 3500 years. Retrospectively the position of the cliff in the past (see Fig 2.19) is complex because recession rates will have varied throughout the last 3500 years as a function of (among other factors) the nature of the chalk within the cliffs themselves and changing climatic conditions (and, more recently, the impact of human constructions, such as the major harbour facilities).

Prior to sea level attaining modern datums, the degraded former cliff line established during the last interglacial would have extended beyond the modern coastline and would probably have become relatively stable after the cycle of weathering and

collapse that took place during the 90,000 years of the last cold stage. Consequently, it is likely that little or no erosion of the cliff line would have occurred in the early Holocene. More significant erosion will have resumed as near-modern sea levels were attained during the Middle Holocene, at which time initial coastal erosion would have removed the unconsolidated debris accumulated from cliff degradation during the Devensian. Only following the removal of this debris would erosion of the basal rock face have resumed. Using the lowest postulated rates of cliff recession provided by Dornbusch (2005b), the distance between the site and the contemporary cliffs would be half that of today. Using the maximum possible erosion rates for the stretch of coast between Dover and St Margaret's Bay (Dornbusch 2005b), the cliff would be some 500m seawards of the site. Another factor to consider here is the water depth at the site. Regional subsidence within south-east England is now a commonly established fact (Shennan and Horton 2002), and rates of between 0.5mm and 1mm per year within the Dover Strait are possible. This observation would suggest a lowering of the wave-cut platform relative to mean sea level of between 1.75m and 3.5m in the last 3500 years (Antony Long, pers comm). This subsidence would have been exacerbated by lowering of the chalk platform through erosion at the same time. Thus, it would be expected that the water depth at the time of site formation would have been significantly less than at the present time.

The evidence from the mouth of the Dour valley (see Fig 2.19) supports the notion that the cliff line was formerly further seawards than at the present day. The distribution of the late Pleistocene gravels suggests that a substantial barrier to the direct flow of the Dour into the Channel area existed in the late Devensian. This barrier is most likely to have been a continuation of the eastern chalk valley side of the Dour valley in a south-westerly direction. That this barrier continued to be an important factor in local geography until after the Middle Bronze Age is suggested by the absence of a marine or brackish water signal in the tufa and peat sediments of the town centre. Thus, we can envisage a scenario within the early Holocene when much of the area now occupied by the port of Dover, within the modern breakwaters, was occupied by low chalk bluffs that subsequently eroded landwards. Much of this erosion would probably have occurred following the establishment of sea levels close to modern datums after c 6000 years ago.

Within the area of Langdon Bay itself little evidence exists to substantiate the suggestions made above owing to the predominantly erosive nature of the area. However, it is interesting to consider two aspects. Firstly, it is possible that Langdon Hole marks the headwall of a former valley that once extended seawards across the study area. If so, flooding of such a feature could have produced a small inlet in the past, perhaps an ideal location for landing a craft such as the Dover Bronze Age boat.

Secondly, the excavation records (Muckelroy 1981) note the presence of stable black-grey clays in the fissures eroded into the chalk wave-cut platform. While it is impossible to determine the precise environments of deposition of such sediments, their description resembles that of deposits usually laid down under low energy conditions of the sort normally associated with estuaries or tidal mud flats, and certainly not the open water conditions now prevalent at the site. Thus, whatever the precise nature of these sediments, they may well attest to conditions in the past that were very different to those of the present day.

In conclusion, using the geomorphological and palaeoenvironmental evidence from the local area, it may be deduced that the site area now occupies a situation very different to that at the time of site formation. If a maritime context is favoured, then the site was formed without doubt in a context considerably closer to the contemporary shoreline than at the present day, and with shallower water depths. The presence of the clays in the rock fissures might also suggest the presence of shallow and inter-tidal contexts occupying the site at some time perhaps contemporary with site formation. However, a number of very strong lines of evidence would argue that even greater local topographic changes have occurred since site formation, and that perhaps a terrestrial or estuarine context may be more appropriate to the site. The higher rates of chalk cliff erosion and the possible offshore extension of Langdon Hole might suggest, as an alternative scenario to a fully marine depositional context, that the assemblage may have been deposited within a small inlet, perhaps occupied by tidal marshes.

Terrestrial hinterland of Langdon Bay

by Stuart Needham and Keith Parfitt

As in the case of the Salcombe/Moor Sand site, consideration has been given to the terrestrial hinterland within a radius of approximately 10km from the Langdon Bay seabed find. The same caveats that were discussed in Chapter 1 apply: lack of certainty as to how the metalwork came to be deposited (our preferred conclusion is reserved for Chapter 5) and, if it is the contents of a wrecked boat, the impossibility of knowing whether that boat intended to make landfall on this part of the coast or was simply passing by.

The findspot lies close to the South Foreland, the point of Britain closest to the European mainland, from which it is separated by the Strait of Dover. It also happens to lie around the centre of a 20km stretch of coastline marked by impressive chalk cliffs – the famous White Cliffs of Dover (Fig 2.21). This striking white façade, rising in places to 150m in height, presents a full transect of the North Downs, cut through by the Channel. The geology of the chalk is outlined by Bates (above); the topogra-

phy is of more concern here. At the west end of the exposure the cliffs fall quickly to give easier access to the hinterland via East Wear Bay, while to the north-east the cliffs recede more gradually, giving way to low ground at Walmer and the marshland of the Lydden Valley beyond Deal. In between, the façade is broken only twice: at Dover, where the small river Dour flows into the sea, and at St Margaret's Bay, where a local declivity in the cliffs is associated with a small beach. These are potential landing places (Parfitt 2004, 101–2). Bates (above) has conjectured that Langdon Bay itself, overlooked by the cliff-top depression of Langdon Hole, may once have been a more significant bay before coastline and cliffs receded.

Inland, our defined study zone thus encompasses a landscape almost entirely of downland, although the chalk bedrock is frequently mantled by clay-with-flints on the crests and by colluvium or solifluction deposits in the dry valleys. The prevailing surface geology, both within and beyond the radius, is indicated in simplified form in Fig 2.21. The river Dour seems, by most standards, to be a rather insignificant watercourse; nevertheless, within this landscape it serves as a thread through the heart of the zone connecting coast and inland areas. The mouth of the Dour lies 2.5km west of the Langdon Bay site today, but there is geomorphological evidence to suggest that its position has shifted a little during the Holocene, its outfall previously being further out to sea than the modern seafront (Bates above).

To the west of the study zone a short length of coastline exposes Lower Greensand (and a little Gault Clay) around Folkestone and Hythe. Beyond is today's peninsula of Dungeness, a landform that was very different in the Bronze Age. It is probable that the estuary of the river Rother fell close to Hythe and was surrounded by a complex of mudflats, saltmarsh, freshwater fen and raised bog, all trapped behind a massive shingle barrier system (Long *et al* 2007, 198 fig 6.4). While rich in certain kinds of resources and undoubtedly frequented by people, as attested by the Lydd find of flat axes (Needham 1988), this expanse would probably not have had much by way of a settled population. To the north of the study zone lies the Lydden Valley; it too has been subject to marine influences and it flanks the entrance to the Wantsum Channel, which had cut off the Isle of Thanet as the sea level rose in the earlier Holocene (Fig 2.21).

The shortness of the crossing between eastern Kent and the facing continental shores would have made this part of the Channel a favoured crossing zone for early man-powered craft (eg McGrail 1993, 200, fig 20.1), but powerful currents through the Strait of Dover would have to be combated. However, there is no reason to suppose that the bulk of cross-Channel trade would have gravitated overland to the regions immediately overlooking the Strait in order to benefit from this short crossing. Instead, we

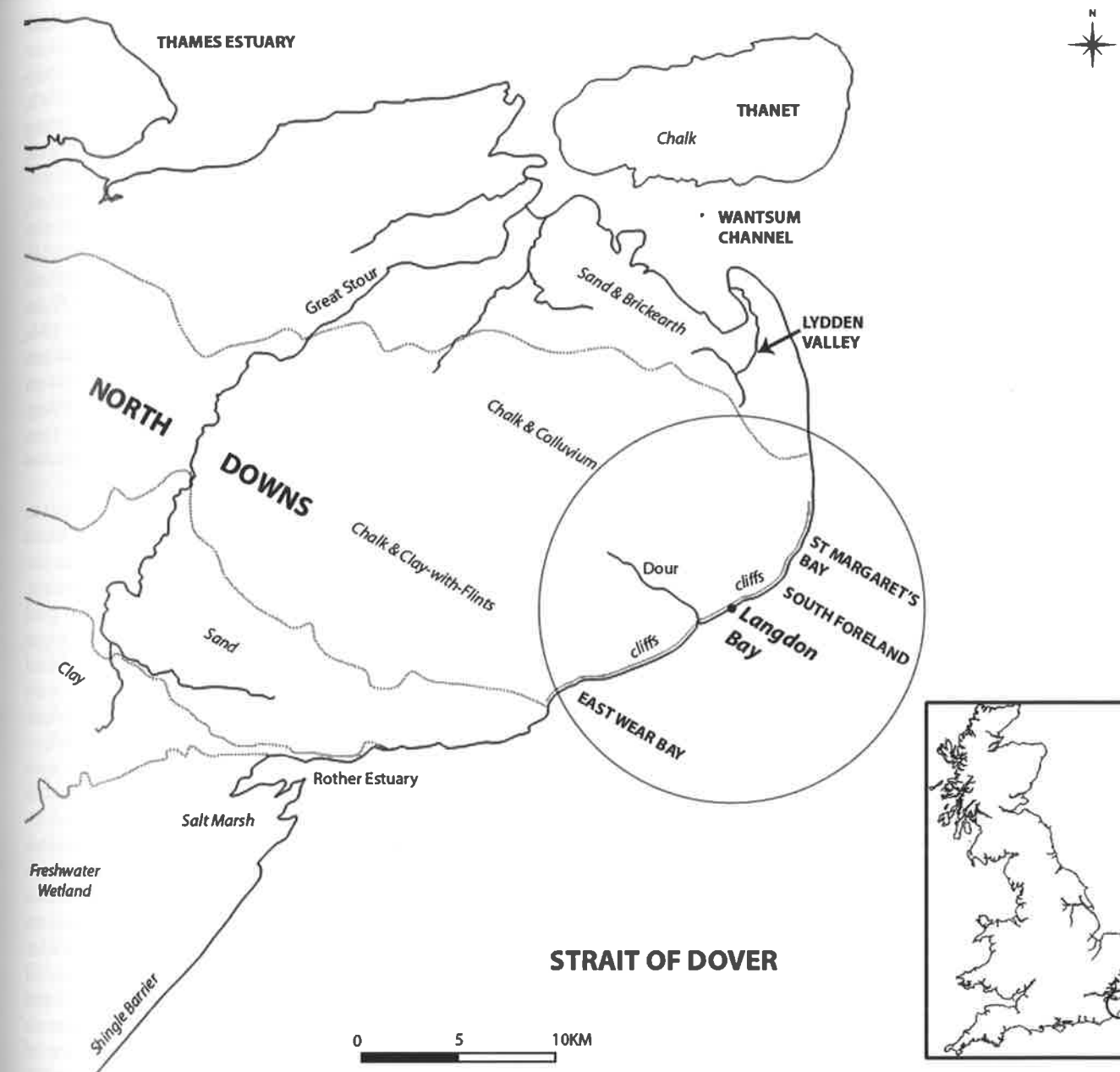


Fig 2.21 Langdon Bay and its hinterland in eastern Kent. The archaeological study zone for the terrestrial hinterland lies within the circle. Romney Marsh is as reconstructed for the Bronze Age by Long *et al* 2007. Base-rocks and habitats are simplified to show those prevailing in the respective zones

have to envisage innumerable cross-Channel routes involving different combinations of near-shore coasting, crossing, and far-shore coasting. Even when the Dour valley and its environs were the destination in cross-Channel transits, the crossings themselves may not consistently have been across the Strait. Irrespective of varied routes, the chalk façade would have provided extremely useful marks for navigation, for both those seeking local landfall and those passing. The modern Ordnance Survey maps mark a number of names for specific locations and features along the coast between Dover and Walmer, such as Fan Point and Old Parkers Cap,

which must have been used for navigation by local mariners for generations.

Neither should we prejudge the extent to which this particular coastline was involved in cross-Channel interactions on the basis of modern preconceptions about economic trade. Such preconceptions might see economic relations being drawn preferentially towards larger or more prosperous populations, leading to the possibility that most sea-borne traffic would have bypassed 'poorer' stretches of coastline. In this context, the apparent wealth of deposited metalwork in the lower Thames valley (in many phases) and the Thames estuary (in certain phases)