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SCHIPLUIDEN

A NEOLITHIC SETTLEMENT ON THE DUTCH
NORTH SEA COAST *c*. 3500 CAL BC

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AND PETER F.B. JONGSTE

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Part III

Ecology and economy

14 Coastal evolution of Delfland and the Schipluiden microregion in relation to Neolithic settlement

Joanne Mol

During the period of occupation the Dutch coastal plain experienced considerable changes. Coastal retreat had ceased only recently and a period during which the coastline closed and subsequently prograded seawards had just started. This newly developed landscape – a tidal lagoon behind a closed barrier system – provided excellent circumstances for settlement. Three palaeogeographic maps that show the landscape during the occupation phases were extracted from geological subsurface data. These data were obtained in augering where that was possible around the site. Together with data from earlier research, this information yielded a detailed picture of the situation in which the people lived.

14.1 Introduction

In the past few decades large infrastructure projects have been executed in the western part of the Netherlands, generating many exposures. The operations not only led to the discovery of archaeological sites, but also enabled sedimentological studies of the subsurface, which have resulted in a detailed picture of the complicated coastal development of the western Netherlands.

This coastal development is the key to understanding the prehistoric occupation history of this part of the Netherlands, because site selection was largely dictated by the natural environment. The main factor in the prehistoric selection process was the presence of natural elevations, since the greater part of the region was regularly flooded. Other factors related to subsistence strategies, as hunting, fishing, gathering and farming will also have been dependent on their natural constraints, such as the presence of water and water courses. Therefore, knowledge of the exact nature of the landscape will result in a better understanding of the archaeology of this area.

During the Holocene, a considerable rise in sea level combined with changes in sediment supply caused the coastline to periodically advance and retreat. Many prehistoric sites have survived in a thick sequence (approx. 20 m) of marine deposits extending inland beyond the present coastline. The oldest preserved sites in this region have been dated to the Middle Neolithic. They include Rijswijk A4 (Van der Valk 1992), Wateringen 4 (Raemaekers *et al*. 1993), Wateringse Veld (Oude Rengerink 1996b) and Ypenburg (Oude Rengerink 1996a; Cleveringa 2000). Schipluiden-Harnaschpolder (fig. 14.1) can now be added to this list.

The positions of these prehistoric sites, on top of low dunes, gave rise to wild speculations about the course of the former coastline. Every time a new site was found further inland the former coastline was pushed progressively further eastwards. But is this really how things were? Although the general development of the landscape is known, the natural settings of the settlements have not yet been studied in an integrated approach. Did the settlements indeed lie along a former coastline or were they perhaps situated further inland, in the extensive wetlands that bordered the coastal barrier system? This study aims to combine the vast amounts of archaeological and geological data available, and to provide a general geological framework in which all sites can be viewed within a single palaeoenvironment. The first part of the chapter gives an overview of the evidence available prior to the Schipluiden excavation. The second part covers the environmental data relating to the new site and its environs, which place the site within the established framework.

14.2 Coastal development of the Holland basin

The coastal development of the Netherlands was strongly influenced by the Pleistocene subsurface. The Late Weichselian surface was an east-west dipping plain with two shallow valleys: the Zeeland basin and the Holland basin. The river Rhine formed the boundary between these basins (Beets/Van der Spek 2000). The Zeeland basin lay in the south and is nowadays the main drainage basin of the Scheldt, Rhine and Meuse. Our study area lies just to the north of this basin.

The increase in temperature after the last ice age caused a rapid rise in sea level, which resulted in gradual flooding of the North Sea basin. By 8000 BP (*c*. 6900 cal BC)[1] the sea had reached the present coastline and the Holland and Zeeland basins were submerged. Large marshes formed, resulting in the development of an extensive layer of peat (Basal Peat) on top of the Pleistocene subsurface. The river Rhine however supplied sediment at the same pace as the rise in sea level (Beets/Van der Spek 2000).

The continuing rise in sea level led to the development of large lagoons within the basins, in which tidal back-barrier

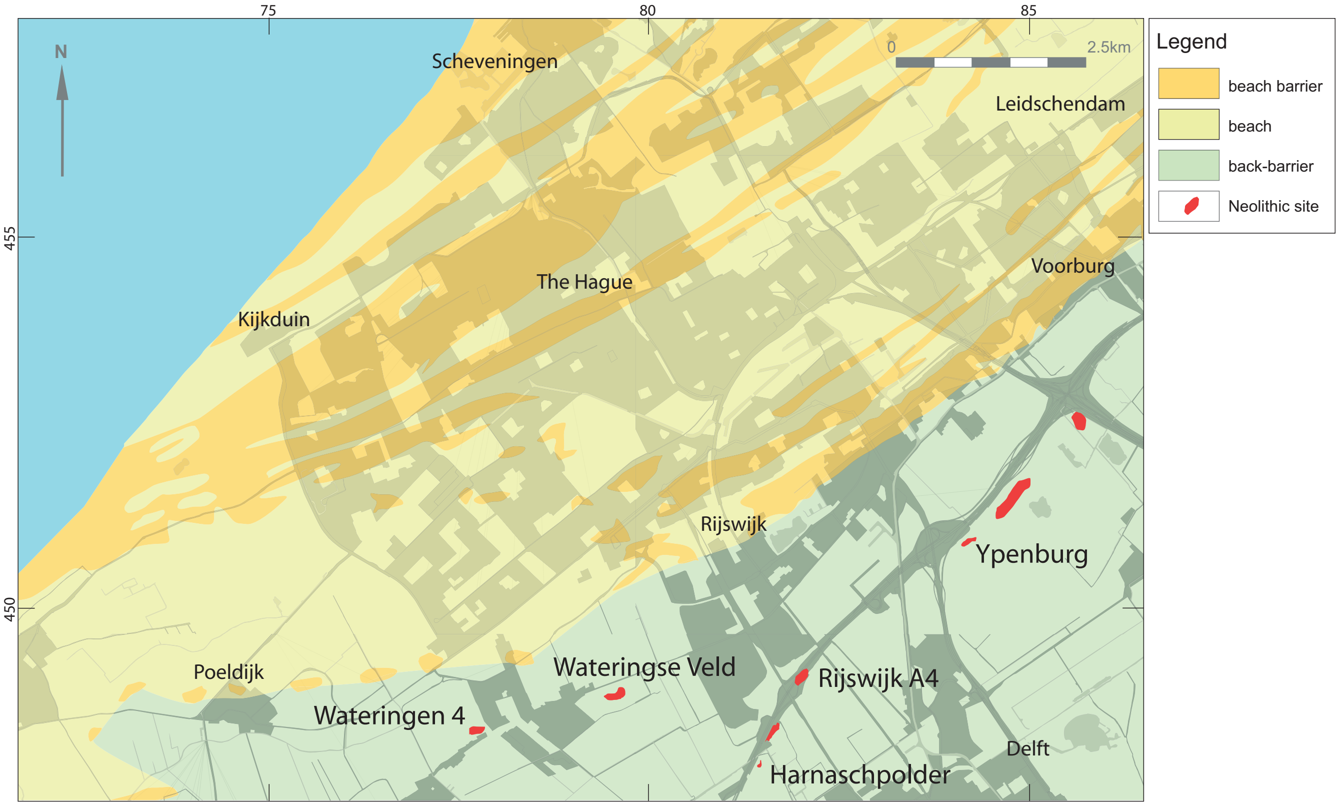


Figure 14.1 Location of Schipluiden-Harnaschpolder and four contemporary sites in the back-barrier area in between the oldest beach ridge (Voorburg-Rijswijk) and the marshes (After Van der Valk 1992 and Deeben *et al.* 2002, scale 1:100,000).

deposition dominated (Calais Member).[2] Apparently, a system of beach barriers shielded the mainland from direct influence of open marine conditions, but those barriers have not survived. Only around 6000 BP (*c.* 4850 cal BC) did the pace at which sediment was supplied begin to exceed the rise in sea level (30 cm per century at that time). Consequently, the tidal inlets filled up and the coast became fixed and began to prograde seawards (Beets/Van der Spek 2000; Cleveringa 2000). The start of this progradation varied from place to place, dependent on local conditions, such as the size of the tidal basin (Van der Valk 1992). All deposits laid down from this time onwards have survived, including the inactive beach-barrier systems, because the newly formed barriers that protected the coast lay seaward of the older ones. On top of these barriers, dune formation took place ('Older Dunes'), resulting in low elongated ridges. These dunes nowadays lie subparallel to the present coastline (figs. 14.1-2). The Neolithic settlements in this region all lay on top of such dunes.

During the Subboreal (5000-2900 BP, *c.* 3800-1100 cal BC) tidal inlets with marine influence were restricted to the areas of Rotterdam, Leiden and IJmuiden (Van der Valk 1992; Beets/Van der Spek 2000). The Holland basin consequently became a vast marsh with extensive peat formation (Holland Peat). The lowest-lying dunes were gradually covered by these aquatic deposits, whereas the ridges further west, which were younger and higher, are still visible as outcrops at the surface today. These ridges are separated by elongated depressions filled with peat.

The period of rapid and extensive coastal progradation came to an end after about two millennia, when large-scale erosion of the coastline started. This resulted in a straightening of the coastline. The protruding coastline in the southwest was eroded, its sand supplementing the central part (near Haarlem) until 1900 BP (*c.* AD 100). Near Wassenaar the erosion started relatively early, around 3500 BP (*c.* 1800 cal BC), but near Haarlem it did not start until after 1900 BP (*c.* AD 100) (Van der Spek *et al.* 1999). The duration of this erosion phase also differed from place to place, even lasting until 750 BP (AD 1270) near Kijkduin (to the south of The Hague; Roep 1984). It was accompanied by a steepening of the coastal profile and the development of an extensive dune system

('Younger Dunes'), which started *c*. AD 1300 near The Hague and several hundreds of years earlier near IJmuiden. These Younger Dunes are considerably higher (20-50 m) than the previously formed Older Dunes. They consist of a series of parabolic dunes characterised by a high ridge and a steep eastward-facing slope on their landward side. They originated as a migrating barren dune system (Zagwijn 1984). It is this system that forms the present coastline (not indicated in fig. 14.1). After the development of the Younger Dunes, marine influence in the Holland Basin was restricted to deposition near small tidal inlets (Dunkirk Deposits), one of which – known as the Gantel – influenced the landscape of our study area.

14.3 Previous research in the study area

The study area lies approximately 10 km from the present coastline, in the coastal back-barrier area (figs. 14.1-2). The base of the Holocene sequence (older than 5900 BP, *c*. 4800 cal BC) consists of Early and Middle Atlantic fluvial, tidal-flat and estuarine deposits, including Basal Peat (fig. 14.3). To the north of Rijswijk the Early Atlantic deposits comprise tidal flat deposits, some tidal channel deposits and lagoonal clays. In the south, however, estuarine and fluvial deposits prevail due to the presence of an estuary south of The Hague. A barrier island must initially have separated the northern tidal area from the southern estuarine area, but it has not survived. A layer of peat found overlying these deposits at Leidschendam has been dated to 5625 ± 45 BP (4550-4350 cal BC) (Van der Valk 1992, 1996).

By *c*. 5500 BP (4350 cal BC) the shoreline had retreated to its most landward position, extending to the Ypenburg and Rijswijk A4 exposures (Cleveringa 2000). By this time no large beach barriers had yet been formed, but a large sandy beach plain[3] dominated by wash-over deposits developed on top of the tidal and estuarine deposits. Deposition of such wash-over deposits is only feasible in the presence of a coastal barrier over which storm-driven deposits are funnelled. The barrier itself probably consisted of similar, older wash-over deposits that were remodelled by waves. The shore-face deposits have not survived. The barrier must have been fairly low and small, and not comparable with the later beach-ridge deposits (with foredunes).

From this time onwards, coastal erosion was replaced by coastal progradation and all younger sediments were deposited seaward (west) of the older ones. Towards the east, back-barrier deposits (mainly clay) were still being deposited and towards the north was a tidal channel that extended 12 km in an easterly direction (Van der Valk 1992, 1996; Gutjahr/Van der Valk 1996; Vos/Kiden 2005; fig. 14.2). These sands have been intensively investigated by Van der Valk (1996) and Cleveringa (2000). Van der Valk called them 'Rijswijk-Zoetermeer sands'. Sedimentary research showed that the base of these sands is wave-dominated, while the top is mainly aeolian. Shells preserved *in-situ* in these sands near Rijswijk have been dated to 5350 ± 80 BP (4340-3980 cal BC) and 5560 ± 80 BP (4590-4220 cal BC).

Continuing progradation led to the formation of a coastal system that comprised a beach ridge, a beach plain and a marsh. This system was associated with the development of dunes and led to the formation of the Voorburg-Rijswijk beach ridge around 4900 BP (*c*. 3700 cal BC) (Zagwijn 1965; Roep 1984; Van der Valk 1992) and progressively younger beach ridges further west. Their height and depth increased towards the west, in line with the rise in sea level (Van der Valk 1992; Cleveringa 2000). These beach ridges (which now support dunes) are still observable in the present-day landscape. They were several metres higher than the previously formed barrier systems and were able to shield the back-barrier area from direct marine influences.

During the next phase of coastal development, an extensive wetland developed behind the newly formed barriers, in which clay was deposited between the Old Rhine in the north and the Meuse inlet in the south. Eventually, all marine influences disappeared for a prolonged period and a vegetation cover developed, resulting in at least 3 m of peat (Cleveringa 2000). Near our study area the onset of this peat growth has been dated to 4670 ± 65 BP (3640-3340 cal BC; Rijswijk-Plaspoelpolder; Van der Valk 1996).

Around 300 cal BC peat development was interrupted by a phase of floods (Van Staalduinen 1979) resulting from a marine incursion in the Meuse estuary near Naaldwijk (south of The Hague). This led to the formation of a vast clay cover on top of the peat, followed by local erosion by the largest channels of this system (Van der Valk 1996; Asmussen 1992; Cleveringa 2000). The tidal deposits formed in this inlet – the aforementioned Gantel – can be traced in the subsurface of The Hague, Rijswijk and Delft. Asmussen (1992) mapped one of the large channels that ran north and east of our study area, with some smaller branches extending northwards. Van Staalduinen (1979) dated this tidal system to between *c*. 940 cal BC (2645 ± 65 BP) and AD 440 (1725 ± 65 BP) near its outlet.

Archaeological finds from Naaldwijk-Broekpolder (approx. 5 km west of Schipluiden-Harnaschpolder) suggest a later date, of around 300 BC, for the beginning of the system's formation in the study area (Van Staalduinen 1979). Asmussen (1992) suggested that there were no long significant episodes of flooding in this region from the Roman period until the Middle Ages, which would imply that this tidal inlet was active for a relatively short episode of flooding in the study area.

14.4 Previously studied Neolithic sites in the region

There are at least four more sites, likewise situated on top of low dunes, which were occupied during the same period as

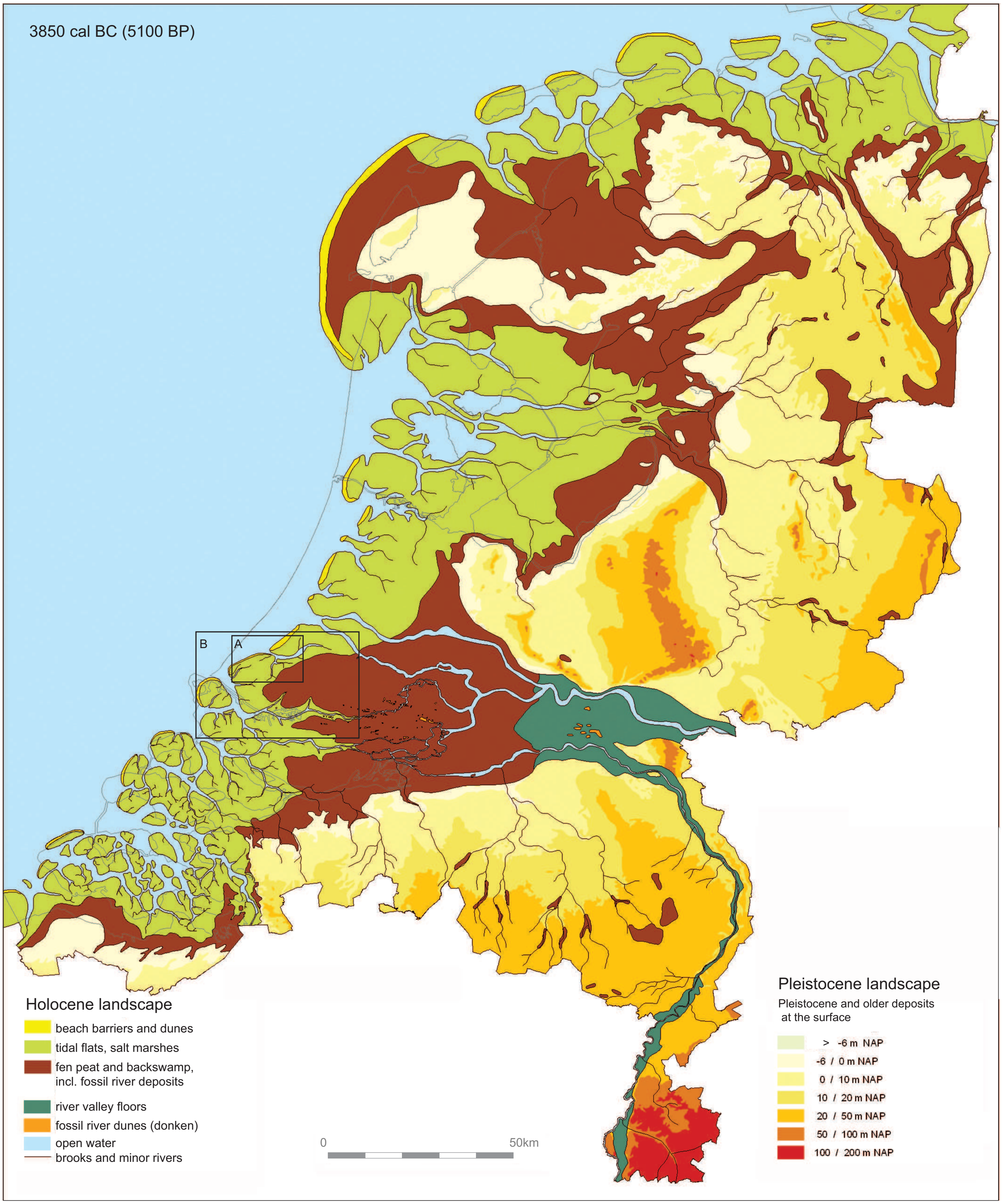


Figure 14.2 Palaeogeography of the Netherlands, c. 3850 cal BC (after Vos/Kiden 2005). Indicated are the Schipluiden site, the location of the maps of figs. 14.1 and 14.8 (A), and of fig. 27.6 (B). This stage is about two centuries earlier than the occupation at Schipluiden. The tidal inlet to the north of the site is still open. Please note that the (uninhabitable) tidal flats and the (inhabitable) salt marshes are indicated with the same green signature, which makes one easily overrate the conditions for occupation.

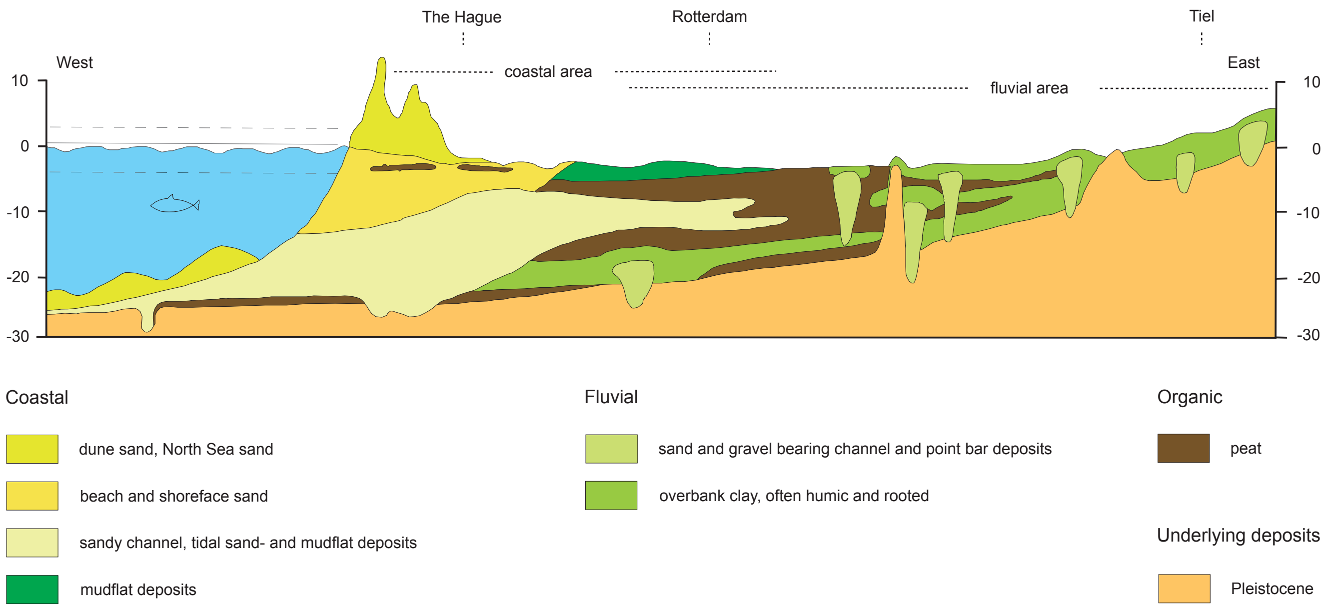


Figure 14.3 West-east section across the coast and the coastal plain between The Hague and the fluvial area indicating the location and stratigraphical position of the Schipluiden site. After Weerts *et al.* 2004.

Schipluiden-Harnaschpolder (fig. 14.1). Two of them have been studied sedimentologically: Ypenburg and Rijswijk A4 (Van der Valk 1992, Cleveringa 2000). They have provided valuable information on the environment in which their occupants lived, although the researchers concentrated on the earlier coastal development and paid comparatively little attention to the environmental conditions during the subsequent period of human occupation. The other studies conducted at these sites were mainly archaeological, but the archaeological surveys also yielded some spatial data that could be incorporated in the previously established framework (section 14.8).

14.4.1 Ypenburg

The Ypenburg site extended across the tops of several solitary dunes (Oude Rengerink 1996a). This site was studied by Cleveringa (2000). The Ypenburg area lies on the most landward palaeocoastline in this region. The subsurface comprises (tidal) channel deposits covered by wash-over deposits representing coastal erosion. They are overlain by beach ridges, a beach plain (the Rijswijk-Zoetermeer sands) and more distally situated marsh deposits representing the subsequent progradational phase in the history of coastal formation. Dunes were formed here and there on top of the beach ridges and beach plain, and they afforded suitable conditions for prehistoric settlement. The largest of the dunes has a length of 1 km and a width of 150 m; the others are much smaller (with lengths of up to 250 m). Some of them overlie the beach plain and marsh deposits, whereas others were formed directly on top of proximal wash-over deposits. These dunes have dates of *c*. 4000 cal BC and younger, as can be inferred from the dates ranging from 5522 ± 45 BP (4450-4250 cal BC) to 5358 ± 43 BP (4300-4000 cal BC) obtained for the underlying wash-over deposits. A channel dissecting the beach plain dates from 5019 ± 35 BP (3900-3700 cal BC).

14.4.2 Rijswijk A4

The Rijswijk A4 site was sedimentologically studied by Van der Valk (1992, 1996), who interpreted the subsurface of the dune as follows: at least 2 m of sand (the Rijswijk-Zoetermeer sands) was deposited in an open coastal situation. The sand is coarser towards the top, indicating a decrease in water depth and the formation of a beach plain at the top. The beach plain deposits are covered by fine sands with clay beds, covered by a layer of clay that is centuries younger. The fine sands represent wash-over deposits that grade into aeolian deposits with a dune morphology at the top. These dunes were formed in a more sheltered (back-barrier) environment and were used as occupation sites several centuries later.

A sample of the peat (Rijswijk Plaspoelpolder) covering the Rijswijk-Zoetermeer sand 900 m west of the exposure was dated to 4670 ± 65 BP (3638-3341 cal BC), which gives a *terminus post quem* date for the dune's formation. Cleveringa (2000) correlated the basal part of the Rijswijk-Zoetermeer sands with the wash-over deposits at Ypenburg on the basis of age and sedimentological characteristics. He suggested that the oldest coastline found at Ypenburg will have extended to the south of this exposure.

14.4.3 Wateringse Veld

Several lithological sections of the Wateringse Veld site show a dune and beach-ridge morphology, covered by thin layers of peat alternating with clay (Oude Rengerink 1996b). The nature of the underlying deposits is not clear because the sections extended no deeper than 60 cm into the sandy top. Comparision with Rijswijk A4 and Ypenburg showed that this site also lay on top of back-barrier deposits covering the Rijswijk-Zoetermeer sands.

14.4.4 Wateringen 4

The top part of the dune that bore the Wateringen 4 site was found to contain a thin layer of soil underlying the peat and clay (Raemaekers *et al*. 1997). Limited information is available on the natural setting of the site; the excavation report describes only the underlying dune and marine sand.

The dune lies on top of layers of fine sand alternating with clay. The clay points to a back-barrier environment. The deposits resemble those of the Rijswijk A4 site (Van der Valk (1992), suggesting that the sands were deposited in an environment similar to that at Rijswijk A4: a tidal or estuarine back-barrier with local dune formation.

14.5 Schipluiden-Harnaschpolder

The Schipluiden-Harnaschpolder settlement lay on top of a small dune (chapter 2) in an extensive tidal back-barrier environment. A survey conducted by Deunhouwer (2001, 2002) revealed a rough impression of the size of the dune, but at that time the dune's setting in the coastal landscape was not yet fully understood. His results moreover suggested that the dune extended further north, beyond the area covered in the survey. Therefore, a total of 419 manual corings were conducted around the site (fig 14.4) in the hope that they would provide a good impression of the stratigraphy within an area of approximately 1 km^2 and would reveal any new sites in that area.

Figure 14.5 presents a NW-SE transect through the study area showing the main characteristics of the stratigraphy of the subsurface. All units that were distinguished during the excavation and discussed in chapter 2 will be referred to below. Figure 14.6 shows a transect through the excavation site that was used to correlate the on- and off-site deposits. It should be borne in mind that the height of the dune indicated in this figure is not its maximum height, because the data on which this figure is based refer to the southern slope of the dune.

The following sediments were encountered (from bottom to top): the first deposit consists of at least 2 metres of weak silty clay containing shells preserved *in situ* and a few layers of peat. The clay was encountered only below approx. -8 m NAP and represents an early depositional phase, well before the period of occupation (not shown in figure 14.5). The shells preserved *in situ* in the sediment point to a tidal to brackish environment (chapter 16). This deposit can be correlated with the lagoonal clays dating from the Early Atlantic which were laid down during the flooding of the Holland basin.

On top of this clay is an approximately 3-m thick sequence of silty sand alternating with layers of clay containing shells preserved *in situ*, which was clearly visible at the base of both transects (figs. 14.5-6). The sand was encountered almost everywhere in the study area. Its height increases slightly from the southeast to the northwest, although local variations resulted in a microtopography which will be discussed below (fig. 14.7). It can be correlated with the Rijswijk-Zoetermeer sands, a large beach plain representing the first phase of coastal progradation in this region (Van der Valk 1992; Cleveringa 2000; fig. 14.1).

The Rijswijk-Zoetermeer sands are covered by a layer of silty clay with a thickness of approximately 1.5 m. This clay was clearly deposited in a back-barrier environment, protected from direct wave influence. Shells found in this deposit point to a saline to brackish environment, while diatoms indisputably indicate brackish conditions (chapters 15 and 16). It must therefore be regarded as an estuarine deposit, equivalent to Unit 40 at the site (chapter 2). The clay is in some parts intercalated with layers of sand (150-210 μm) of varying thickness, one of which represents the dune bearing the Schipluiden-Harnaschpolder site (fig. 14.5). Thin intercalated layers of clay at its base point to aquatic deposition (Unit 26), though the upper part is clearly aeolian (Unit 25), with a soil in the top. Van der Valk (1992) and Cleveringa (2000) made similar observations and interpreted the base of these sands as wash-over deposits and the top as dune sands. The presence of wash-over deposits points to a back-barrier environment, shielded from direct influence of the sea.

Clay sedimentation continued after the dune's formation, as could be inferred from the fact that clay was encountered up to -3.8 m NAP (chapter 2). This unit was not easy to identify in borings, mainly because in most areas it lay directly on top of the older clay (Unit 40). It can be correlated with Units 19 and 18 discussed in chapter 2. This clay contained the lowermost archaeological finds. Diatoms in this clay likewise point to estuarine conditions (chapter 15).

The entire sequence is covered by a layer of peat, which has oxidised in most places. This layer can be followed over long distances. It can be correlated with Unit 10 at the site (occupation phase 3) and covers almost the entire study area, except for a small part of the dune bearing the Schipluiden-Harnaschpolder site and two other small dunes to the north and south of the site (fig. 14.7a). The oxidised peat is covered

Figure 14.4 The study area showing the boring points and the excavation (scale 1:10,000).

by a thin layer of clay with a maximum thickness of 20 cm (equated with Unit 2). It represents a short flood event representing the last phase of marine influences in this region for a long period. After the deposition of this clay peat development continued, ultimately resulting in a layer with a maximum depth of 2 metres consisting mainly of reed and sedge peat here and there mixed with wood peat (chapter 18).

The final deposit overlying the peat in this region is clastic and has suffered erosion. Its thickness varies from 30 cm in the southwest to at least 6 m in the north of the study area. This upper unit can be correlated with Unit 0 and shows a sequence of sand alternating with layers of silty clay and reworked peat that becomes finer towards the top, grading into silty clay mixed with layers of sand. The unit was deposited by the Gantel, a tidal inlet that removed a large part of the underlying deposits along its course, including the top of the dune.

14.6 Palaeoenvironmental reconstructions of the surroundings of the Schipluiden-Harnaschpolder site

14.6.1 Method

The palaeolandscape of the microregion has been reconstructed entirely on the basis of the data obtained in the borings in

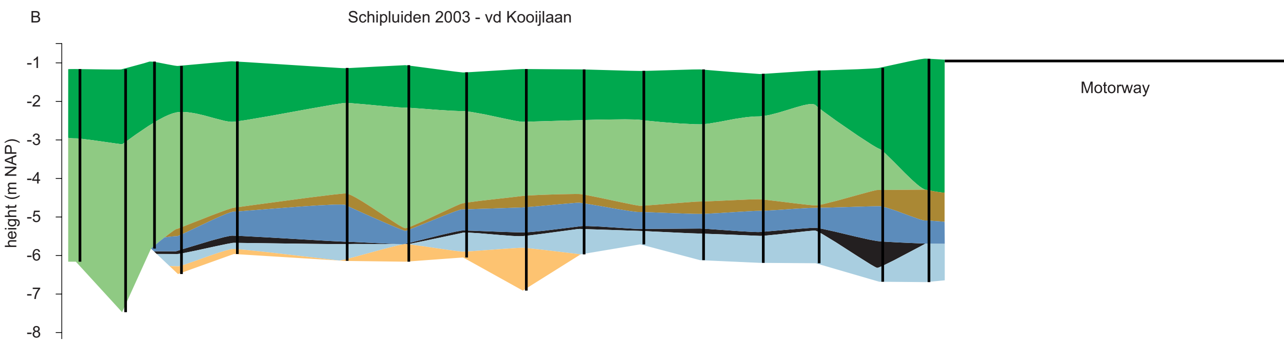


Figure 14.5 Transect B-B’ through the study area. Horizontal scale 1:4000, height exaggerated 20×. See fig. 14.6 for the legend.

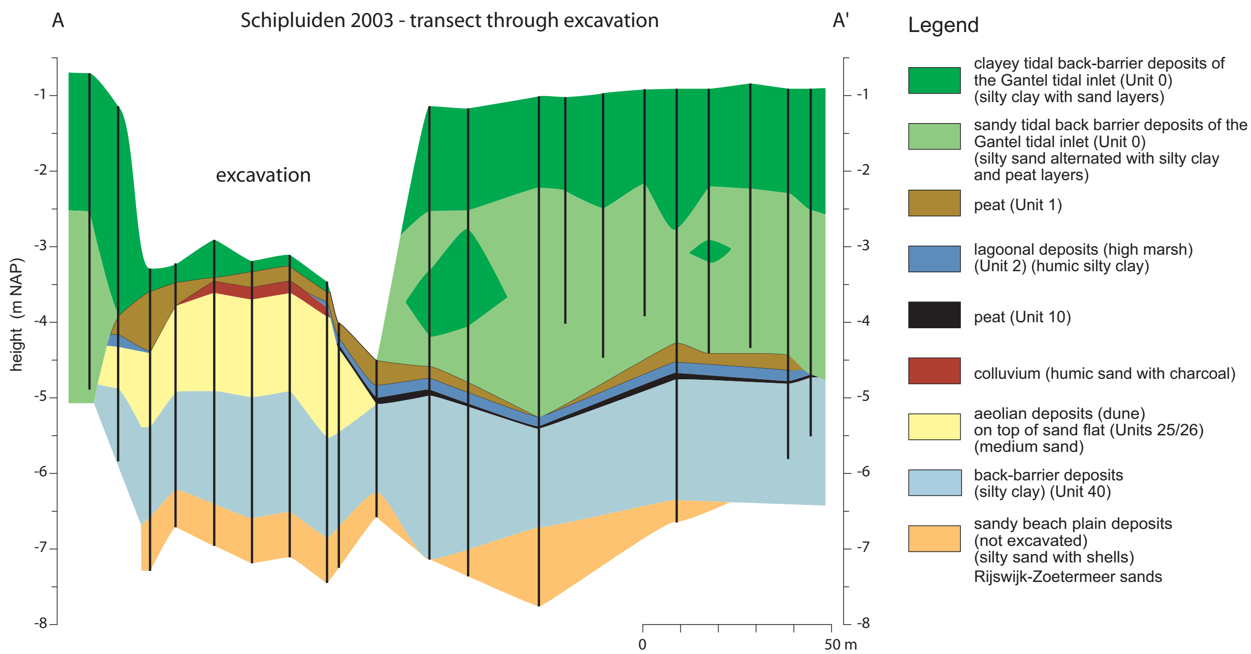
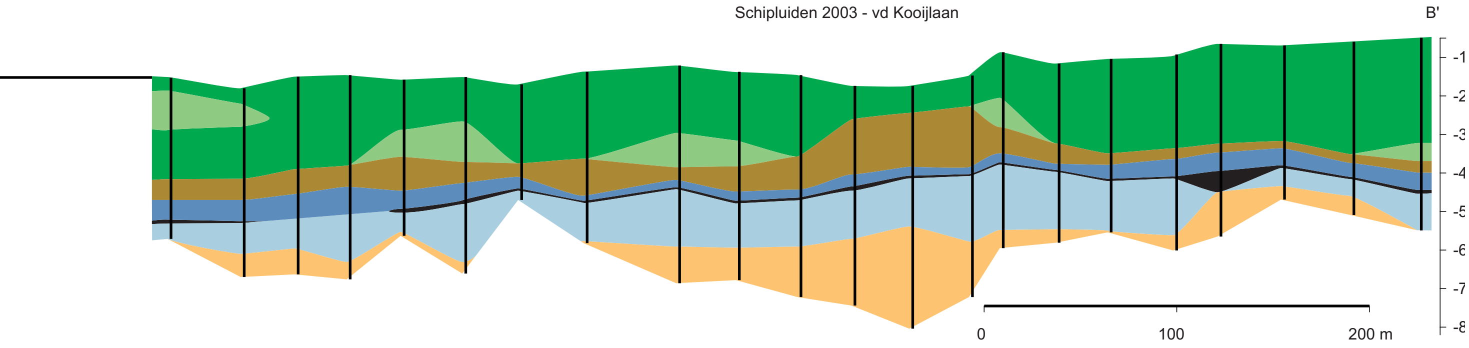


Figure 14.6 Transect A-A’ through the excavated dune. Horizontal scale 1:2000, height exaggerated 20×.

relation to the chronostratigraphic subdivision of the site. A contour map of the clay cover overlying the Rijswijk-Zoetermeer sands was reconstructed with the aid of the Surfer program. The original map was smoothed to obtain a general survey of the variations in height. As a result of this smoothing, the indicated height of the Harnaschpolder dune is lower than the actual height (*cf.* fig. 2.4).

As observed at the Schipluiden-Harnaschpolder site, the clay cover in the site’s surroundings also includes some sandy intercalations and shows substantial variations in height. Although this clay has probably undergone some degree of compaction, its settling appears to have responded not so much to the non-uniform sediment cover (thick layers of sand or peat), but mainly to the variations in height of the underlying Rijswijk-Zoetermeer sands (fig. 14.5). This means that variations in the height of this clay cover are entirely due to different sedimentation levels, and may represent subfacies such as a salt marsh, a tidal flat or a channel.

Whether the sandy elevations represent (marine) beach barriers or dunes is not clear in all parts. Beach barriers consist of slightly clayey (beach) sand (approx. 210 μm) that grades into (aeolian) sand of a similar grain size but without clay. The boundary between the aeolian and the marine deposits is difficult to establish (Van Staalduinen 1979; De Groot 2001). The barriers were observed in the borings only as morphological undulations. Beach-plain deposits may



contain more layers of clay, but it is difficult to distinguish between the two on the basis of data obtained in augering.

The size of the dune during each occupation phase was determined by combining the depth variations of the subsurface with the maximum sedimentation level of the find layers preserved *in situ*, which is -4.5 m in the case of phase 1, -3.8 m in the case of phase 2b and -3.4 m in the case of phase 3 (chapter 2). All morphological elevations above these depths must have been exposed and suitable for occupation during the phases concerned.

It should however be noted that the densities of the data points differ considerably due to the presence of buildings, roads and many cables below the surface. This resulted in unequal coverage of the area. The positions of the borings are therefore indicated in all the reconstructions, to give an impression of the reliability of the reconstruction in each part of the area.

14.6.2 *Occupation phase 1* (fig.14.7a)

The landscape during the first occupation phase is reflected by the contour map of the clay cover overlying the Rijswijk-Zoetermeer sands, though it should be noted that in some places the clay contains sandy intercalations. The oldest archaeological finds came to light at a depth of -4.5 m, which represents the mean sea level and was used as a marker in figure 14.7.

The Schipluiden-Harnaschpolder dune projected well above the mean water level during this phase, but the greater part of the surrounding area did not: clay was deposited there. The clay was not deposited as a horizontal blanket covering all the underlying deposits. Variations in the height of the clay layer can be attributed to differences in sedimentation levels: the deep-lying clay was deposited in tidal channels, whereas higher clay deposits can be seen to represent a tidal flat that was exposed during low tide. The clay that was found above the mean sea level must be regarded as a supratidal deposit representing a salt marsh, though the exact nature of the water (fresh or salt) is not clear.

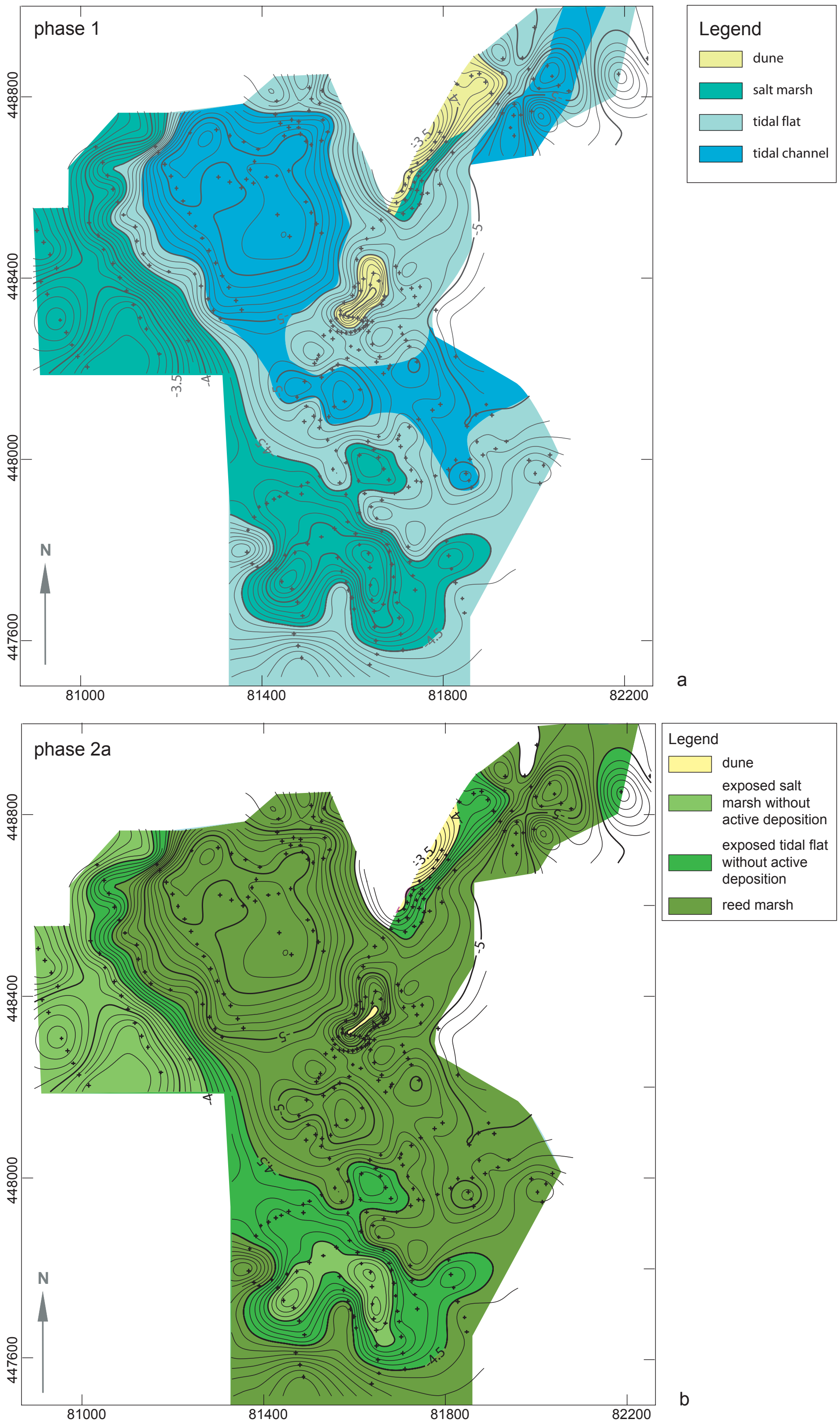
The origins of these clay sediments cannot be inferred from the geological data, but the molluscs and diatoms clearly show that the water was not entirely salt (chapters 15 and 16). The area must be regarded as estuarine, with influx of fresh water resulting in brackish conditions, though with a tidal influence.

Only two other elevations were also exposed: one directly to the north of the Schipluiden-Harnaschpolder dune and another large elevation to the south and west of the site. The northern elevation was obviously the continuation of the dune previously observed by Deunhouwer during the survey of the site (2002). It was half a metre lower than the dune that was chosen for occupation – that may have been a relevant factor in the site's selection – but it nevertheless appears to have held some attraction for the occupants of Schipluiden. Several borings revealed the presence of a colluvium similar to Unit 20 in the excavated area. Sieved samples however yielded nothing besides charcoal dust, making it uncertain whether this dune was occupied at the same time.[4] Oude Rengerink (1996b) likewise found charcoal without any other archaeological evidence on top of two dunes near the Wateringse Veld site. Small-scale excavations revealed only a few archaeological features on one of the dunes and nothing whatsoever on the other one.

The other elevation comprised a large area in the west, where the underlying Rijswijk-Zoetermeer sands lay at a relatively high level. These sands are now completely covered by clay, but lay above the mean sea level during occupation phase 1. This area evidently represents a (brackish) salt marsh on which clay was deposited only during spring tides.

14.6.3 *Occupation phase 2a* (fig. 14.7b)

Occupation phase 2a has no synchronous sedimentation phase. Occupation started during a break in deposition: the deposition of the clay of Unit 19 on the tidal flat and the tidal (salt) marsh had ceased and the growth of peat around the site had


phase 1
Legend
dune
salt marsh
tidal flat
tidal channel
N
448800
448400
448000
447600
81000
81400
81800
82200
a
phase 2a
Legend
dune
exposed salt marsh without active deposition
exposed tidal flat without active deposition
reed marsh
N
448800
448400
448000
447600
81000
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b

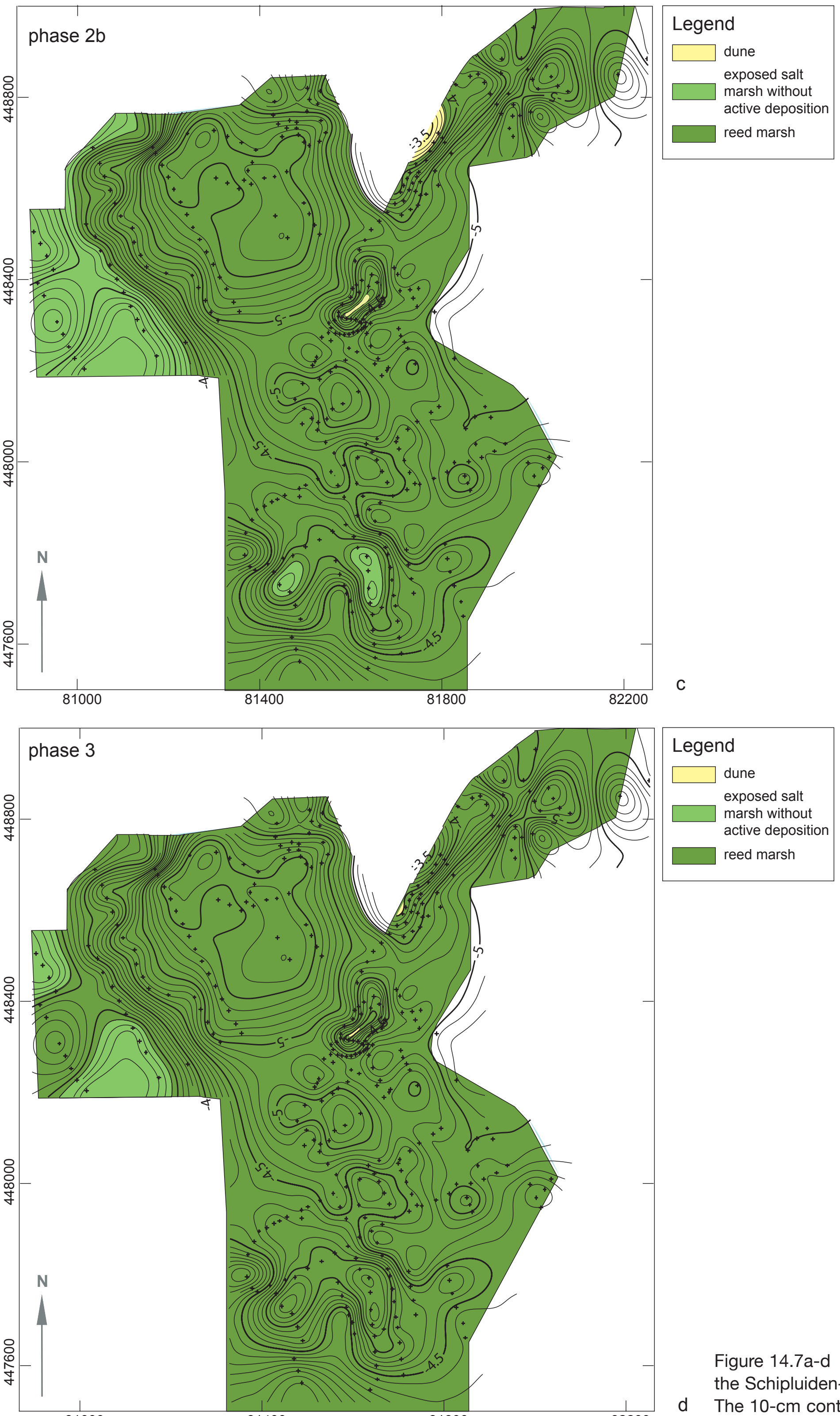

Figure 14.7a-d Reconstruction of the landscape around the Schipluiden-Harnaschpolder site during phases 1-3. The 10-cm contour line map of the top of the clay Units 40-26-19 is used as background.

not yet started. It is difficult to reconstruct the contemporary landscape because this phase cannot be linked to deposits. Figure 14.7b should therefore be regarded as a tentative impression. The higher parts of the top of Unit 19 will have been covered by a pioneer vegetation, while a reed marsh had by this time presumably already developed in the lower parts. The three areas that lay above sea level in phase 1 had by this time decreased in size, but were still prominently present. There was no more active sedimentation; the inactive salt marsh may have been suitable for agricultural activities, but the subaerially exposed tidal flat was probably too wet.

14.6.4 Occupation phase 2b (fig. 14.7c)

The landscape during the last two occupation phases (2b and 3) was quite different from that which preceded it. By the beginning of phase 2b a large reed marsh had expanded from the lowest parts to cover the entire area. The palaeogeography of this phase is fairly easy to reconstruct. The maximum height of the sedimentation level of phase 2b was -3.8 m (chapter 2), which is the level that the groundwater-dependent peat growth will have reached. By this time the entire area had become covered by this peat marsh, with variable depths, and only the tips of two dunes still projected above it. The more swampy parts of the landscape will have been unsuitable for agrarian use.

14.6.5 Occupation phase 3 (fig. 14.7d)

The maximum sedimentation level at the end phase 3 was found to be -3.4 m. Whether or not the dune was occupied throughout the entire period of peat formation is difficult to ascertain as the peat has suffered severe compaction. The archaeological remains however suggest that this was indeed the case (chapter 2).

During phase 3 peat growth continued at a steady pace with the peat reaching a thickness of 1.2 m. It covered the greater part of the dune, leaving an area of around 30 × 100 m exposed. The landscape must be envisaged as a large swamp, in which grew sedges, reed and in places also willow and alder (chapters 18, 19 and 21). Whether the marsh contained open pools or channels affording better access to the site is not clear. Additional information could not be obtained from the geological data due to the severe compaction in combination with oxidisation of the peat.

14.7 Palaeoenvironmental reconstructions of the macro-region

The Schipluiden-Harnaschpolder settlement lay on top of a small, low dune in an extensive beach plain that developed during a period of coastal progradation. On the basis of a series of stratified radiocarbon dates in combination with the exclusive presence of Hazendonk pottery, the dune is assumed to have been occupied from 3630 until 3380 cal BC (chapter 2). By this time, the northeastern part, at least, of the Voorburg-Rijswijk beach barrier had already formed along the coast. This beach ridge, which lay approximately 3 km northwest of the Schipluiden-Harnaschpolder site (fig. 14.8), protected the hinterland from direct influence of the sea. It is not clear whether the barrier extended further to the southwest. The patchy appearance of the barrier in that area may be attributable to later erosion, as observed by De Groot (2001) in the case of the Naaldwijk-Wateringen barrier, or to the presence of an estuary to the south of The Hague (Van der Valk 1996) that prevented further barrier formation in this area, or to a combination of the two. This lack of certainty hinders the reconstruction of the coastline in figure 14.8.

During the formation of this barrier, the complex sedimentation around the Schipluiden-Harnaschpolder site was controlled by this estuary. Clay was deposited in the low-lying parts, while aeolian dunes continued to be blown up on higher parts, such as beach ridges, but also sandflats adjacent to channels. The formation of these dunes can be dated to the period of coastal progradation, up to the development of peat in the entire back-barrier area following the closure of the Voorburg-Rijswijk beach barrier. The dunes were probably formed between *c.* 4000 cal BC – the minimum age of the wash-over deposit at Ypenburg (Cleveringa 2000) – and *c.* 3550 cal BC, by which time clay deposition at Schipluiden-Harnaschpolder had ceased (this study). This is in good agreement with the date of 4670 ± 65 BP (3640-3340 cal BC) obtained for the base of a peat deposit in the nearby Plaspoelpolder (Van der Valk 1996). So dune formation in the entire back-barrier area was probably restricted to a period of around 400 years: from *c.* 4000 cal BC to 3550 cal BC at the latest. Occupation prior to 4000 cal BC is moreover highly unlikely due to the assumed absence of dunes before that date.

All the Neolithic features found in this area came to light on the tops of similar dunes in this beach plain. The sites in question all lay behind the Voorburg-Rijswijk barrier and their environmental conditions must hence have been comparable with those of the Schipluiden site. Figure 14.8 shows the positions and sizes of the dunes in the beach plain on which the sites concerned were found. The positions of the three dunes (with archaeological finds) near Ypenburg were determined in a study by Oude Rengerink (1996a) and were later confirmed by data obtained by Cleveringa (2000). The exact size of the dune of site Rijswijk-A4 is not clear; the dune is schematically represented in the map.

It should be borne in mind that the dunes indicated on this map probably represent only a small proportion of the original number in this area. The geological study of the surroundings of the Harnaschpolder site revealed three dunes occupying approximately 12% of the investigated area. These

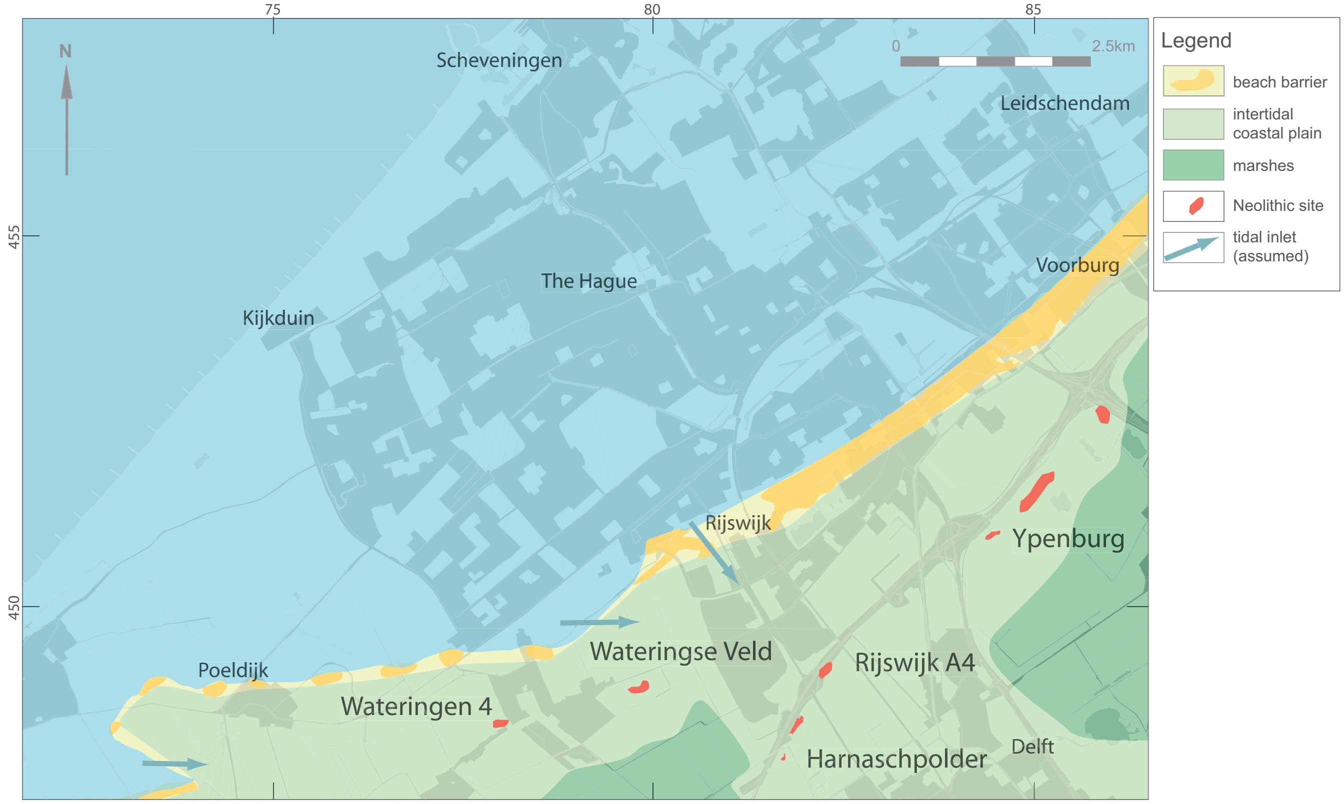

Figure 14.8 Palaeogeography of Delfland, *c.* 3600 cal BC showing contemporary Neolithic sites (scale 1:100,000).

results suggest that there are many more similar dunes concealed beneath several metres of younger deposits in this back-barrier area. They may have been exploited as sources of wood or used for the cultivation of crops. Some may indeed have borne other settlements.

Figure 14.8 represents the landscape during the first occupation phase of Schipluiden-Harnaschpolder, during which this area was still under estuarine influence. The Rijswijk-Voorburg barrier is assumed to represent the coastline at this time, although the coast prograded further west during the later occupation phases. The exact position of the coastline during each occupation phase is not known and difficult to ascertain, especially since Cleveringa (2000) estimated that the rate of progradation near Wassenaar was 800 m per 100 radiocarbon years! The estuary gradually became inactive and the ingression of seawater came to an end. The tidal basin became overgrown with reed and sedges, except for the higher parts, *i.e.* the small dunes, which were probably wooded (chapter 21). Schipluiden-Harnaschpolder remained occupied throughout this development, even though the outcrop became very small during the final occupation phase, with dimensions decreasing to 30 × 100 m (section 2.4).

14.8 Conclusions

The study has shown that the Schipluiden-Harnaschpolder site lay several kilometres behind the coastline in the period of Neolithic occupation. By the time of the arrival of the first settlers, the Voorburg-Rijswijk beach barrier had already been formed, and behind this barrier a wide beach plain had been cut off from the open sea. Small beach ridges, some supporting dunes, had formed in this plain during the earlier period of coastal progradation, and more developed in the later estuarine environment. During the first occupation phase salt water could still enter the back-barrier area via an estuary in the south, resulting in clay deposition in low-lying places. The higher parts of this beach plain were all suitable for occupation. All the sites of known Neolithic settlements experienced similar formation processes and were situated in the same natural system.

It should however be borne in mind that we have only limited detailed information on the subsurface. The patchy nature of the geological data may very well obscure other dunes and associated archaeological sites in this area. After all, all the sites that have so far been discovered came to light only as a result of large infrastructure projects. The spatial information obtained in this study suggests that around 12% of the back-barrier area consists of buried dunes.

notes

1 The majority of the geological papers refer to non-calibrated radiocarbon dates. In this study all dates have been calibrated with the aid of the OxCal program (Bronk Ramsey 2001).

2 A new stratigraphic subdivision of the Dutch Quaternary deposits has recently been developed. In particular, the Holocene marine deposits have been placed in a new formation (the Naaldwijk Formation), in which the Calais Member has been renamed the Wormer Member and the Dunkirk Member the Walcheren Member. (http://dinoloket.nitg.tno.nl/dinolks/SilverStream/Pages/LksNomShMainFS.html).

3 A beach plain can be regarded as an intertidal-supratidal flat behind a beach ridge where sediments are deposited during spring floods and storms. Beach-plain deposits consist of sand-mud intercalations. Marsh deposits (root-bearing sand-mud laminations) are the lateral equivalents of beach-plain deposits (Cleveringa 2000).

4 In October/November 2004 a small-scale excavation yielded pottery, indicating that this site was also occupied during the Neolithic.

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