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SCHIPLUIDEN

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

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The Holocene stratigraphic sequence around the site was determined by the rise in sea level. This sequence is the key to assessing the dates and duration of the occupation period. On the basis of the stratigraphy, the settlement history can be subdivided into four phases. This subdivision gave us an opportunity to identify any changes that may have taken place in the life of this local group of people.

The absolute dates of the settlement were established by means of radiocarbon dates relating to the stratigraphy. Regrettably, wiggles in the calibration curve hampered the analysis. Nevertheless, the outcome is consistent with external geological, ecological and archaeological evidence.

2.1 Introduction

The Middle Neolithic site Schipluiden lies on top of a small dune (approx. 0.5 ha) oriented NE-SW. It was formed in the dynamic environment of a large estuary. Clay sedimentation and peat formation continued around the dune during the period of prehistoric occupation, which resulted in a succession of sediments in which archaeological remains were embedded in primary positions (figs. 2.1 and 2.2).

The stratigraphy was studied and recorded during the excavation by means of a series of parallel sections, spaced 6 m apart at right angles to the dune axis, created by the first series of excavation trenches. The layout of the trenches at

Figure 2.1 North section of trench 20 showing the deposits covering the southeastern slope of the dune.

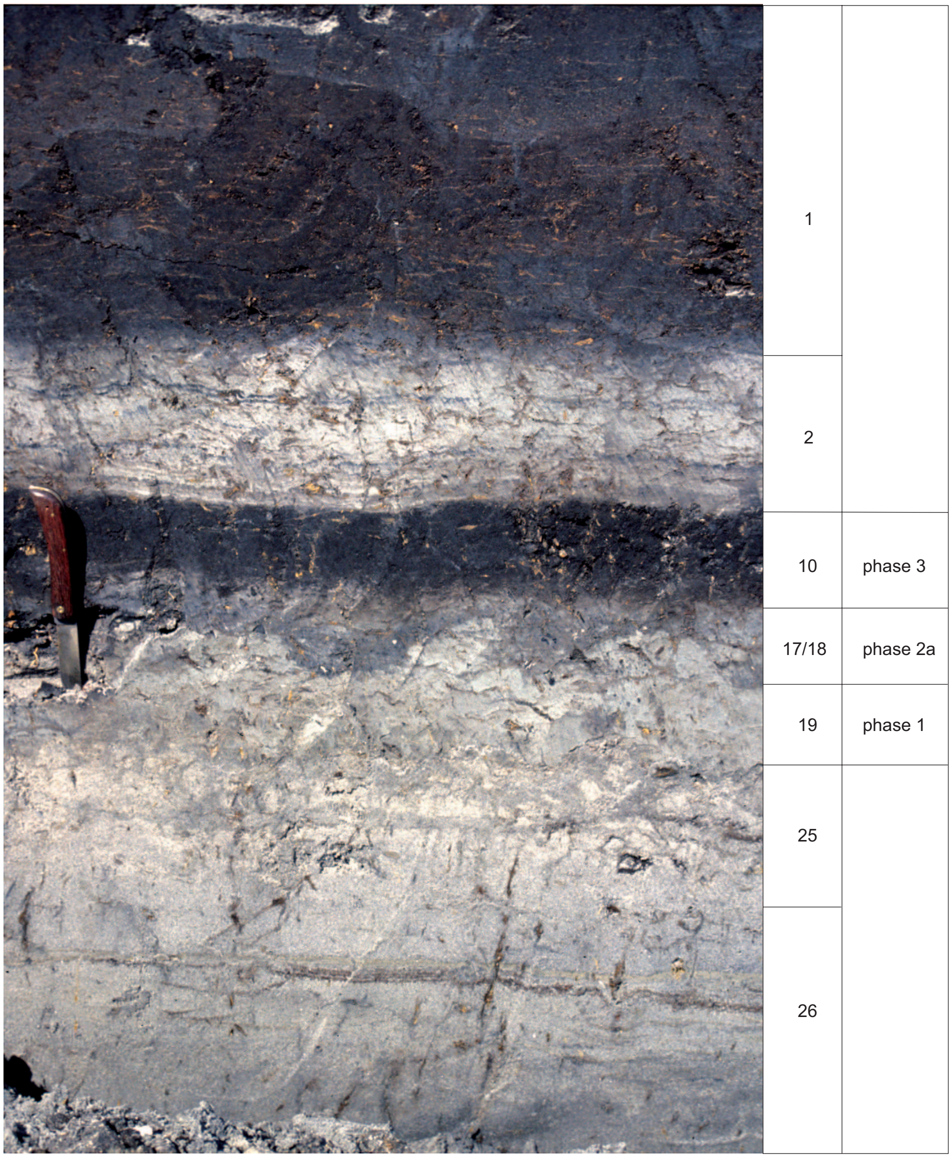


Figure 2.2 Detail of the section shown in figure 2.1 beyond the limit of the colluvium of Units 15/16.

the SW and NE ends was adjusted to create sections more or less at right angles to the contour lines of the dune there, too.

A series of lithostratigraphical units was distinguished, each with its specific sedimentary characteristics and stratigraphical position. Initially, the deposits of the four dune sides were coded in separate series. After the stratigraphical sequence on each side had been distinguished, the units were correlated on the basis of their absolute heights and stratigraphical positions.[1] The stratigraphy basically appeared to be uniform around the dune, but in some periods the dynamics of the depositional environment caused dissimilarities in deposition between the different sides of the dune (figs. 2.3 and 2.4). This was especially the case during the period of occupation.

Remains from the overall period of occupation were embedded as a mixed assemblage in the 'occupation layer' and in colluvial deposits on the top of the dune and on its slopes. The majority of the archaeological finds were however found embedded in a primary position in the aquatic deposits on the northwestern slope and especially on the long southeastern side. On the basis of this natural stratigraphy three phases were distinguished in the overall period of the site's occupation. This phasing could however not be applied to the majority of the finds recovered outside this stratigraphy, nor to the majority of the features observed in the dune sand.

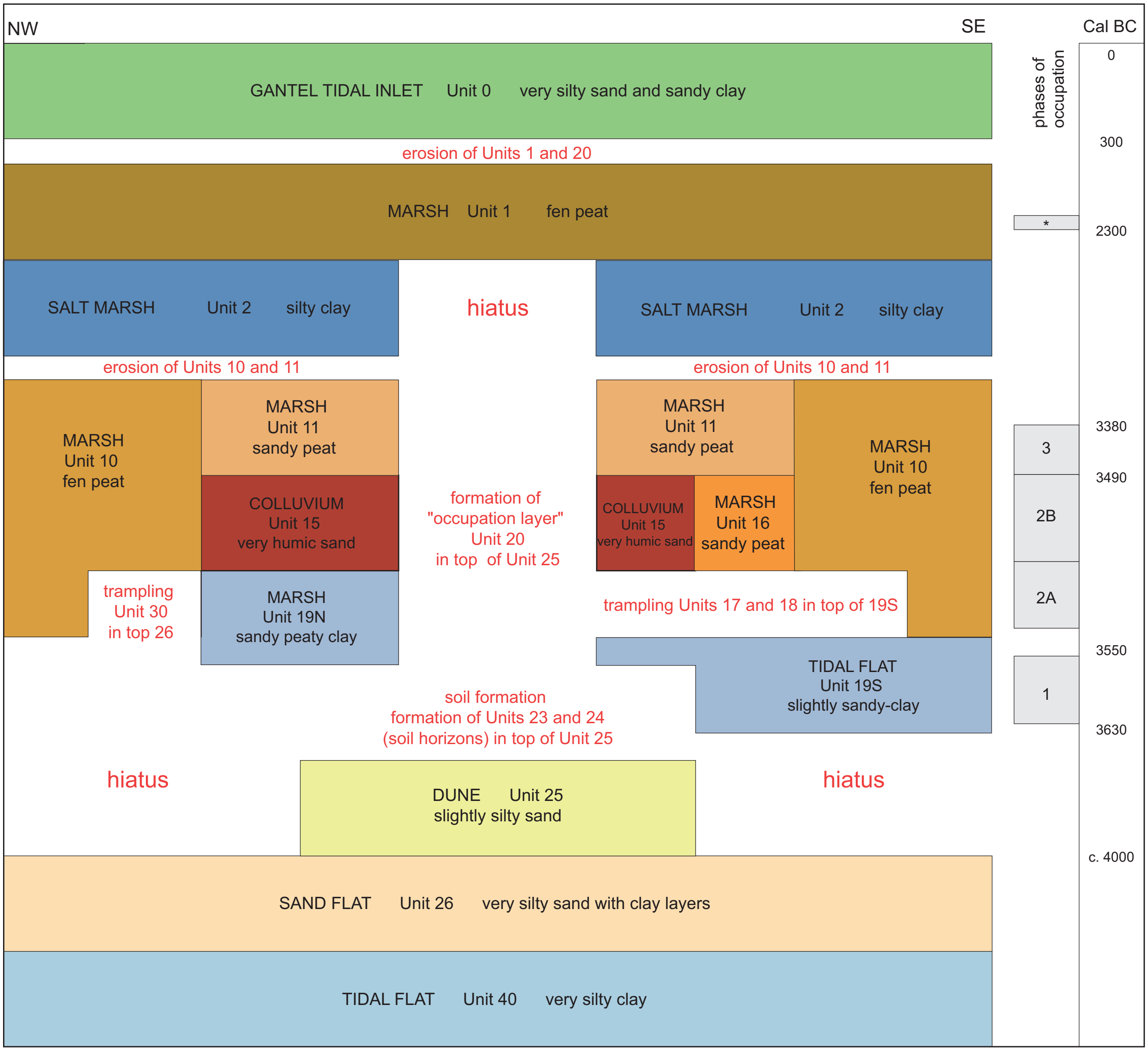


Figure 2.3 Schipluiden-Harnaschpolder. Chronostratigraphical diagram of the lithological units. Units at the same height in the diagram were deposited synchronously. The thickness of the blocks refers to the period in which the unit was deposited and provides no indication of the sedimentation rate or the actual thickness of the deposits.

2.2 STRATIGRAPHY[2]

The identified stratigraphical units are listed in table 2.1 and shown in a series of sections in figure 2.4. The depositional sequence can be divided into three main stages:

Stage A: deposition prior to the period of occupation
Stage B: deposition during occupation
Stage C: deposition after the period of occupation

2.2.1 *Stage A: deposition prior to the period of occupation* (fig. 2.7a)

Stage A comprises the basal part of the sequence, Units 40, 26 and 25 (table 2.1). The entire sequence shows a gradual change from a wet to a dry environment. The units were deposited before the actual period of occupation and evidently afforded an attractive environment for Neolithic settlement and exploitation.

Unit	texture	maximum thickness (m)	synchronous with	material from occupation phase*	interpretation
0	alternation of thin very silty sand and sandy clay layers	4	–	–	tidal inlet
1	fen peat	0.15	–	4	marsh
2	silty clay with peat fragments	0.4	–	–	tidal flat
10	fen peat	0.1	11	3	marsh
11	sandy peat	0.1	10	3	marsh with colluvium input
20	very humic sand with charcoal	0.15	15 and 16	1, 2	'occupation layer' and colluvium
15	very humic sand with charcoal	0.15	16 and 20	2b (1, 2a)	colluvium
16	sandy peat with charcoal	0.15	15 and 20	2b (1, 2a)	colluvium
17	very humic silty clay	0.1	18	2a	trampling horizon
18	sandy clay, ripened	0.1	17	2a	trampling horizon
19S	silty clay with some shells	0.5	19N and 30	1	tidal flat
19N	very humic silty clay	0.1	19S and 30	1, 2	local marsh conditions
30	well-sorted clayey sand (105-150 μm)	0.1	19N and 19S	1, 2	trampling horizon in 26
23	well-sorted, slightly silty sand (105-150 μm)	0.3	–	–	eluviation horizon of soil in 25
24	well-sorted, slightly silty sand (105-150 μm)	0.2	–	–	humus illuviation horizon of soil in 25
25	well-sorted, slightly silty sand (105-150 μm)	1.5	–	–	dune
26	well-sorted very silty sand (105-150 μm) with thin silty clay layers	1.1	–	–	tidal sand flat
40	silty clay, with a soft consistency and in situ shells	> 0.4	–	–	tidal flat

* phases in brackets: material in secondary position

Table 2.1 Lithostratigraphical units of the Schipluiden site and its immediate surroundings in chronological order (youngest at the top). Several units were simultaneously deposited in different places; this is indicated in the fourth column.

Unit 40 consists of soft silty clay mixed with shells from marine and brackish environments (chapter 14). It is completely covered by Unit 26, consisting of silty sand containing thin layers of clay. Deposition of Unit 26 reached a maximum level of -4.5 m on the NW side and a slightly higher level beneath the later dune. On the SE side the top of this unit will have been eroded.

This unit is partly overlain by Unit 25, a 1.5-m-high sand rise in the middle part of the section, to be interpreted as a low dune. It represents the subsoil of the settlement. A podzolic soil developed in its top, containing a clear eluviation horizon (Subunit 23) and a humus illuviation horizon (Subunit 24, fig. 2.5). The A_1 and A_2 horizons suffered a good deal of erosion due to colluviation and the formation of the 'occupation layer'. The profile was however preserved at the western end of the dune. Unit 40 was found to contain shells of tidal species preserved *in situ*. The molluscs were evidently buried too rapidly to be able to escape. Their presence points to a brackish to salt tidal environment (chapter 16). This means that this poorly ripened clay was deposited in a back-barrier environment and represents a 'lower tidal flat' that was exposed to the atmosphere for short periods only.

The occurrence of layers of clay in Unit 26 and its diatom flora point to aquatic deposition under (tidal) conditions similar to those under which the underlying unit was laid down (chapter 14). This means that Unit 26 must also have been deposited in a back-barrier environment, and is to be regarded as a sand flat in a beach plain (chapter 14).

Unit 25 on top of this sand flat has no indications of running water: it contains no layers of clay or any shells and the podzolic soil (Subunits 23, 24) in the top part of this unit shows no gley features. Since these (sub)units developed during a continuously rising sea level it is highly unlikely that this unit is water-lain; such a deposit would never have lain at the surface for the length of time required for the formation of a podzolic soil. The unit most likely represents a low dune, blown on top of the sand flat. Such a sedimentary unit lay well above the water level and allowed sufficient time for soil development. It is this dune that apparently attracted the Neolithic people.

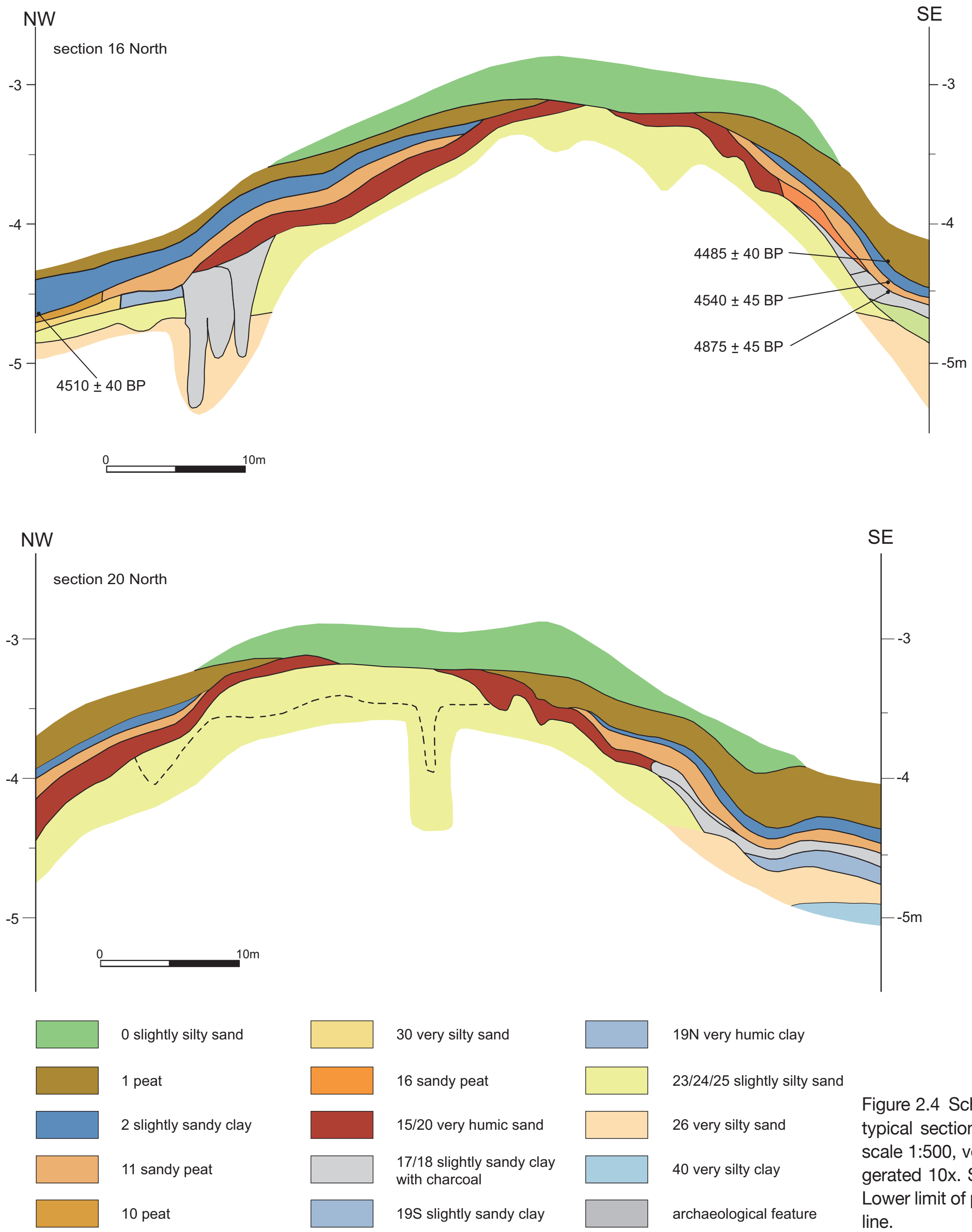


Figure 2.4 Schipluiden-Harnaschpolder. Two typical sections through the site. Horizontal scale 1:500, vertical scale 1:50, height exaggerated 10x. Smoothed after field drawings. Lower limit of podzol indicated with a dashed line.

2.2.2 *Stage B: deposition during occupation*

The main focus of this research was the part of the sedimentary sequence that formed during the period of human occupation (stage B). It is represented by Units 30 to 10 (in stratigraphical order; see table 2.1), which gradually covered the older layers. The environment during this stage showed the widest variety of facies and land-scape changes. During this period the landscape changed from an open, tide-dominated area to a closed, densely overgrown reed marsh, with a progressively declining estuarine influence (chapter 14). The top of Unit 26 will consequently not have been flooded on a regular basis. This condition – together with the

Figure 2.5 Podzolic soil in the north section of trench 10 showing B_h and A_2. The turf horizon and part of A_2 were transformed into occupation layer Unit 20.

presence of the low dune – will have made the site and its surroundings suitable for occupation.

Occupation phase 1 (fig. 2.7b)
The beginning of the sedimentary sequence is complicated as a result of facies variations on the different sides of the dune. The topography and the dynamics of the environment were apparently such that the sedimentary conditions differed on a micro-scale, resulting in three Units that were formed synchronously (19S, 19E and 19N).

Clay sedimentation started in the lowest parts and was concentrated on the southeastern side of the dune, preceded by some erosion of Unit 26 in those parts. There, 0.5 m of clay (Unit 19S) was deposited. It contained the lowermost stratified artefacts found, but only in its basal part, its top 25 cm being archaeologically sterile. These remains represent the first occupation phase (phase 1). This clay was deposited in a tidal environment similar to that in which Unit 40 was laid down. Its clay was slightly more consistent than that of Unit 40, and must therefore have been exposed to the atmosphere more frequently. It was probably deposited in a morphologically slightly higher position than Unit 40, and can be regarded as a 'higher tidal flat' that was frequently exposed during low tide. The archaeological finds recovered from its basal part were deposited during its active stage, while clay sedimentation still occurred.

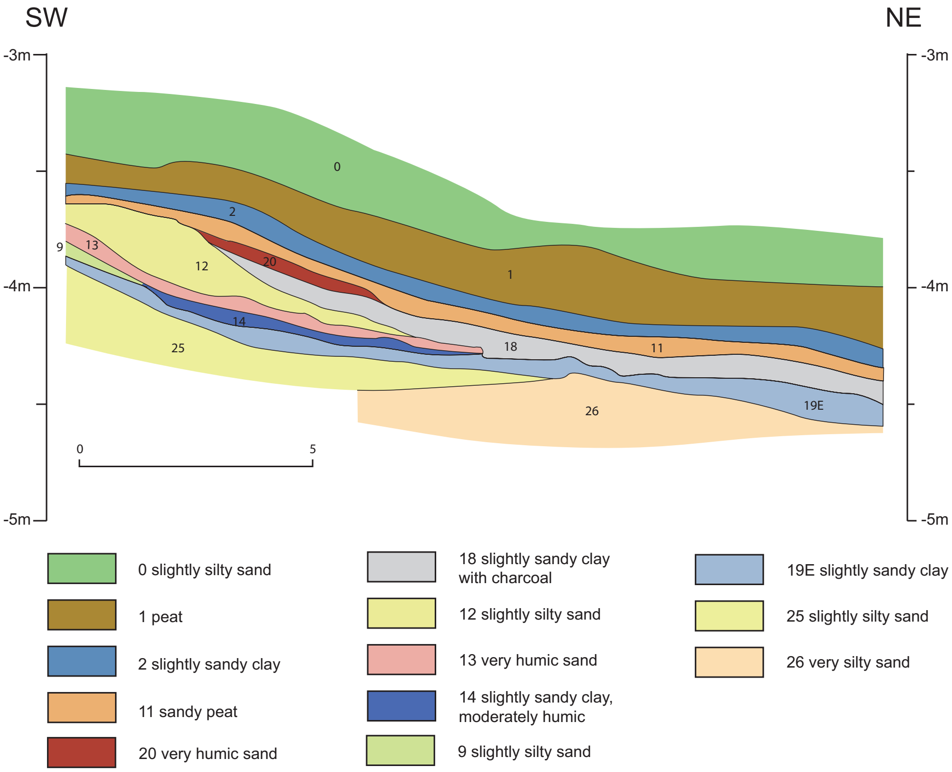
A maximum sedimentation level of approx. -4.0 m. on the southern dune slope was reached at the end of the formation of 19S. During the next occupation phase, this top part became Unit 18 as a result of the subsequent human activities.

Deposition of this clay was discontinuous in terms of both space and time. At the northeastern end of the dune the clay is here and there interrupted by layers of well-sorted sand (Units 13 and 14) representing a phase in which some aeolian deposition took place on top of the tidal flat (Unit 19E; fig. 2.6), after which clay deposition continued (Unit 18).

On the northwestern side different conditions prevailed in the time span between the formation of Units 26 and 10/11. In a restricted zone next to the dune some 10 cm of very humic clay was deposited (Unit 19N). The maximum level of sedimentation of this deposit was difficult to establish in the sections due to the many wells in this area, which disturbed the stratigraphy. Its regular occurrence up to a level of -4.2 m was however recorded in the matrix variable of the find registration and in the sections over the water pits. This implies a close parallel to the end of Unit 19 on the southeastern slope. There is a similar parallel in the stratigraphic relation to the oldest fence (section 3.8.2).

The special local conditions that led to the formation of this humic deposit may have been caused by groundwater seeping from the dune body, but the digging of the unlined

Figure 2.6 North section of trench 24 on the NE side of the dune showing a very confined dune deposit (Unit 12), which was formed during sedimentation of Unit 19.



wells or water pits (section 3.4.2) and the resulting heaps of sand may also have played a part.

It is more than likely that Unit 19N is separated from the underlying Unit 26 and the covering Units 15/16 and 10/11 by hiatuses, but their time spans are difficult to make out.

The underlying sand flat outside deposit 19N meanwhile remained subaerially exposed and was trampled on in this period, leading to the creation of Subunit 30.

It is quite plausible, finally, but difficult to ascertain, that the formation of the 'occupation layer' in the top of the dune sand started as early as this phase at the settlement site.

Occupation phase 2 (figs. 2.7c, d).
The top 5-10 cm of Unit 19S differed considerably from the underlying part and was classified as Unit 18. Its colour was (very) dark grey, its lower boundary irregular and its structure heterogeneous. It graded further uphill into a very

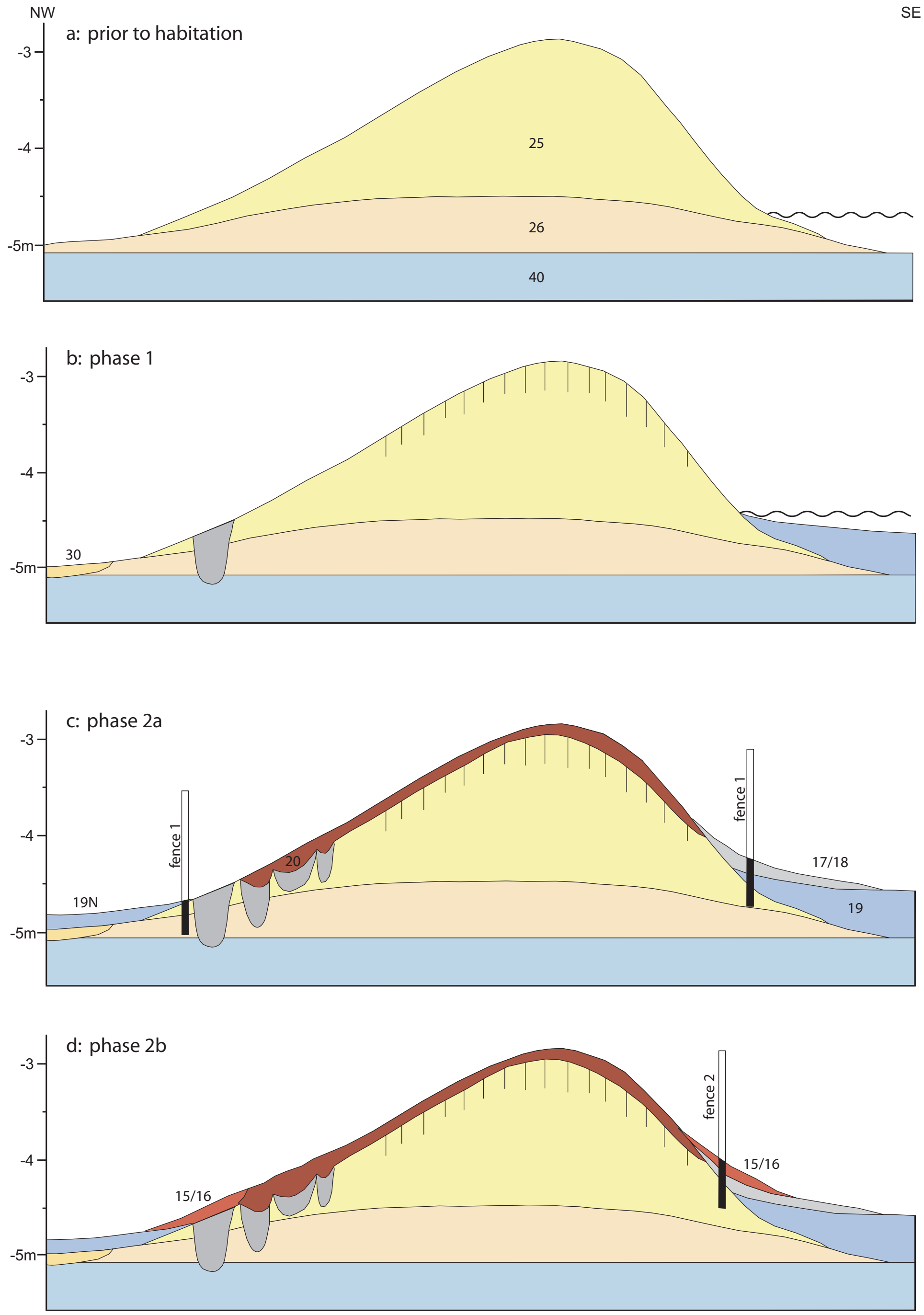

NW
SE
a: prior to habitation
-3
-4
-5m
25
26
40
b: phase 1
-3
-4
-5m
30
c: phase 2a
-3
-4
-5m
fence 1
fence 1
20
17/18
19N
19
d: phase 2b
-3
-4
-5m
fence 2
15/16
15/16

Figure 2.7

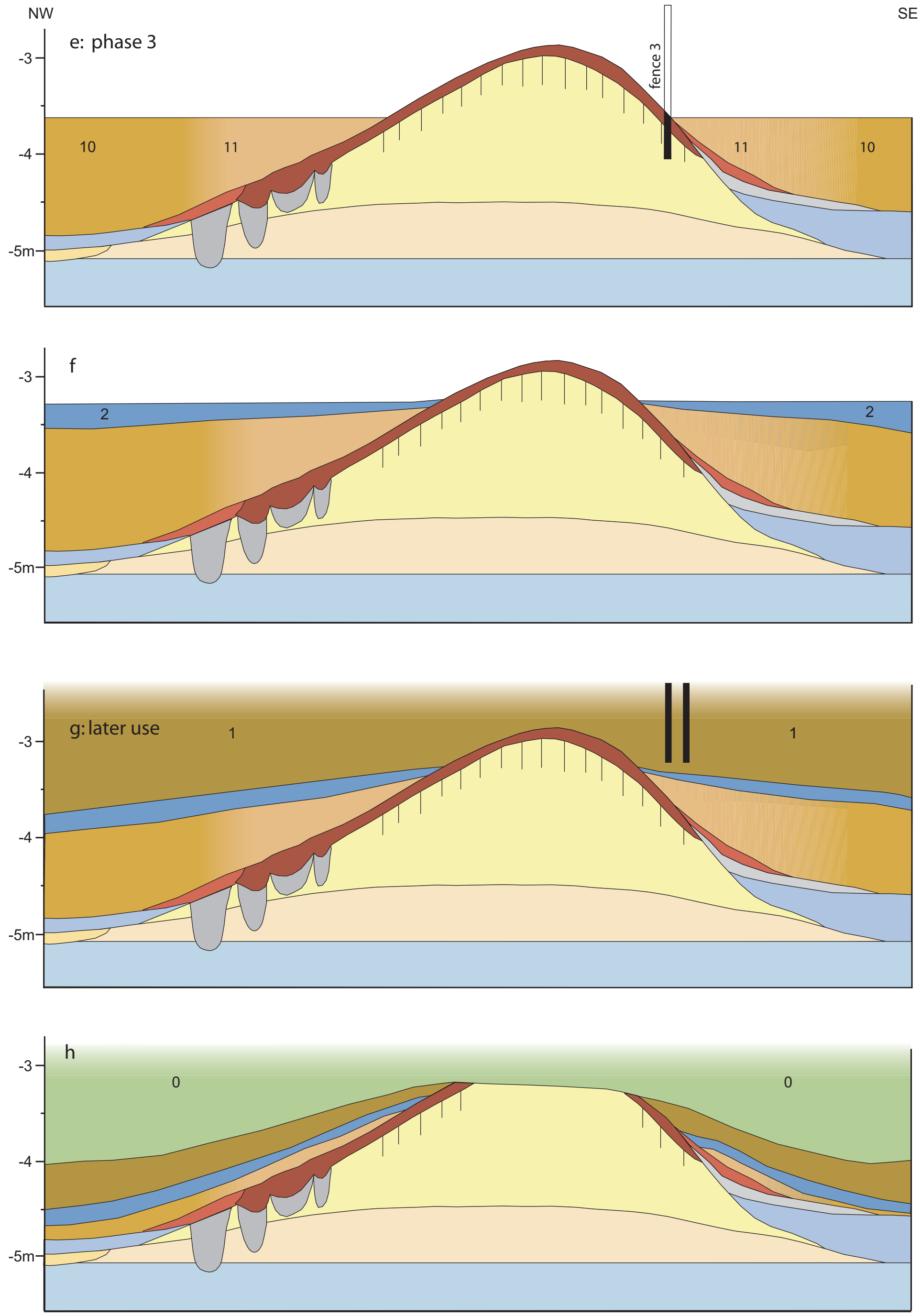


Figure 2.7 Schipluiden-Harnaschpolder, schematic representation of landscape development before, during and after the period of occupation. Only the newly formed units have been numbered. Soil formation indicated by shading.

humic clay, which was classified as Unit 17 (fig. 2.7c). Unit 18 was apparently exposed subaerially for a prolonged period, resulting in ripening and the possibility of people walking on it and trampling its top. So it is essentially part of 19S in a sedimentological respect and was only separately classified because of the later anthropogenic transformation. This means that the archaeological finds are all younger than the actual period of clay deposition. These finds, representing the onset of occupation phase 2 (phase 2a), were separated from those of phase 1 by approx. 25 cm of sterile clay (19S).

This distinction of two individual occupation phases separated by a (short) hiatus was observable in Units 19 and 18 all along the southeastern edge of the site. We consider a short-term interruption in occupation the most plausible explanation for this widespread hiatus in archaeological deposition.

Deposition of clay continued in the northeast, too, resulting in a clay cover on top of the very confined aeolian deposit (Unit 12) up to a height of -3.8 m. The top of this clay layer was also trampled, and was classified as Unit 18. A 4-6 m-wide and approx. 35-m-long zone with evidence of deeper and more intensive trampling extended all along this edge of the dune.

It should be emphasized that the northwestern side of the dune experienced limited or no deposition during occupation phase 1 and the onset of phase 2(a), as this has consequences for the phasing of the artefacts found in layers 19N and 30. Remains contained in these units may date from either occupation phase 1 or phase 2, having ended up in their present position due to trampling of these thin (10 cm!) units after their formation.

After the deposition of the clay (19 and 18) around the dune, the land became fully covered by vegetation. Peat formation started in the lower parts of the landscape away from the dune and made the dune an isolated elevation within a large marsh dominated by reed. The top of the dune sand and the podzolic soil were transformed into an 'occupation layer' (Unit 20) – a very dark and very humic unit containing artefacts – as a result of trampling in the settlement in combination with colluviation on the dune slopes (fig. 2.7d). This colluvial deposit extended several metres as Unit 15 into the surrounding aquatic deposits, where it was intercalated between the top of the preceding clays (Units 17, 18 and 19N) and the peat cover (Units 10 and 11). Part of Unit 15 was peaty and in that case classified as Unit 16.

The humic appearance and dark colour of Units 15 and 20 are only partly due to the presence of plant remains. These units also contain considerable quantities of charcoal dust, as was observed in the samples taken for the study of botanical macro-remains and arthropod identifications. Their formation will have been the result of the removal of the vegetation from the dune surface combined with trampling, wind erosion and slope wash, affecting the distribution and preservation of the archaeological remains.

The archaeological remains recovered from the colluvium (Units 15 and 16) primarily represent the continuation of occupation phase 2 (phase 2b), possibly contaminated with secondarily deposited older remains deriving from the dune surface. The remains from Unit 20 consequently represent both phases 1 and 2, and – in its central part – phase 3, too.

Occupation phase 3 (figs. 2.7e)
After this colluviation phase, peat growth continued. The slopes of the dune gradually became covered by sandy peat containing artefacts (Unit 11) and peat without sand and fewer artefacts further away from the dune (Unit 10). In view of their dimensions and their occurrence in a peaty matrix, it may be assumed that the larger finds contained in this deposit were in a primary position and as such represent a separate (last) occupation phase 3. All archaeological remains (pottery, flint, bones) selected for analysis on the basis of minimum dimensions are considered to have been in a primary position.

The sand contained in Unit 11 is probably attributable to a combination of aeolian action and colluviation, triggered by the human disturbance of the vegetation on top of that (small) part of the dune top that was not yet completely covered. The wider landscape around the dune during this last phase of the human occupation was characterised by peat growth only.

It was not easy to establish the boundaries between the various more or less sandy peat deposits in the field and during the excavation work. This holds especially for Units 15/16 and 20, which gradually merge laterally and could be distinguished only on the basis of the absence/presence of clay 18 in the section. This had some consequences for distinguishing archaeological remains from phases 2(b) and 3 where Unit 11 was involved (see also below).[3]

2.2.3 *Stage C: sedimentation after the period of occupation* (figs. 2.7f-h)

The sequence is completed by three deposits (Units 2, 1 and 0 respectively), which concealed and preserved the archaeological site (stage C).

The dune was abandoned some time before the surrounding peat became flooded and a thin layer of clay (Unit 2) was deposited at a level of approx. -3.50 m, as indicated by the uncompacted maximum sedimentation level on the slopes of the dune, 50 cm below its tip (fig. 2.7f). No finds were recovered from this clay. Its deposition was preceded by an erosion phase, which is clearly visible in the southeast, where reworked peat from the underlying deposits is contained in the clay. The clay probably developed in a marshy environment, possibly a salt marsh. In the absence of shells, the pollen and diatom data in this case yield conclusive the salinity of the environment (chapters 15, 18).

After the deposition of this clay, a reed swamp developed, resulting in a layer of peat (Unit 1) dominated by reed remains. This peat concealed the dune by overgrowing it completely; it must ultimately have covered it by several metres.

The peat of Unit 1 covered not only the clay of Unit 2, but also the sandy peat of Unit 11, where it extended beyond the clay, and the occupation layer 20 on the dune's top.

Distinguishing Units 11 (phase 3) and 1 above the -3.5 m contour line was sometimes very difficult. In the first place, it should be borne in mind that the two peat layers merged into a single thin seam in this zone. In some sections and trenches a peat unit – containing artefacts and therefore classified as 'Unit 11' – was recorded all over the dune, except in the eroded zone at the top. Such a peat cover does however not seem to be in agreement with the fact that the dune was occupied. In view of the water levels it is moreover incomprehensible that Unit 11 should have been formed much higher than the clay of Unit 2 that was deposited during subsequent inundation. Most probably there was some confusion in the field – in the interpretation of the sections as well as the collection of finds – concerning a transitional horizon between Unit 20 and the peat cover Unit 1 (see below), which will have looked very similar. It was decided to regard -3.4 m as the upper limit of Unit 11 and to consider all (sandy) peat deposits containing archaeological finds above this level as belonging to the peaty top of Unit 20.

It should be noted that the upper part of Unit 20 will have been influenced by rooting and other forms of bioturbation, especially in the stage of the first peat overgrowth, and that a transitional horizon will have formed that will easily have been misinterpreted as an extension of Unit 11.

A concentration of wooden posts was found embedded in the preserved base of Unit 1 in one trench (22) on the eastern side of the dune, implying that activities took place at the site in the final phase of the Neolithic, long after the dune had completely disappeared (fig. 2.7g; section 3.8.7). The position of the dune in the subsoil may however have been visible in the vegetation.

The Gantel system (fig. 2.7h)
The greater part of the peat of Unit 1 was eroded at a relatively early stage and replaced by the thick clastic Unit 0. The highest parts of the dune, including the occupation layer 20 at the top, were also eroded, resulting in an erosion base at -3.2 m (figs. 2.8-9). Unit 0 consisted of horizontally bedded sand and clay intercalations with dense concentrations of molluscs that extended all the way up to the present surface. It was up to 4 m thick in this part, as recorded in borings in the immediate surroundings of the excavation trench. The greater part of this deposit was removed by machines in the preparation of the excavation site, but its base could be studied in the trench sections. Unit 0 is clearly an aquatic sediment deposited by either fresh or saline water. Molluscs and diatoms in this case point to a saline to brackish environment with occasional fresh influxes (chapters 15 and 16). The deposit is to be associated with the former river Gantel, a large tidal system that brought in salt water from the Meuse estuary near Naaldwijk and drained the region in early historic times (chapter 14, Van Staalduinen 1979).

The deposits of the Gantel system in this area have been dated pre-Roman on the basis of Roman settlement remains found overlying them in the western part of the excavated area. External dating evidence points to an Iron Age date (Van Staalduinen 1979). At the base of the sediments enigmatic N-S oriented parallel linear features were observed in the excavated layers on top of the dune (fig. 2.10). They were up to 10 m long and up to 20 cm wide and clearly visible in the dark soil of the partially eroded Unit 20. The features must be regarded as subaquatic, in view of the facies of Unit 0, and seem to have been created by fairly firm, heavy objects scratching the floor of the (tidal) gulley, presumably at low tide water levels. The objects in question may have been ships, trawl nets or tree trunks. The sharp outlines, straightness and parallel orientation are more indicative of an anthropogenic than a natural cause. Heavy ships and massive trawl nets are however not what one would expect in the Iron Age.

2.3 Absolute chronology

2.3.1 Restrictions

A series of radiocarbon samples was used to estimate the duration of the period of occupation. The radiocarbon samples were obtained from stratigraphically indisputable units and miscellaneous materials. A major problem, however, are several pronounced wiggles in the calibration curve coinciding with the period of occupation (fig. 2.11). Between 5000 BP and 4500 BP the curve shows a series of peaks and associated troughs, which are reflected in the calibrated radiocarbon dates. The related dating problems were partly solved by the additional stratigraphical information.

A second problem concerns the samples of human bone and crusts of charred food on pottery, which were both affected by a reservoir effect.

2.3.2 The radiocarbon dates

All radiocarbon dates obtained during the project, including those from the prospection phase, are given in table 2.2. The dates were calibrated using the OxCal program, version 3.9 (Bronk Ramsey 2001, fig. 2.11, updated with the latest dataset *IntCal04* (Reimer *et al.* 2004).

Figure 2.8 South section of trench 18 showing the erosion of the top of the dune by the Gantel system (Unit 0).

Figure. 2.9 Detail of the section of figure 2.8 showing an irregularity at the base of the Gantel deposits and their finely bedded structure.

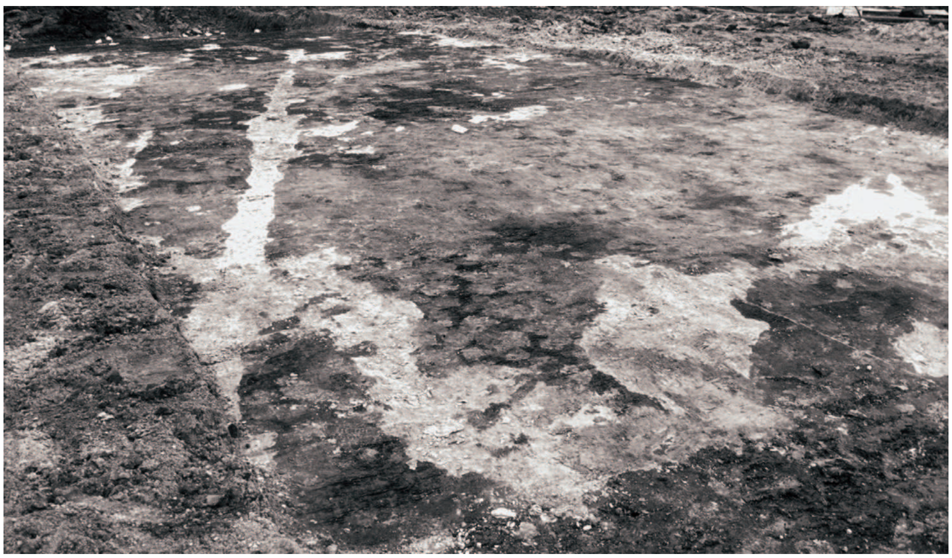


Figure 2.10 Trench 17, level C, showing irregular and straight linear features at the base of Unit 0, in the top part of the dune.

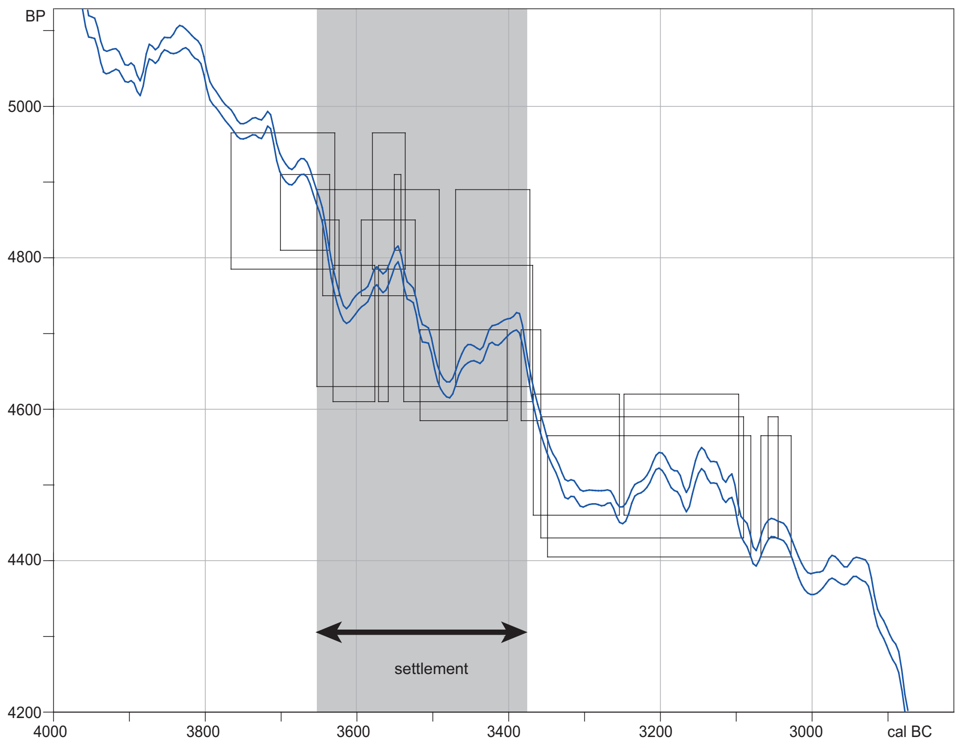


Figure 2.11 Calibrated radiocarbon dates obtained for the terrestrial samples (phase 4 excluded) plotted on the IntCal98 calibration curve. The individually calibrated radiocarbon dates are indicated as rectangles. The dates show a cluster between 3650 and 3380 cal BC. Calibrated with the aid of OxCal v.3.9 (Bronk Ramsey (1995, 2001).

The radiocarbon dates obtained in the prospection, shown separately in figure 2.12, were all obtained from charcoal, which usually gives reliable age determinations. Some of the dates are from a series of samples in a stratigraphical order (*e.g.* boring 41), but they show no clear trends. Regrettably, the dates cannot be linked to any of the occupation phases, but grouped together, they represent a time span of *c.* 3800-3400 cal BC, which we may assume includes the period of occupation.

The remaining dates were all obtained for samples from lithostratigraphical units, which could be linked to one of the occupation phases. Several types of samples were submitted and dated:

– samples of terrestrial plant macro-remains from the top or base of a lithostratigraphic unit, which provide the chronostratigraphical framework from a geological perspective;
– samples of archaeological artefacts of various materials that were indisputably associated with the individual occupation phases. They provide dates for the actual period of occupation;
– samples from the graves.

All the samples were grouped in stratigraphical order, so they should have shown a consistent pattern after calibration. Regrettably they do not. The dates obtained for the charred food remains found encrusted on pottery and those for the graves are completely out of phase with those obtained for charcoal, wood and seeds. The two sets of dates were therefore analysed separately.

The samples of terrestrial botanical sources (wood, charcoal, seeds), which are usually considered the most reliable age indicators, were analysed first. Phase 1 was dated on the basis of three samples of wood showing cut marks, implying that they most probably dated from the actual period of occupation. Phase 2 was dated on the basis of seven samples, two of which consisted of charred cereals and five came from wooden fence posts (chapter 4). Phase 3 could not be dated on the basis of a comparable series of samples; only one sample was available, from a post from the last fence. Two samples of uncharred seeds obtained from the top of Unit 10 yielded a *terminus ante quem* for that phase. The estimated duration of phase 3 will consequently be too long. The post cluster in Unit 1 was dated by two of the pointed posts, which characterised this later reuse of the site.

The following step was a sequence analysis based on the stratigraphy (Bronk Ramsey 2001). Such an analysis allows assumptions regarding relative age differences to be included in a chronology. The analysis usually results in a narrowing of the 2σ-range, since older samples cannot overlap with younger ones and vice versa. The resulting calibrated distributions are usually more confined than the initial values, and show a clear pattern from old to young. Figure 2.13 shows the result of the

sample code	material	context	phase	lab code	date	$\partial^{13}C$	$\delta^{15}N$
Samples from prospection							
NSH-1	charcoal	boring 41 sample 1 (top)	–	AA-50074	4745 ± 50	-26.2	
NSH-2	charcoal	boring 41 sample 2	–	AA-50075	4950 ± 50	-25.8	
NSH-3	charcoal	boring 41 sample 3	–	AA-50076	4770 ± 60	-25.7	
NSH-4	charcoal	boring 41 sample 4	–	AA-50077	4715 ± 50	-26.7	
NSH-5	charcoal	boring 41 sample 6 (base)	–	AA-50078	4875 ± 55	-26.6	
NSH-6	charcoal	boring 72 sample 1 (top)	–	AA-50079	5105 ± 55	-26.0	
NSH-7	charcoal	boring 72 sample 6 (base)	–	AA-50080	4755 ± 60	-26.8	
NSH-8	charcoal	boring 27 sample 2 (top)	–	AA-50081	4790 ± 50	-23.7	
NSH-9	charcoal	boring 27 sample 3 (base)	–	AA-50082	4955 ± 50	-22.9	
NSH-10	charcoal	test trench sample 1	–	AA-50083	4680 ± 50	-23.9	
NSH-11	charred seeds	test trench sample 2	–	AA-50084	4900 ± 60	-25.0	
NSH-12	charcoal	test trench feature 101	–	AA-50085	4930 ± 50	-23.7	
NSH-13	charcoal	test trench feature 112	–	AA-50086	4890 ± 55	-28.0	
Samples from excavation							
no. 1338	wooden post	base Unit 1	phase 4	GrN-28864	3720 ± 20	-28.30	
no. 1855	wooden post	base Unit 1	phase 4	GrN-28865	3790 ± 20	-28.13	
no. 4838	charcoal	base Unit 1	t.a.q. Unit 10	GrA-24372	4485 ± 40	-24.04	
no. 4850	seeds	top Unit 10	t.a.q. phase 3	GrA-24373	4510 ± 40	-24.35	
no. 4839	seeds	top Unit 10	t.a.q. phase 3	GrA-24334	4540 ± 45	-26.34	
no. 2061	wooden post	fence, third phase	phase3	GrN-28860	4700 ± 45	-27.86	
no. 7506	charred remains on pot	Unit 10	phase 3	GrA-26361	4900 ± 35	-26.00	
no. 7927	charred remains on pot	Unit 10	phase 3	GrA-26362	4985 ± 40	-26.50	
grave 3	human bone	grave 3	phase 3	GrA-26670	5055 ± 40	-21.52	12.79
id.*	id.	id.	id.	GrA-28037	5010 ± 40	-21.56	
grave 2	human bone	grave 2	phase 2	GrA-26653	5055 ± 40	-18.81	15.55
grave 4	human bone	grave 4	phase 2	GrA-26671	4650 ± 40	-20.50	10.07
id.*	id.	id.	id.	GrA-28150	5120 ± 45	-19.34	
grave 6	human bone	grave 6	phase 2	GrA-26737	5070 ± 40	-21.05	16.36
grave 1 ind.1	human bone	grave 1 ind.1	phase 2	GrA-26650	5005 ± 40	-18.67	15.77
grave 1 ind.2	human bone	grave 1 ind.2	phase 2	GrA-26652	5080 ± 40	-19.02	15.95
no. 5160	wooden post	fence, first phase	phase 2	GrN-28862	4740 ± 25	-29.64	
no. 6006	wooden post	fence, first phase	phase 2	GrN-28863	4800 ± 25	-28.51	
no. 6006	wooden post (fine frac.)	fence, first phase	phase 2	GrN-28884	4760 ± 65	-28.91	
no. 4603	wooden post	fence, first phase	phase 2	GrN-28861	4860 ± 25	-28.96	
no. 8683	worked wood	Unit 17	phase 2	GrN-28962	4645 ± 30	-28.98	
no. 4847	charred wheat	Unit 18	phase 2a	GrA-24335	4875 ± 45	-25.92	
no. 340	charred wheat	Unit 18	phase 2a	GrA-26892	5250 ± 35	-24.38	
no. 8630	charred remains on pot	Unit 18	phase 2a	GrA-26363	5055 ± 40	-21.50	
grave 5	human bone	grave 5	phase 1 / 2a	GrA-26672	5170 ± 40	-18.50	
no. 8006	worked wood	Unit 19	phase 1	GrN-28963	4710 ± 35	-22.57	
no. 9509	worked wood	Unit 19	phase 1	GrN-28965	4720 ± 35	-23.90	
no. 9507	worked wood	Unit 19	phase 1	GrN-28964	4745 ± 35	-27.13	
no. 5431	charred remains on pot	Unit 19	phase 1	GrA-26359	5205 ± 40	-26.80	

* redated samples

Table 2.2 Radiocarbon dates obtained for Schipluiden-Harnaschpolder

applied procedure. The prior distribution is still visible, showing which part of it was used for the age determination.

It should be emphasised that some restrictions may limit the value of such an analysis. For instance, a stratigraphically incorrectly interpreted sample or unit will result in an incorrect age estimation of an entire sequence. Another dating problem concerns the possibility of old remains having become incorporated in younger layers. Samples

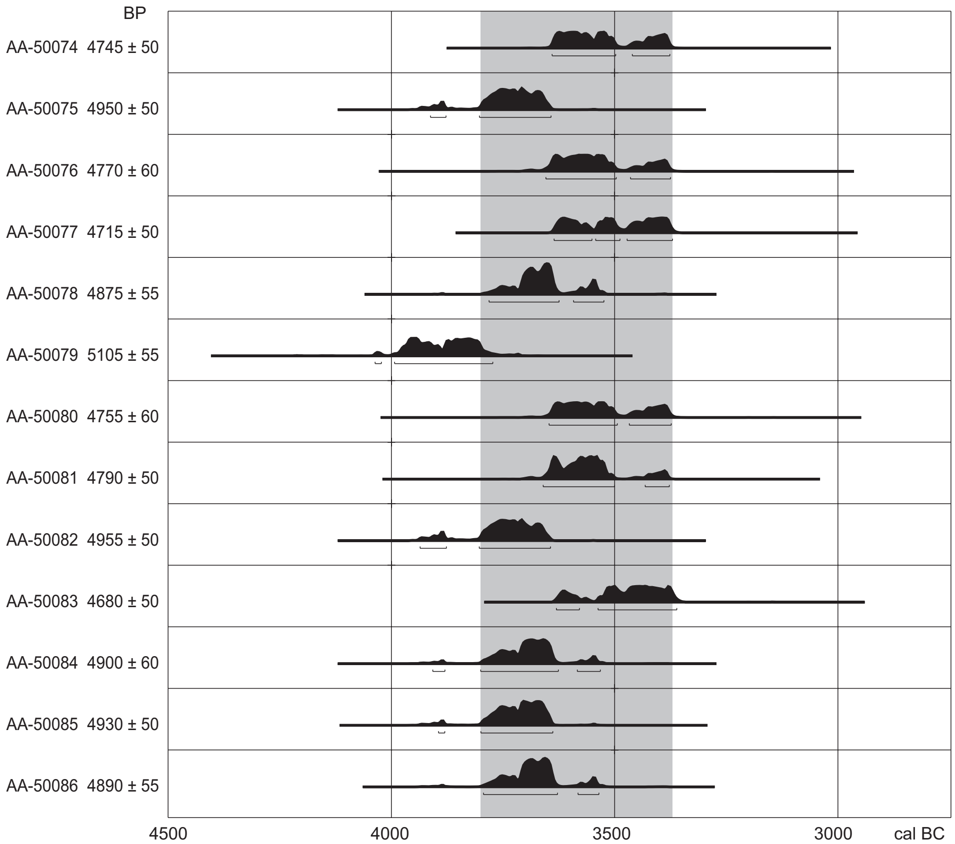


Figure 2.12 Calibrated radiocarbon dates obtained during the prospection of Schipluiden-Harnaschpolder. Although the dates cannot be put in stratigraphical order, lumping reveals the period in which the site was occupied (indicated in grey). Calibrated with the aid of OxCal v.3.9 (Bronk Ramsey 1995, 2001).

taken from such layers will of course yield a too wide chronological range for those layers. Errors in a stratigraphical sequence are usually revealed by a low agreement value for all the samples. The agreement value should be at least 60% (shown at the top of the diagram). The reliability of the individual samples is indicated by the percentage behind each sample, which should also be at least 60%.

Although the botanical samples were expected to provide a reliable chronology, there are some stratigraphical inconsistencies. The three wood samples from phase 1 (samples 8006, 9507, 9509) are younger than the majority of the samples from phase 2. Especially the two samples of charred cereal from phase 2 (samples 340, 4847) yielded earlier dates. Such results are statistically unreliable (lower than 60%).

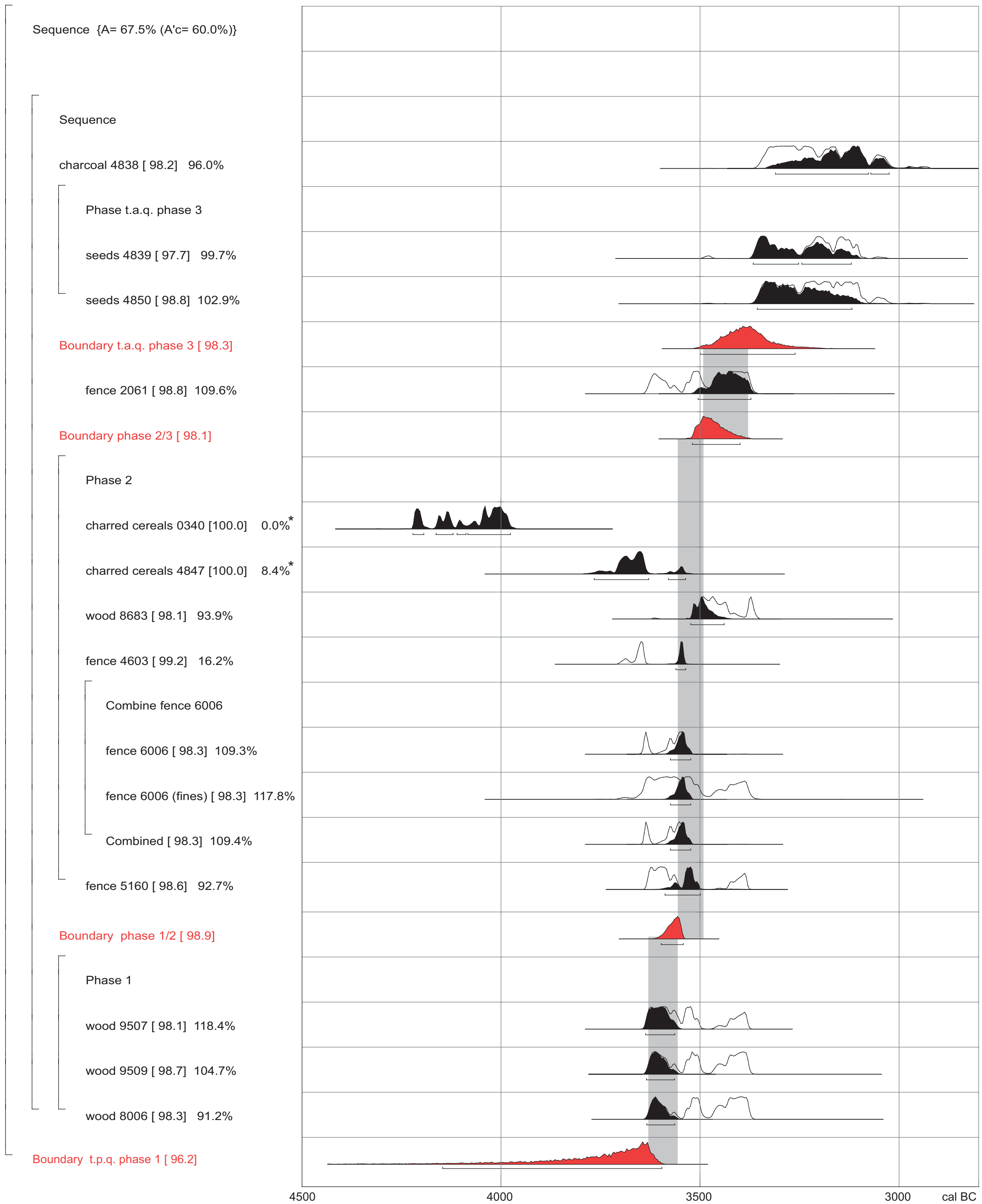
The results obtained for both sets of samples seem to constitute reliable evidence for human occupation, but they do not agree with each other: either the wood dates from a later phase or the cereals from an earlier phase. The wood came from Unit 19, from beneath an archaeologically barren layer of clay that was mechanically excavated. So this wood cannot date from a later phase. The consistency of the three samples moreover suggests that the estimation is reliable. The charred cereal grains were obtained from Unit 18, the trampling zone at the top of the clay. Although they were found in a clay context, which could imply reworking, they were also considered to be reliable age indicators on account of the fact that the cereal was charred. As can be seen in figure 2.13, sample 340 is nevertheless completely out of range with the other dates. Sample 4847 can be assigned to phase 2 due to its lower age limit, but this results in an agreement value that is too low. These two samples were therefore not used for the establishment of the chronology.

After rejection of these samples, figure 2.13 clearly shows a decreasing age from old to young.

On the basis of this analysis, the following boundaries were derived using the mode of the curves and an error based on the width of the curve (curves indicated in red in fig. 2.13):

3630 ± 25 BC for the beginning of phase 1
3550 ± 20 BC for the beginning of phase 2
3490 ± 25 BC for the beginning of phase 3
3380 ± 35 BC for the end of phase 3

These dates indicate a chronological sequence of *c*. 3630-3380 cal BC for phases 1 to 3, with 3380 being a *terminus ante quem*. This agrees well with the ages inferred from the prospection samples.



Sequence {A= 67.5% (A'c= 60.0%)}
Sequence
charcoal 4838 [98.2] 96.0%
Phase t.a.q. phase 3
seeds 4839 [97.7] 99.7%
seeds 4850 [98.8] 102.9%
Boundary t.a.q. phase 3 [98.3]
fence 2061 [98.8] 109.6%
Boundary phase 2/3 [98.1]
Phase 2
charred cereals 0340 [100.0] 0.0%*
charred cereals 4847 [100.0] 8.4%*
wood 8683 [98.1] 93.9%
fence 4603 [99.2] 16.2%
Combine fence 6006
fence 6006 [98.3] 109.3%
fence 6006 (fines) [98.3] 117.8%
Combined [98.3] 109.4%
fence 5160 [98.6] 92.7%
Boundary phase 1/2 [98.9]
Phase 1
wood 9507 [98.1] 118.4%
wood 9509 [98.7] 104.7%
wood 8006 [98.3] 91.2%
Boundary t.p.q. phase 1 [96.2]
4500
4000
3500
3000
cal BC

The following age constraints based on radiocarbon dates were consequently derived for each individual phase:
phase 1 3630 – 3550 cal BC
phase 2 3550 – 3490 cal BC
phase 3 3490 – 3380 cal BC at the latest

2.3.2 *^{14}C reservoir effect*

The dates obtained for the graves and charred food remains are given in figure 2.14. The period of occupation based on these dates clearly predates the time span inferred from the prospection samples and the samples of wood and seeds. The human bones and food residues yielded a time span from *c*. 4050 until 3650 cal BC for the period of occupation. There is a difference of approximately 300 calibrated years with respect to the dates yielded by the terrestrial botanical samples. This suggests a ^{14}C reservoir effect.

This phenomenon is well known from earlier studies in the Dutch coastal plain, and was on those occasions attributed to a fish diet on account of the high δ^{13}C values (Mol/Louwe Kooijmans 2001, Mol 2003). The δ^{13}C values obtained for Schipluiden are also high, as are the δ^{15} N values (table 2.2). These values are indeed indicative of a high-protein diet, comprising substantial quantities of fish, and point to a ^{14}C reservoir effect with associated age offsets (*cf*. Bonsall *et al*. 1997).

The relationship between the dates obtained for the food residues and the human bones is consistent (fig. 2.14), suggesting a ^{14}C reservoir effect for the food residue samples, too. The δ^{13}C values of these samples are rather low in comparison with those of the human bones. Their δ^{15}N values were not measured (table 2.2). These values are however similar to those obtained in a study in Denmark, in which both recent freshwater fishes and prehistoric food residues containing remains of freshwater fish were measured (Fischer/Heinemeier 2003). The δ^{13}C samples showed a reservoir effect of 300 ^{14}C years, which was attributed to a diet of freshwater fish. Earlier studies (Lanting/Van der Plicht 1998; Cook *et al*. (2001) similarly showed that not only a marine diet, but also a diet of freshwater fish can lead to ^{14}C reservoir effects of up to 500 ^{14}C years. As a result of this fish diet, figure 2.14 does not represent the correct period of occupation. Correction of this reservoir-effect is in principle possible; purely marine diets can be corrected with ^{13}C-values and purely fresh-water diets with ^{15}N-values (Arneborg *et al*. 1999; Cook *et al*. 2001). However, the reservoir-effect in our dataset cannot be quantified because of the assumed mixed diet.

2.3.3 *External evidence*

The absolute chronology is confirmed by other evidence, such as the style of the pottery and the development of the landscape. All the pottery belongs to the Hazendonk group (chapter 6). No representatives were found of the predecessor of this style – Swifterbant pottery, which was in use until *c*. 3800 cal BC. Neither were any remains found of Vlaardingen pottery, which was produced from *c*. 3400 cal BC onwards. The pottery tradition consequently points to an occupation period in the interval of 3800-3400 cal BC. This agrees well with our findings based on radiocarbon dating, including the end of phase 3, which was dated to 3380 cal BC at the latest.

The dune bearing the occupation site was formed some time after *c*. 4000 cal BC, by which time coastal erosion had ceased and coastal progradation and associated dune formation had only just started (chapter 14). This also agrees with the date of *c*. 3630 cal BC for the beginning of the occupation period.

It was decided to compare the levels established in the excavation with the curve representing the relative rise in mean sea level (Van de Plassche 1982) in order to double-check the dates and estimate the water regime, more specifically the tidal range. The estimated age of the tidal deposits underlying the dune at a level of -4.5 m is *c*. 4000 cal BC or slightly younger. According to the MSL graph, the mean sea level must then have been around -5 m, implying a tidal amplitude of about 0.5 m, or a little more if we allow for some compaction. These can be considered very accurate fits.

2.4 Occupation phases: conclusions

Phase 1 may actually have begun a little earlier than the 3630 cal BC suggested by the prospection dates. A slightly earlier date would still be in agreement with the dates of the pottery and the development of the dune. But the fact that the artefacts from phases 1 and 2 almost all have more or

◄Figure 2.13 Sequence analysis of the terrestrial samples from Schipluiden-Harnaschpolder (wood, charcoal. cereals and terrestrial seeds) performed with the aid of the OxCal v. 3.9 program (Bronk Ramsey 1995, 2001). All dates are in stratigraphical order (oldest at the top). Individual ages within each phase have been lumped in cases in which their relative positions were unknown (shown by brackets). The combination of stratigraphical position and calibrated time range results in narrowing of the 2σ range. The original distribution is shown by a line.

Value A (top left) gives the agreement index of the total sequence (in this case 67.5%), which should be at least 60%. The percentages behind each individual date show the extent to which the final distribution overlaps with the original. Values >100% indicate that only the very highest parts of the distribution overlap. Two dates were rejected on statistical grounds (indicated by *) because the agreement index was initially too low in the case of these samples.

The time windows resulting for each individual phase are indicated in grey.

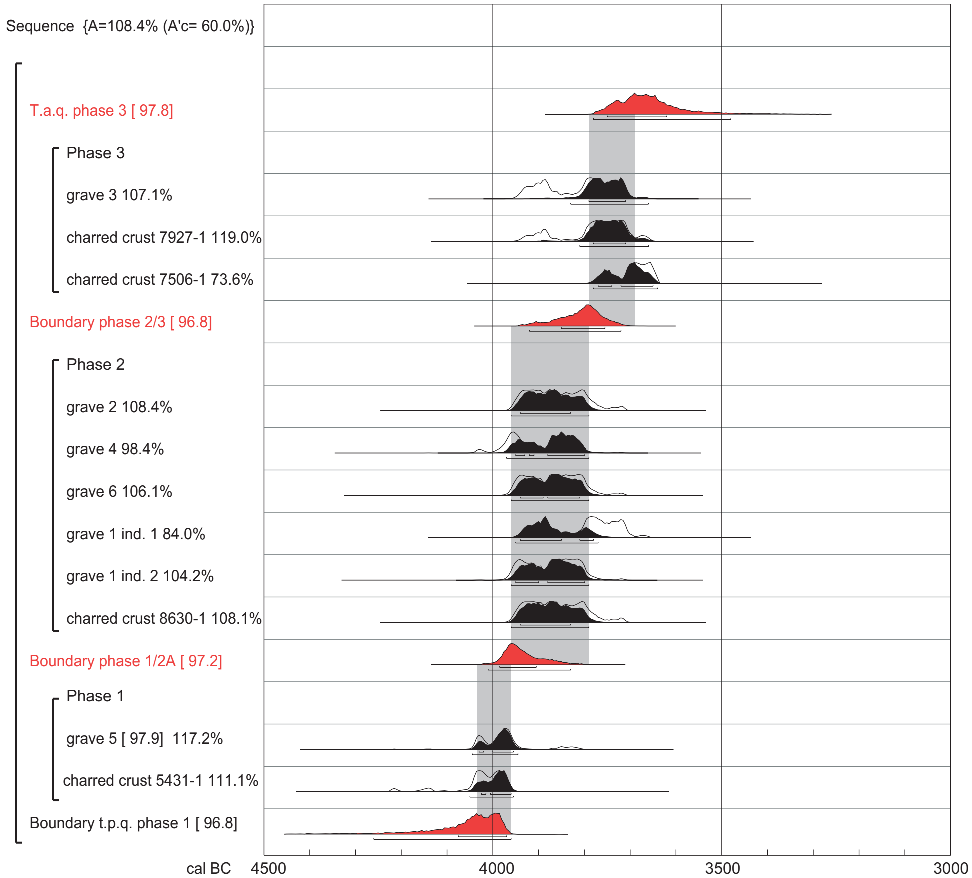


Figure 2.14 Sequence analysis of the samples of the graves and charred food remains (from pottery) from Schipluiden-Harnaschpolder. The analysis was performed with the aid of OxCal v. 3.9 (Bronk Ramsey 1995, 2001). A clear age difference of at least 300 calibrated years is visible with respect to the results obtained in the analysis of the terrestrial samples (figure 2.13); this is the result of a reservoir effect. Results of redating were used for graves 2 and 4 (*cf.* table 2.2).

less the same dates suggests a short time span rather than a long one. For this reason the date of the beginning of the occupation period was left unchanged at 3630 cal BC.

As for the end of the occupation period, there is good agreement between the calculated value of 3380 ± 30 cal BC and external evidence for the end of the Hazendonk group (*c*. 3400 cal BC). It should however be noted that the latter date should be regarded as a *terminus ante quem*, implying that phase 3 probably lasted shorter than the proposed 90 years. These factors make it difficult to estimate the overall duration of the period of occupation. It is estimated to have been between 2 and 3 centuries. During this 200-300 years' time span the dune was gradually covered by deposits and the area available for occupation became smaller and smaller.

Figure 2.15 shows the extent of the dune during each occupation phase.

Occupation phase 1 (3630-3550 Cal BC)

The dune was occupied for the first time during the initial formation of clay 19S. Remains were left on the dune surface (embedded in 20) and on the northwestern side (later embedded in 19N, trampled into 30) and were dumped in the water along the southeastern side (embedded in the base of 19S) up to a height of -4.5 m.

Only in 19S did remains from this occupation phase become covered and protected against contamination with later remains. Unit 20 certainly and Unit 19N most probably contain mixed assemblages from this and the subsequent phase.

Occupation phase 2 (3550-3490 cal BC)

The second phase most probably started after a short hiatus, which could not be dated due to its very short time span. Remains were again left on the dune surface and were later trampled into 20. On the southeastern side remains were also trampled into the previously formed clay 18/17 and were possibly left on/in the very humic silty clay of 19N on the northwestern side at a height of -4.0 m. The dune had by this time already shrunk considerably, to between -4.0 and -3.8 m.

Continued intensive use of the site resulted in partial colluviation of 20, with extensions 15/16 into the aquatic stratigraphy. So the remains from 20 and 19N are essentially mixed assemblages from phases 1 and 2, and the smaller fraction from 15/16 must also be considered a mixture. The larger artefacts from this colluvium may be regarded as primary deposits from phase 2. This phase is however exclusively represented only in clay Unit 18/17, where it is separated from earlier and later remains by sediments.

The remains from Unit 18 may be regarded as representing an early stage of phase 2 (2a), those from Units 15/16 a later stage (2b).

Occupation phase 3 (3490-3380 cal BC)

The inhabitable part of the dune will have shrunk considerably by the time of phase 3, not so much in length, but especially in width. Occupation will have been restricted to the highest parts of the dune (above -3.7 m), which are precisely the parts that were eroded by the Gantel system. Most of the remains from phase 3 will have vanished due to erosion, but the deposits at the level at which features became visible seem to have been untouched. It is assumed that the assemblage of Unit 20 contains very little or no admixed remains from phase 3 as the greater part of the slopes of the dune were already covered by peat 10/11 at this time. Phase 3 is attested exclusively by remains embedded in peat layer 10/11.

Later use (2300-2050 cal BC)

The dune itself had disappeared a few centuries later, but its position may still have been visible in the vegetation. Wooden posts embedded in layers 1/2 testify to human activity.

notes

1 The field codes are composed of two parts: a prefix (20, 40, 60, 80) for each of the four sides of the dune (NW, SE, NE and NW, resp.) and a suffix for each layer. The layer codes were chosen as uniformly as possible for each series. Only a few units had to be recoded to obtain a uniform site stratigraphy: Unit 2017 was recoded as 19N (= North) and Units 4019, 6019 and 8019 as 19S (= South).

2 All heights refer to the local Dutch ordnance datum (NAP), which roughly coincides with the mean sea level.

3 This was demonstrated by the results of the physical anthropological analysis. Two human diaphyses with very similar characteristics, most probably deriving from the same individual, were found about. 80 m apart: No. 8808 in the NW of trench 13,

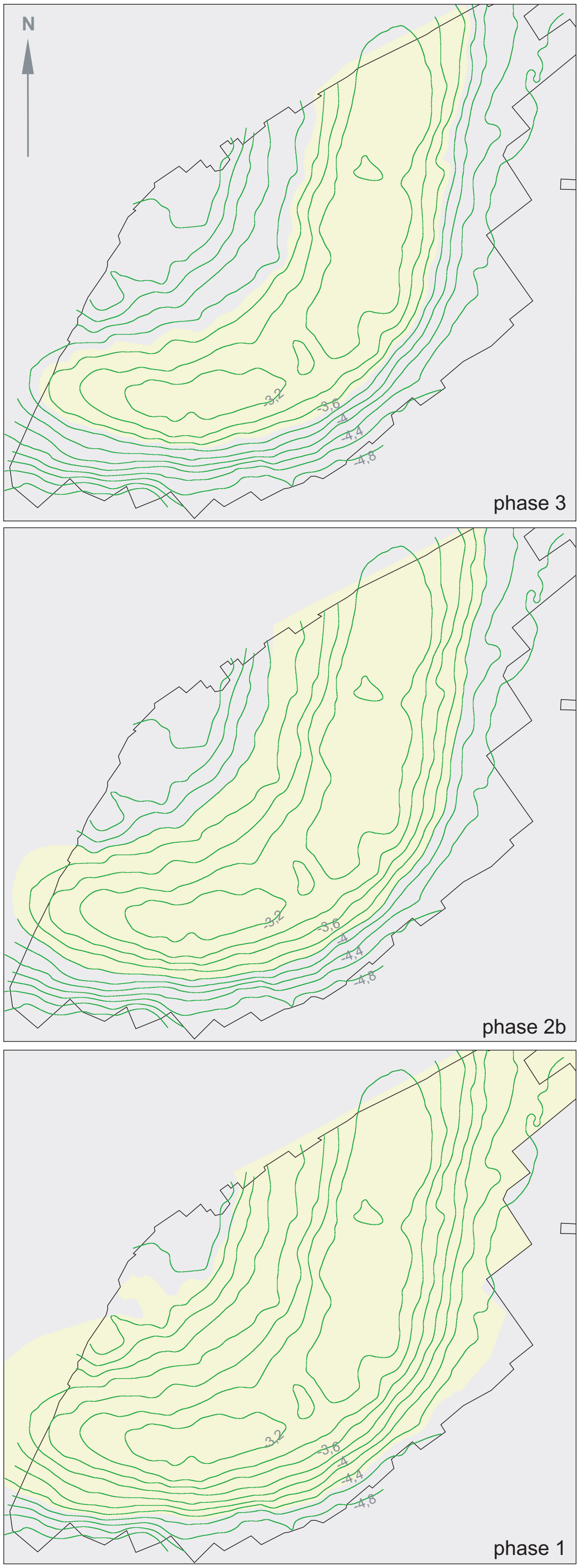


Figure 2.15 Phases of submergence of the dune based on the uncompacted maximum sedimentation levels of the clastic deposits. The contour lines represent the height of the underlying dune and sand flat.

Unit 10, No. 5525 on the other side of the dune in trench 26, Unit 16. The latter may very well have been incorrectly coded as the stratigraphy was locally rather diffuse.

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