Reports from the Environmental Archaeology Unit, York **94/61**, 9 pp.

Assessment of thin sections of sediment samples from excavations at Withow Gap, Skipsea, Humberside (Site Code: CAS 489)

by

M. Raimonda Usai

Summary

Thin sections of undisturbed sediment samples from a CAS excavation at Withow Gap, Skipsea, were analyzed. The samples had been collected and prepared in 1993 by Dr M. McHugh, who carried out an assessment of soils and sediments.

A succession of sediments including basal silty humus forms deposited in water (gyttja), overlain by a peaty sequence (from a lower primary peat to upper secondary humus formation from peat), in turn overlain by well-differentiated sub-soil mineral (B) horizons, was confirmed. Evidence for periodical waterlogging in the upper layers and more prolonged waterlogging in the lower layers was observed. There had also been input of sand during the deposition of the peat and during the soil forming processes, with allochthonous charcoal and ash in the lower soil horizons and in the upper peaty humus formation, but absence of in situ artefacts or other disturbance, was observed.

It seems that further work, although confirming such interpretations, quantifying them and describing the samples in more detail, would not have sufficient potential for producing useful or significantly new results in strictly archaeological terms.

Keywords: Withow Gap; Skipsea; Humberside; prehistoric; soil; sediment; peat; gyttja; micromorphology.

Author's address

Environmental Archaeology Unit
University of York
Heslington
York YO1 5DD

Telephone: (01904) 433847
Fax: (01904) 433850

Prepared for:

Central Archaeological Service
English Heritage
Fort Cumberland
Fort Cumberland Road
Eastney
Portsmouth
PO4 9LD

16 December 1994

Assessment of thin sections of samples from excavations at Withow Gap, Skipsea, Humberside (Site Code: CAS 489)

Introduction

The Skipsea Withow Gap, Humberside (TA 1839 5463) - drained since medieval times - has been described as a section of what had probably been a channel (sub-perpendicular to the present shoreline) between two adjacent late or post-Devensian meres, one of which would have been eroded and dismantled by coastal erosion, and the other preserved and buried by successive deposits. Carved and worked wooden remains (timbers) were found on the margins of the Skipsea Withow Mere, described by Gilbertson *et al.* (1984), who attributed them to coppicing techniques during the early Neolithic.

The English Heritage Central Archaeological Service (CAS) carried out an excavation in the Skipsea Withow Mere in 1993, with the aim of investigating possible Neolithic timber structures in the Skipsea Withow Gap and of establishing whether the timbers formed part of an *in situ* structure and, if so, determining its origin (man made or beaver activity or dam, hide, platform, fish trap etc.), function and framework (cultural or environmental) and the relationships between the structure and the sediments at the mere edge. The objectives of the environmental sampling described in the CAS project design included obtaining samples of peat associated with the structure for analysis of pollen, plant microfossils, insects and other biological remains.

Separate soil and sediment samples were selected and collected at various depths within one profile by Dr M. McHugh, who carried out an assessment of soils and sediments (McHugh, 1993). The aim of the present study is to assess the potential and significance of complementing such work with a micromorphological analysis of the same samples collected by Dr M. McHugh.
A tentative integration with other information available is also carried out.

Site description and sample location

The Humberside and Holderness areas have been studied by various authors and under different perspectives. Correlations between archaeological characteristics, stratigraphy, landscape and soils in the Withow Gap and the surrounding area are complex and information may be derived from different authors who assessed them from different points of view. A summary of geology and drift successions, however, is outlined in Table 1. The Pleistocene to recent sediments have produced the present landscape and soils. Drift is mainly represented by the Late Devensian till with sand, gravel, silt and clay-rich soils that bury Pleistocene beach deposits with their associated cliff and shoreline platform, and Mesozoic chalk. The surface of the drift is gently undulating, with natural hollows. Abundant wetlands and lakes existed in the area of Holderness from post-Devensian to medieval times, and were probably formed in the original depressions in the till (Gilbertson *et al.*, 1984). Sites identified by Varley (1968) suggested prehistoric occupation in a wetland landscape with settlements on the fringes of the marshland characterized by piled structures.

Mesozoic	Deposition of chalk and other Cretaceous rocks and successive valley cutting within the Mesozoic rocks. The chalk underlies the whole of Humberside at depth but only outcrops in the Wolds, as the lower ground is covered by a succession of drift deposits.
Pleistocene	Beach deposits and their associated cliffs and shoreline platform (interglacials) and tills (glaciations) in the order: *Hoxnian or earlier*[shelly greenish sands]; *Wolstonian glaciation*: Basement till; *Ipswichian interglacial*: buried cliff and beach deposits; *Late Devensian*: (Dimlington) Silts (Silty loam and sand), followed by loess (fine sand and silt) and by the Skipsea (dark grayish brown slightly stony to stony clay loam) and Withernsea (brown slightly stony to stony clay loam to silty clay) Tills, dated 18,250 BP at their base (Penny *et al*. 1969, radiocarbon).
Holocene or recent-Flandrian	-Retreat moraines (sand, gravels, often with flint, chalk, and assorted detrital sedimentary, igneous and metamorphic pebbles); -Peat, alluvium and aeolian deposits (grey clay, sand, gravel); -Alluvium, marine and riverine, with grey clay and silty clay; -Carr peat (black humified, with bog oaks) -Alluvium (estuarine warp)

Table 1. Summary of geological and drift succession, based on Furness (1985).

Depth of layers or horizons	**Thin sections**		**Context**
	Nr	**Depth (cm)**	
0-30 cm	none		209
30-65 cm	10	30-38	
65-95 cm	9 1 2	65-73 81-89 90-98	
95-111 cm	2 2.5 3	90-98 102-110 109-117	210
111-121 cm	3 4	109-117 117-124	211
> 111 cm	5	129-137	212
0-29 cm 29-67 cm > 67 cm	6 7 8	0-8 29-37 67-75	214
Cliff	9		

Table 2. Sampling strategy of McHughs (1993) for thin sections. Datum (0 cm) for the samples in context 214 is the base of context 212.

At Skipsea, the cliff is cut solely in the Skipsea Till, which is the most important soil forming material of the area.

The sampling strategy for undisturbed Kubiena tins (and related thin sections) and the soil/sediment stratigraphy, both carried out during the 1993 CAS excavation by Dr McHugh, is described in Table 2.

Methods

Thin sections were observed with a polarizing microscope under parallel and polarized light at different magnifications.
Methods and terminology for description are mainly those of Bullock *et al.* (1985), but some additional terms and methodologies have also been used. Quantitative descriptions are tentative, and were carried out using comparative tables from Bullock *et al.* (1985), and Hodgson (1976). Sorting is approximately described on the basis of comparative figures of Pettijon *et al.* (1973).

A broad description, including a wide range of variables, was made of thin section 10. Selected sections (Nos. 9, 2, and 1) were analyzed for a smaller number of characteristics - with the selections of features being based on a comparison with section 10, from within the same context.

For contexts 210 and 212, it was preferred to observe the vertical variation of features (such as presence of well-preserved vegetable tissues, humification, or other characteristics) in the profile, rather than their individual occurrence in each section. Sections 6, 7, and 8 represented a deposit that was uniform in all sections, and these sections were therefore briefly described together.

Results

Context 209

Thin section No 10

Two groundmass types are present in the same section. The first one (hereafter no 1) is dominant and includes a reddish/light brown fine material with reddish Fe concentrations; clouded or masked limpidity [(1)]; grey to yellow 1st order dominant interference colours. The b-fabric is striated (strongly poro- or mono-striated, and random striated, with discontinuous speckles up to 100 µm streaks, with random basic orientation) and subordinately mosaic speckled. The coarse material, for a total of 5-10 % of the area, includes angular sand grains and few (<1% area) rounded very coarse sand grains, all in a porphyric related distribution with the fine fraction. The second groundmass type (hereafter no 2) includes an opaque to masked red fine material, with masked interference colours and a moderate (20-60% area) poro-, mono-, parallel-, cross reticulate- and random striated b-fabric, with discontinuous streaks (size up to 200 µm diameter) in a random basic orientation and parallel referred orientation in relation to planes. The coarse material, < 2% area, is mainly fine to fine sand, angular or rounded, in a porphyric related distribution. In both groundmasses, coarse material mainly includes quartz and alkali feldspars. Mottles are represented in both groundmasses. Stress features are dominant while textural pedofeatures are less common, thinner then 70 µm, and include mainly light brown to reddish and partlly masked or dotted coatings, hypocoatings and quasicoatings, with interference colours variable between yellow, reddish and fully masked. Most hypo- and quasi-coatings are very strongly related to the surfaces of pores, grains and any surfaces of weakness, with parallel basic orientation (of domains), and both referred orientation (of domains within coatings) and distribution (of coatings) patterns parallel to void and grain surfaces. Stress and textural pedofeatures are not preferentially concentrated in groundmass 1 or 2. Dominant moderately developed very fine to medium (Hodgson, 1976) compound subangular and angular blocky structure (here the largest size is determined by the section size), with partly accommodated or accommodated planes and 5 to 20% packing voids.
Root channels are of variable size (10 µm to 3 mm, but dominantly between 1 and 2 mm) with rare roots preserved within the channels. In some cases, root channels occupied by roots cut pre-existent relic quasicoatings. Fe mobilisation and precipitation is expressed by mottles (unrelated to grains, voids and peds) and by ferruginous hypo- and quasi-coatings. Some root channels cut through mottles, others through birefringence zones (streaks and speckles) and through Fe quasicoatings or other textural clay pedofeatures, with the soil b-fabric not being reorganized around the channels, irrespectively of the type of groundmass (nos 1 or 2); other root channels have Fe segregations and impregnations accommodated on, or the soil b-fabric reorganized around, their surface.

----
(1). Masked by dark colours.

Thin section No 9

Light-brown slightly dotted fine material with grey to yellow 1st order dominant under cross polarizers. Speckled or differentiated but not speckled[(1)] b-fabric, alternating with a porostriated fabric, the latter with thin (< 20 µm) discontinuous streaks of variable length. The coarse fraction is mainly constituted by very well sorted very fine to fine sand, angular and subrounded grains, generally quartz, with occasional very well rounded apparently well sorted 200-300 µm sand grains, all in a porphyric related distribution with the fine material. Dominantly (~75% area) massive structure, with (~25%) subordinate very weekly developed 10-20 mm subangular blocky ped types. Rare, <0.5 mm diameter, partly accomodated planes defining peds larger than the thin section area are accompanied by <2% packing voids, and approximately 5% 200-400 µm cavities and unaccommodated elongated voids[1], all with random orientation and distribution patterns. Textural pedofeatures are absent. Dominant (>50% area) large (up to 3-5 mm) mottles with gradual to clear boundary.

----
(2). Not defined in Bullock *et al.* (1985), indicates a fine mass composed dominantly by birefringent clay, with birefringence present throughout the fabric but *without* speckles or other highly birefringent zones.

(3). Subdivision in vughs, vesicles and chambers is avoided and voids are classified in non accomodated elongated voids, equant cavities and planes.

Thin section No 1

Soil development, fabric differentiation and biological activity are again well represented as in the uppermost specimen (section 10). This specimen's fine material is less limpid, more dusty and clouded than those from sections 9 and 10, and shows diffuse light grey zones. Such characteristics are repeated more intensively in the specimen representing the lowest sampling depth of this context (soil fraction of section 2), as described below.

Thin section No 2

This sample consists of a soil fraction (context 209) and a peat fraction (context 210).

The soil fraction is brownish grey to reddish fine material, dotted as a result of abundant (often > 50%) very fine (<5 µm) microcontrasted dark, grey at 400 x, ash particles and less frequent larger (from 10 µm to 50 µm) particles, including charcoal fragments and other non readily identified opaque minerals. Yellow 1st order or masked (reddish or brownish) interference colour and speckled dominant fabric with weak to moderate poro-, mono-, cross-reticulate- and random striated b-fabric. Coarse grains, generally quartz and subordinately alkali feldspars and microcline, include approximately 10% of silt and approximately 20% fine to medium sand and occasional coarse sand, though values for size and frequency are only approximate. Voids include medium cavities and elongated unaccommodated voids and very fine accommodated elongated voids with strongly parallel basic orientation, and partially accommodated planes defining prismatic peds (20-50 mm). Frequent (>50% area of the section) large (up to more than 2cm) diffuse mottles within peds. Depletion pedofeatures on void and ped surfaces. No textural pedofeatures are readily distinguished, though organic tissues, clearly from the peat below, tend to line the larger planes.

The peaty material includes a sandy, mainly amorphous and very well humified brown to very dark brown peat, with only occasionally recognizable organic material, apparently including plant tissues, but mainly amorphous organic particles, dark brown to black under parallel light, generally opaque under cross polarizers, interspersed with coarse grains (the latter are similar to those in the soil fraction in size, shape and frequency). Lamination is absent and the material is randomly distributed. Charcoal particles are present but rarer than in the above soil fraction.

The boundary between the peat and the soil fraction is clear, but the two fractions have undergone concomitant weathering processes and parts of each fraction are present within the other fraction.

Contexts 210, 212 and 214

Thin sections 2, 2.5, 3, 4 and 5 all describe humified peat (depths are indicated in Table 2). In the lowermost section 5, twig transverse and longitudinal sections, other wood fragments,

leaves, and other plant residues are visible and significantly layered parallel to each other to form a laminated fabric with strong parallel basic and related orientation of most components and residues. Twig longitudinal and ellipsoidal sections, and even the humus accumulations, though not frequent, tend to be arranged in parallel horizontal bands. In section 4 above in the same context, the material is the same but with a significantly higher proportion of arthropod droppings replacing wood and other vegetable tissues, and of humus accumulations. Parallel orientation and distribution are still present but a larger component is randomly oriented. In section 3 (above section 4), the intact tissues are darker and homogeneous humus accumulations and droppings more abundant. In thin section 2.5, the proportion of homogeneous humus is even higher, recognizable plant remains and other tissues are still present but less than in section 3. In thin section 2 (described above) layering has completely disappeared, almost all the organic tissues are replaced by droppings and humification is almost complete (homogeneous humic matter dominant).
A sand lens is present within the peat layer; the lens includes mainly quartz and feldspar sand grains and rare charcoal fragments.

Thin sections 6, 7 and 8, from context 214, are very similar to each other and represent comminuted particles of plants, rare wood, leaf and other organic remains, together with silt particles. No humification is readily observed, and the fine fraction is intensely fissured. Mn precipitations are rare.

Discussion

Context 209 and its lower boundary

The pattern of the uppermost section (no 10), including stress cutans, Fe precipitations, biological features, all distributed more or less uniformly in both groundmasses, suggest that pedogenesis has occurred after the two groundmasses were put into place, and therefore differences between them are simply a result of differences in parent material.

Stages of periodic, probably seasonal, wetting and drying, and related soil shrinking and swelling, are shown by the reorganisation of the fabric, presence of streaks and of clay hypo- and quasi-coatings, resulting from stress of the fabric around voids and minerals. This is particularly clear in the uppermost and lowermost sections No 10, 1 and 2, and similar to this but less differentiated in section No 9, where structure is also much less developed and other traces of biological activity and soil development (e.g. root channels and mottles) are still present but less well represented. Textural pedofeatures are few, and mainly in section 10; they result from translocation of clay-sized material, often rich in Fe^{3+}, as shown by their reddish brown colour. Fe mobilisation and precipitation, however, also resulted from seasonal waterlogging, as suggested by the mottle pattern (pseudo-gley) of this context, though the Fe arrangement also suggests that the material may have been exposed to oxidation and air circulation to a considerable extent.

Although roots and their channels, mottles, quasi- and hypo-coatings, fabric rearrangements and textural pedofeatures are arranged in a relative spatial pattern and (time) order of occurrence which vary between and within the four sections representing this context, there are not, in these thin sections, any components that can be even broadly dated through comparison or correlation with dated objects, to which the relative order of occurrence of features could be related in a time sequence. The arrangement of features in a variable relative spatial pattern and order of occurrence does not necessarily mark different stages of pedogenesis, with environmental changes between each stage and formation of the relative remaining relic features. In fact, "two and frequently more generations of ferruginous pedofeatures can occur side by side in present day soils as well" (Bullock *et al.*, 1985) and therefore are not diagnostic of paleopedogenesis or relic soils. This is valid despite the presence of fragmentation and disturbance of pedofeatures (which is often interpreted as diagnostic of relic character) in the uppermost materials (section 10); in fact, fragmentation may have occurred at any particular stage of soil development, or even up to the present day. Furthermore, variability and changes of features are typical of soil development.

The features of this material, however, particularly the vertical horizonation and the considerable degree of fabric reorganisation and structure development even in absence of intense clay translocation, together with stress feature and root channel frequency, either indicate intense soil forming processes (including wetting and drying), or result from the occurrence of such processes through a considerable, but unknown, period of time. No upper or lower dating horizon is available to quantify the time of soil development (though it post-dates the Neolithic peat underneath).

The size of the coarse grains and their apparent degree of sorting and roundness, vary both within each section and between different sections; although sand seems more abundant in the lower part of the profile, frequency has not been accurately quantified at this stage. Only speculative answers can be given to questions regarding the provenance or transport agent for sand and silt. One explanation could be that at least part of them could have been wind-blown. If it is assumed that the thin sections are representative of the entire layers or horizons, the fact that in sections 1 and 2 ash and charcoal are not accompanied by any evidence of burning or disturbance suggests that they have been transported from the surrounding areas. However, it is clearly impossible to establish the distance of transport or the provenance on the basis of thin section evidence alone, though it is known that such small particles can travel for very long distances with aeolian transport - this is particularly well known for ash, which here is in particles as small as a few μm.

Although the description of section 10 was carried out on a large selection of features and variables, and the other sections were analyzed using selected features, none of these suggest anomalies and *in situ* disturbance or artefacts: the material is simply in agreement with the pattern of soil development, specifically with the characteristics of a subsurface mineral horizon (**Bg**, with possible sub-horizons Bg1, Bg2 and Bg3) of a surface-water gley soil.

Contexts 210, 212 and 214

The sequence from 95 cm to more than 111 cm depth (contexts 210 and 212), with increasing humification (and decreasing compaction?) from the lower to the upper peat, is similar to sequences of peat described by Babel (1975) where secondary humus formations have occurred on primary peats, with the secondary humus in the upper layers. The author also describes such sequences as reverse sequence in comparison with soils: the H layer is above the F layer, where the lower peat could be considered the original parent material. In other words, higher humification in the upper layers of the peat results from the fact that the lower peat has not been exposed to secondary decomposition. The same author describes such sequences as the result of changes in ecological conditions, particularly drainage or cultivation. If this was the case, a higher degree of waterlogging and higher stability of the ecological conditions would have characterized the lower peat since the time of deposition, and drier conditions would have occurred in a time stratigraphically corresponding to the top of the peat; this would be in agreement with the presence of sand in lenses and in the upper horizons of the peat and higher frequency of sand in the layers above, and by the unconformity with the soil above the peat. It is difficult, however, to prove this without further evidence.

No evidence of physical disturbance correlatable with cultivation can be observed in thin section (nor have they been reported in the field assessment). Although it is possible that the other differences observed in the sand could be related to different sources or differences in the agent of transport, this, again, cannot be confirmed just by observing this thin section.

The material of context 214 corresponds to organic silts (gyttja) described by Babel (1975). No artefacts are visible in the thin sections in any of the organic layers described.

Statement of potential

It seems that further analysis or work does not have sufficient potential for producing the results desired or, in archaeological terms, significantly new results.
In fact, it is unlikely that the archaeological and paleoecological

questions proposed in the project design and later by McHugh (1993) can satisfactorily be answered through further micromorphological analysis.

There is no evidence of *in situ* archaeological artefacts in thin section.

Further, although a great deal of tentative interpretation of the thin section evidence and a reconstruction of processes and events have been attempted, it seems that confirming such interpretations, quantifying them and describing the samples in more detail would be the only possible outcome from further work on this material.

Although the variability of the sediments is high, it seems that the number of samples collected and prepared by Dr McHugh, the number of thin sections observed (with 3 or 5 sections for each unit of the profile), and the location of the thin sections in the profile, are adequate for the description and characterization of the profile. Thus, further sampling would not be particularly useful for obtaining new information, unlesss other questions are posed by work in other disciplines.

Features, such as sorting, angularity and size frequency distribution, cannot be quantified with accuracy and, therefore, some of the questions, such as the source of sands and the agent of transport, cannot be answered by micromorphological analysis alone. Although point counting would significantly contribute to this, its significance would be doubtful considering issues such as the representativeness of a thin section for the characterization of the coarse fraction of all materials, the representativeness of the profile for the area and the very high number of counts required.

Recommendations

No further micromorphological analysis or related work is recommended. An attempt to compare the information with paleoecological data from comparable sites on the East coast would be an interesting topic for non-archaeological paleoenvironmental research.

Retention/disposal

Thin sections will be retained at the EAU, York.

Archive

All papers and electronic records are retained at EAU, York.

Acknowledgments

The author thanks Dr Maureen McHugh for the useful discussions and information and for providing thin sections, Clare de Rouffignac for providing information and material on the site, and Dr Allan Hall for constructive comments on plant material and their identification in thin section.

References

Babel, U. (1975). Micromorphology of soil organic matter. In: *Soil Components. Vol.1* Giaseking J.E. (eds). Berlin-Heidelberg: Springer Verlag.

Bullock, P., Fedoroff, N., Jongerius, A., Stoops, G., Tursina, T. and Babel, U. (1985). *Handbook for soil thin section description.* Wolverampton: Waine Research Publications.

Furness, R.R. (1985). Soils in Humberside. *Soil Survey Record No 82*. Harpenden: Lawes Agricultural Trust (Soil Survey of England and Wales).

Gilbertson, D.D., Briggs, D.J., Flenley, J.R., Hall, A.R., Hunt, C.O. and Woodall, D. 1984. Late Quaternary environments and man in Holderness. *B.A.R. British Series* **34**.

Hodgson, J.M. (1976). Soil survey field handbook. Describing and sampling soil profiles. *Soil Survey Technical Monograph No 5*. Rothamsted Experimental Station, Lawes Agricultural Trust, Harpenden.

McHugh, M. (1993). *Withow Gap, Skipsea, Humberside*. Field Assessment. Report to English Heritage Central Archaeological Service.

Penny, L.F., Coope, G.R. and Catt, J.A. (1969). Age and insect fauna of the Dimlington silts, East Yorkhire. *Nature*, **224**, 65-27.

Pettijohn, F.J., Potter, P. E. and Siever, R. (1973). *Sand and sandstone*. Berlin-Heidelberg: Springer Verlag.

Varley, W.T. (1968). Barmston and the Holderness crannogs. *East Riding Archaeologist* **1**, 11- 26.