BURIED SOILS OF THE WENTLOOGE FORMATION

by Martin Locock

The evidence for various stabilised soil horizons reported from the Severn Levels is reviewed for the environmental implications; a typology is proposed on the basis of the likely circumstances in which the deposits developed. The methodological implications for future work are discussed.

Introduction (Figure 1)

The post-glacial alluviation of the Severn Levels is dominated by the Wentlooge Formation of alluvial clays and peats (Allen and Rae 1987). The uppermost parts of most areas of the Levels now protected by sea walls are part of Upper Wentlooge Formation, a grey-brown silty clay (Rippon 1997a, 42-43). The topmost 0.6-1.0 m is usually oxidised to a yellow-brown colour. Evidence of preserved soil horizons within the upper sequence was considered to be sparse, and most reports were content to adopt a binary 'peat or clay' terminology (e.g. Lawler *et al*. 1992).

Recent fieldwork, however, has revealed numerous examples of preserved horizons, and in this paper an attempt is made to describe the various layers and their likely formation processes, in order to allow a better understanding of the microenvironments that they reflect.

The examples cited are drawn mainly from recent work by GGAT, and are intended to display the range of conditions reflected in horizons where confirmatory evidence from laboratory analysis has been obtained, in the hope that this may provide a model for other horizons noted in the field.

Soil terminology (Figure 2)

To the European geologist, soil is 'the weathered mantle of the Earth' (Cornwall 1958, 75); weathering is the effect of weather and vegetation on the minerals. American geologists, in contrast, consider any exposed surface as a 'soil', regardless of longevity or the extent to which it has been altered;

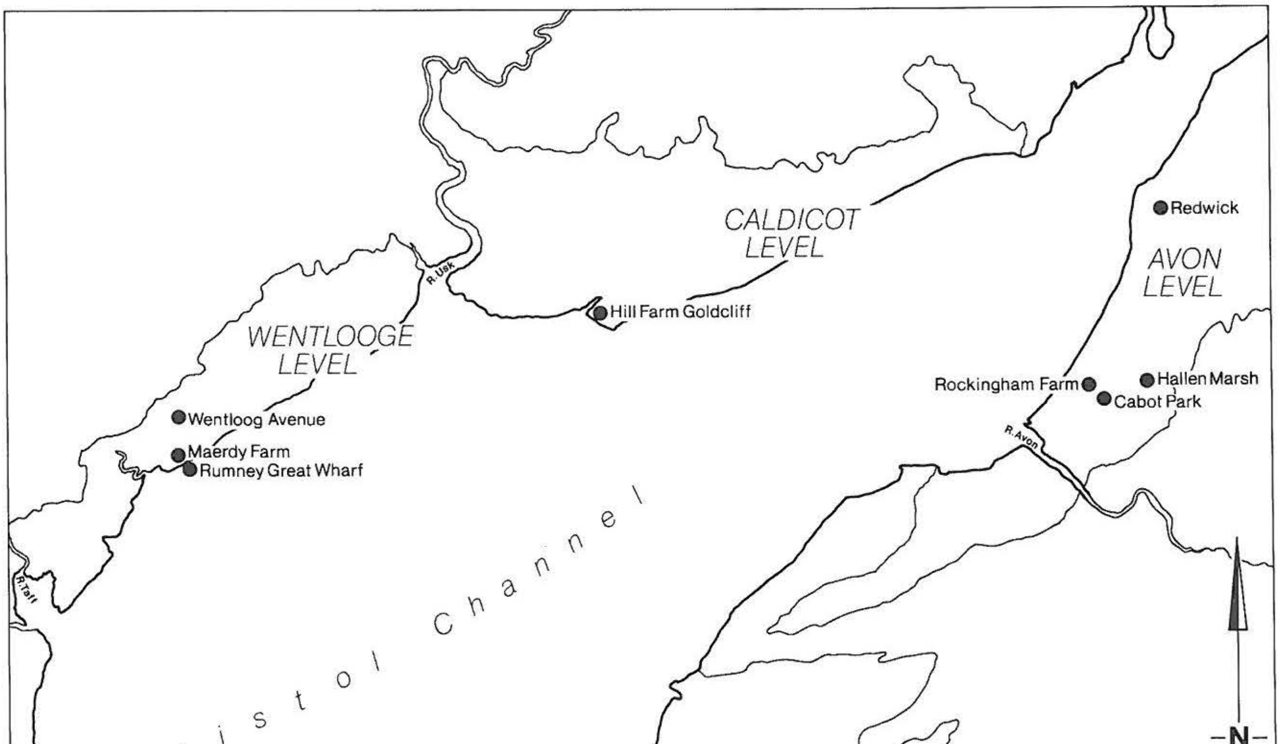


Figure 1: The Severn Levels, showing sites discussed in the text

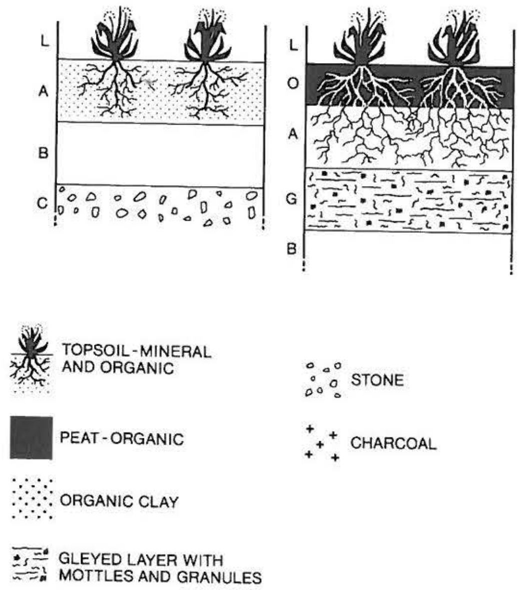


Figure 2: Typical soil profiles in terrestrial conditions (left), profile with a high water table and intermittent drying (right)

on this definition, intertidal mud exposed as each tide retreats constitutes a soil.

Weathering (of some sort) is a universal phenomenon, and in analysing soil formation processes, it is convenient to focus on examples where there remains evidence of the alteration of the distribution and nature of the mineral components (through changes in the physical, chemical or spatial nature of the mineral element or by the addition of material to the mineral).

At a macroscopic level, evidence for alteration may comprise a change in colour (from the oxidation or reduction of iron, for example) or texture (addition of organic material, or the creation of granules); chemical analysis may reveal organic enhancement, or changes in magnetic susceptibility and phosphate levels; micromorphological study may recognise changes in the shape and distribution of air spaces (root channels, worm burrows). This evidence may often be destroyed or masked by later processes, and it may be that the surviving examples are a small proportion of soils that once became established.

In other circumstances (for example the rapid burial of an exposed intertidal surface by further silting), the weathering processes may operate for too little time to impose any significant alteration on the mineral material.

Because most of the weathering effects are depth-dependent, processes operating for some time usually create horizontal zones, or horizons; these have a fairly standardised definition (those which follow are based on Limbrey 1975, 76-82 and Hodgson 1976, 71-80). Soils are described from the top down; sub-divisions are given suffix letters or numbers.

L, F, H horizon

Litter layer of decomposing plant material on the soil surface, above the mineral soil; L is fresh litter, F partly decomposed, H well decomposed and lost structure

A horizon

Mineral horizon containing organic material introduced by bioturbation (root and earthworm activity)

B horizon

Mineral horizon, below A, without rock structure or organic material

C horizon

Mineral horizon retaining rock structure

O horizon

A deposit of organic material formed on the surface of the mineral soil when acidity or waterlogging prevents decay of the L material (e.g. peat formation)

G horizon

A horizon which is significantly paler than the underlying B horizon as the result of the loss of some of its constituents, usually as a result of waterlogging and redeposition lower down (typically as mottles). Hodson (1976) uses the term E horizon for Limbrey's G horizon. It should be noted that this process is correctly known as gleying (as a whole); the common archaeological use of the term to describe a pale horizon in isolation is dubious.

Upon burial of a soil profile in aerobic conditions, continued bacterial activity is likely to cause any organic material incorporated within it to further break down and effectively be lost. Similarly, accumulated O horizons will rapidly decay if the water level drops. The preservation of organic material within buried silts is therefore dependent on two factors: sufficient time for a horizon to develop, and subsequent waterlogging preventing or minimising decay. It is precisely because these conditions have a direct bearing on the environment of the locality that their analysis can be so productive.

The Wentlooge Formation

The circumstances of deposition for the very widely-found and long-lived Wentlooge Formation are well understood, and have been confirmed by various specialist analyses (Allen and Rae 1987). The material comprises silty clay, with very little sand (less than 2%) and no larger fractions. Organic material (as measured by loss-on-ignition) is usually 1.5–2.5 %. The silty clays are 'unlaminated and poorly stratified, bedding surfaces appearing only here and there' (Allen and Rae 1987, 160). The deposit is remarkable for its homogeneity, and has been subject to bioturbation. Archaeological features are often noted 'floating' within a clay sequence which bears no trace of the established surface that must have existed.

Foraminifera and diatom data shows that the silty clay was mostly deposited in an upper saltmarsh estuarine environment. The organic component and bioturbation reflects the existence of a surface cover of reeds which trap the silt on each tide and grow up through the depositing layer, creating what is called a 'permanently immature soil' (Eyre 1963, 40).

More rarely encountered is evidence for the rapid deposition of clay as a semi-liquid deposit, rapidly filling hollows without any vegetational input. This results in a clean blue-grey clay, with minimal organics, sometimes called a 'marine clay' or 'flood silt' (Bell 1994; Locock 1996).

Peat deposits may form where the remains of vegetation are prevented from decay by waterlogging; if maintained over a long period, the vegetation may change from *Phragmites* (shallow water) to alder carr. If exposed to salinity, this vegetation is vulnerable, and so a marine transgression will result in a change from peat to peaty clay to clay. Drying out would lead to rapid decay of the accumulated material.

These three types of deposit cover the normal range observed in the Wentlooge Formation; variations warrant detailed analysis.

Rockingham Farm, Avonmouth, Bristol (ASMR 5215)

ST 5273 8091: present ground level 6.2m OD

The evaluations around Rockingham Farm were focused on the medieval moated site, but also encountered a lower deposit (layer 729) within the grey silty clay at 5.2 m OD, extending over an area in excess of 100 m across. The layer is characterised by a zone of pale blue silty clay, within which (usually towards the top) is a very thin band of organic material. In one place, two separate organic bands were found, at 5.1 m and 5.2 m OD. When exposed in area, the layer was seen to have gently undulating form, with some vertical cracks (Locock 1997b [note that the main text description and dating is superseded by the footnote, p. 88]; Walker *et al.* 1998a; Locock and Lawler in press).

Limited pollen and foraminifera data from a column through the silty clays suggest that the lower deposits are from an upper saltmarsh location, with some freshwater input; there follows a terrestrial phase (associated with the organic band) before intertidal conditions return. The organic band is of limited thickness (less than 1 mm), and granular; it is possible that part of its strong black colour is the result of the deposition of Manganese around the carbon and at the layer boundary. The organic layer is probably the decayed remains of the last vegetation (H horizon), with the clay below representing an undeveloped mineral horizon (B), with no evidence for organic development. Later waterlogging and silting was accompanied by gleying of the clay. The presence of two organic bands in places presumably reflects this process repeated twice, with an intervening period of deposition of 0.10 m of silt. The two horizons are separated by *c.* 300 years (radiocarbon dates Beta-118378, 3040 +/- 60 BP, 1401-1131 cal BC at two sigma; Beta-118379, 2810 +/- 70 BP, 1131-813 cal BC at two sigma).

Cabot Park, Avonmouth, Bristol

(Figures 3-4)

ST 535 800: present ground level 6.2 m OD

This site lies immediately southeast of Rockingham Farm, and has revealed a complex sequence of horizons which have been examined by a range of analyses (Locock *et al.* 1998; Walker *et al.* 1999a, 1999b).

At the base of the sequence, at 4.5 m OD, is an organic clay (contexts 162-164), first noted by a watching brief undertaken by Bristol and Region Archaeological Servcies (BARAS) on the construction of the Seabank Effluent Pipeline (and therefore sometimes referred to as the 'BARAS layer' (BARAS 1998). Two radiocarbon samples yielded dates *c.* 2500 cal BC (Beta-125794, 4170 +/ - 70 BP; 2905-2500 cal BC; Beta-125795, 3970 +/- 60 BP, 2585-2280 cal BP), closely agreeing with a sample previously taken by BARAS (Wk-5804, 3930 +/- 50 BP, 2580-2290 cal BC). Although the layer

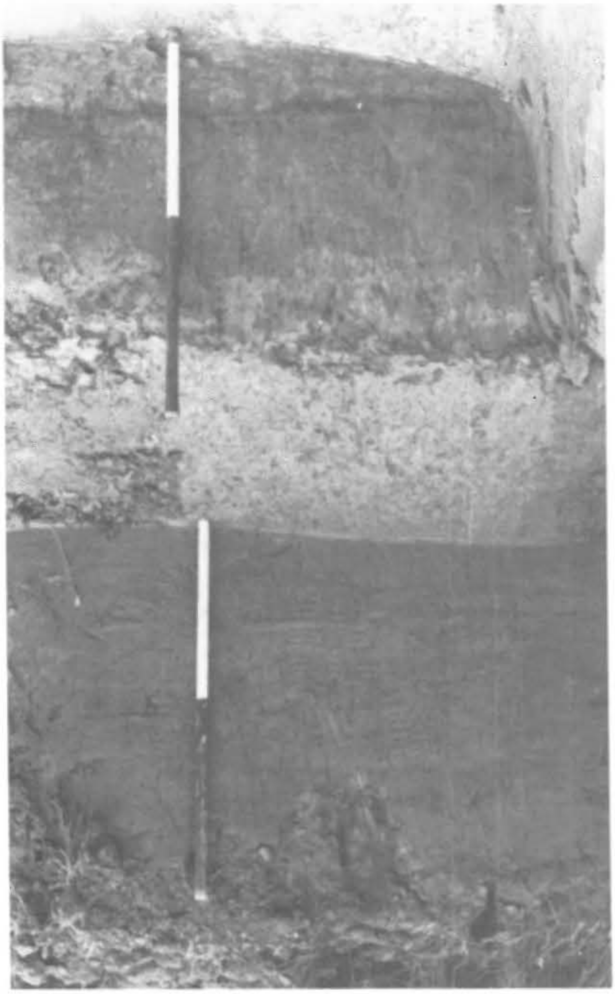


Figure 3: Cabot Park section, showing 'BARAS' layer at base, main gley at top of deep section. Scales 1m in 0.5m sections.

was visible as a strong black stain, with an almost 'oily' appearance, the organic content was less than 5%. Below the organic horizon were shallow blue-grey and mottled brown horizons.

The pollen evidence suggests saltmarsh with woodland nearby (arboreal pollen included *Corylus avellana*, *Alnus*, with some *Pinus* and *Tilia*). Soil micromorphology suggest a process of soil ripening (defined by Buol *et al.* (1980, 100) as exposure without accretion allowing air to reach previously reduced material) and the growth of vegetation. Small charcoal particles may reflect nearby human activity. Post-depositional flooding has led to the collapse of ped structures and the deposition of iron and manganese in root holes. In general, the environmental evidence suggests a more terrestrial location than that at Rockingham, but still close to the saltmarsh. The profile is considered to represent a developing soil with O, A and G horizons. It is remarkably extensive, and has been traced in trial pits over more than 500 m.

At 5.1-5.2 m OD, a second soil horizon was noted, showing usually as a pale grey clay with a slightly bluish tinge, in contrast to the grey-brown silts above and below. This has now been analysed in two locations, close to the Little Googs burnt stone site and the Kites Corner site. The organic component is about 2.5%, little higher than the main silty clays. Soil micromorphology shows evidence of a moderately long-lived soil, with seasonal drying of surface horizons; there is earthworm activity, but there is no indication of an overlying humic topsoil or

Figure 4: Cabot Park section: detail showing 'BARAS' layer, with organic layer overlying pale clay and mottled horizon. Scale 0.5m in 0.1m sections.

organic enhancement. There is some evidence for hazel growing nearby. The layer has been dated to *c.* 1500 cal BC (Beta-134900, 2970 +/- 60 BP, 1390-100 cal BC at two sigma; Beta-134901, 3350 +/- 60 BP, 1760-1505 cal BC at two sigma); this is substantially earlier than the date reported previously from the charcoal from the activity scatter at Kites Corner (Beta-12954, 2610 +/- 70 BP, 910-424 cal BC at two sigma), which may suggest that the activity post-dates renewed flooding and thus is intertidal.

A less extensive upper gleyed horizon has been found at Kites Corner, at 5.7 m OD, similar to the main gley. The horizon is sometimes capped by a thin organic band, as found at Rockingham Farm. The organic band was sampled for radiocarbon dating by AMS, yielding a date inconsistent with the main gley (Beta-134092, 2850 +/- 40 BP, 1120-910 cal BC); this may be because of the small carbon content that was extractable from the sample.

Hallen Marsh, Bristol (ASMR 6390)

ST 5431 8042: present ground level 6.5 m OD

The group of Iron Age roundhouses excavated in 1993 (Graham and Barnes 1993) was associated with a distinct soil horizon, whose presence in a geotechnical pit in 1990 led to the discovery of the site. In 1992, trenching and sampling had established the nature of both the site and the horizon, which lay at 5.7 m OD, comprising a silty clay of dark grey-brown colour, with numerous charcoal flecks, 0.3 m thick. A surprising feature of the layer (135) was the presence of stones, presumably associated with the human activity; high phosphate and magnetic susceptibility levels had a similar explanation. The carbon content was measured as 4.8% by loss-on-ignition. Lawler *et al.* (1992) considered that the layer was subject to periodic flooding and silting throughout its development. The carbonised plant remains include both possible arable cultivars (oat) and reeds (*Juncus*) suggestive of saltmarsh (Jones 1992), and thus may imply a location on the fringes of cultivated fields. The layer has produced numerous coarse pottery sherds of late prehistoric type; an Iron Age-Romano-British date was inferred. (Crowther 1992; Jones 1992; Lawler *et al.* 1992, 101).

The stabilised surface was static for long enough for a good degree of organic enhancement, presumable reflecting vegetation becoming established; the periodic flooding was not sufficiently heavy or long-lasting to bury or waterlog the surface, which has the characteristics of an A horizon. Subsequent renewed flooding was accompanied by some gleying at the base of the profile.

This soil horizon is particularly significant for two reasons; firstly, it is associated with the roundhouse settlement and possible agriculture; and secondly, its extent has been established by extensive auger transects by Wessex Archaeology. Although in the immediate area of the site the layer produced charcoal and pottery, elsewhere the survey may have encountered other horizons, of different date and nature, indistinguishable from the Hallen horizon by inspection of the extracted cores. The horizons recorded by the auger survey (as unit 3.1: Wessex Archaeology 1994) have sometimes been described for simplicity as the 'Wessex palaeosol'; in fact, there may be two or more horizons, that found at Hallen Marsh (the Hallen palaeosol), and those found some distance away (which may not be of the same date or type as Hallen).

Redwick, South Gloucestershire

Trial Pit G004 (ASMR 6433)

ST 5475 8576: present ground level 6.4 m OD

This trial pit was excavated in 1992 as part of the evaluation of the Second Severn Crossing route. Its main purpose was to permit sampling of a peat horizon at 3.8 m OD noted during previous geotechnical works. The upper sequence comprised a series of silty clays and sandy silty clays, separated into three deposits; none seemed to have a significant organic component. Analysis of the molluscs from the deposits from 4.5 m - 5.5 m OD showed that context 137 included only dryland species, implying grassland with shade (?hedges); context 136 had a similar assemblage but also include marsh and estuarine species. On the basis of the molluscs, Bell and Johnson suggested that context 137 may represent a land surface, at 4.9 m OD (Lawler *et al.* 1992, 44-45; Bell and Johnson 1992). There is no direct dating of the sequence; the land surface was tentatively linked to the Hallen Marsh Iron Age/Romano-British palaeosol.

The source of the mineral elements of the silts was presumably estuarine, and thus the molluscs are presumably reflecting a period in which estuarine conditions are suspended for long enough for a terrestrial vegetation to develop. Since this is probably incompatible with regular silting, it seems more likely that context 137 is an A horizon formed during a dry period. With the renewal of flooding (context 136) the vegetation (and fauna) changed to reflect the new estuarine/marsh conditions.

Goldcliff, Hill Farm

(Figure 5)

ST 368 825: present ground level 6 m OD

The discovery of an extensive soil horizon associated with a system of banks and ditches prior to the construction of the Gwent Levels Wetlands Reserve has been reported at length previously (Locock 1996; 1997a, 1997c). Although initially assumed to be Roman, a suite of radiocarbon dates has pushed its origins to the Middle Iron Age (Locock and Walker 1998; Walker *et al.* 1998b). The specialist analyses presented in Locock and Walker 1998 can be summarised as showing a long-lived stabilised soil with very limited organic component; the organic band is an L or A^0 horizon of charred reed, overlying a blue-grey gleyed horizon with, at the base, rusty mottling and siderite granules (A^1/G), (similar to Eyre 1963, fig. 22). Despite its location at the mouth of Goldcliff Pill, the environmental indicators suggest that estuarine conditions prevailed throughout silting, with a high normal water table preventing decay of the organic litter and its incorporation in the mineral soil A^1, but with periodic drying out allowing partial oxidation of the lower part of profile. Closure of the deposit did not take place until after 350 AD (Beta-126108, 1600 +/- 50 BP, 362-596 cal AD at two sigma). Although the considerable gap between the dates for the mineral and organic components of the soil has led some to doubt their accuracy, the stratigraphic relationship shows that in any case the gap between the two deposits was sufficient to permit the construction of three phases of sea bank on the surface, covered by the vegetation; a centuries-long timescale is therefore not inconceivable.

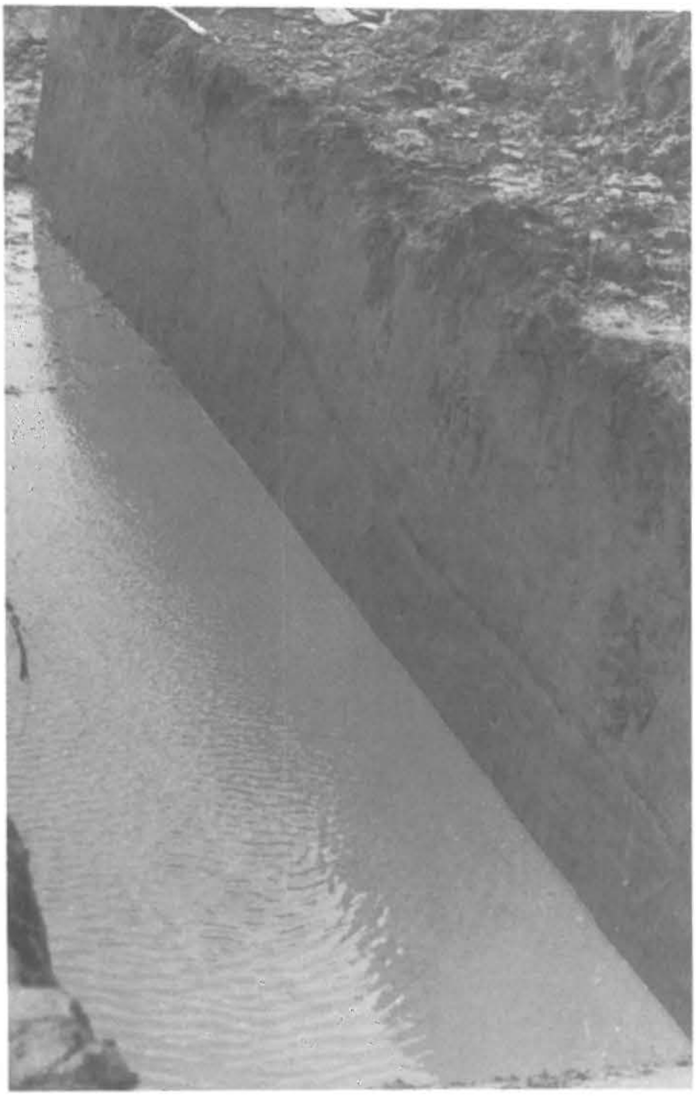


Figure 5: Hill Farm, Goldcliff; section through bank, showing soil surface sloping down to northeast (right).

Trowbridge, Wentloog Avenue

ST 234 793: present ground level 6 m OD

A watching brief on the construction of the Acer factory recorded a sequence of deposits, including an upper peat horizon at 3 m OD, 0.1m thick, (dated to Beta-118378, 3430 +/- 70 BP, 1886-1526 cal BC at two sigma), an intermittent organic clay at 4 m OD and an organic clay at 4.7 m OD, also 0.1-0.15 m thick (Locock 1998). Although the organic clays may mark the beginnings of peat growth, their horizontal nature and low organic content are more suggestive of a developing A horizon during a period when silt was not accreting and the water table was low.

Rumney, Maerdy Farm

ST 236 780: present ground level 5.8 m OD

The evaluation of a large area immediate northeast of the present sea wall at Rumney in 1990 was the first examination of the Wentlooge Formation within the protected part of the Wentlooge Level (Parkhouse and Parry 1990). In addition to a widely-found peat, 0.2 m thick, at 3.6-3.8 m OD, the evaluation also encountered numerous local examples of a thin organic band; Trial Pit 108 revealed two, at 4.4 m and 4.6 m OD. These lie beneath a further 1 m of Wentlooge Formation clay, and were dated by archaeomagnetism to *c.* 100 BC and *c.* 300 BC, although the curve was too noisy for precision (Clark 1990). These layers sealed a ditch cut into the underlying peat in Trial Pit 119.

Although at the time attention was focused on the peat deposit, it is now possible to recognise the upper organic bands as similar to those noted at Rockingham Farm and Hill Farm Goldcliff, and thus stabilisation events within the alluvial sequence.

Rumney Great Wharf

ST 237 776: present ground level 7m OD

The foreshore exposures of the Wentlooge and Rumney Formations at Rumney have been reported at length (Allen and Fulford 1986, 94-96; Allen 1987; Allen and Rae 1987; Fulford *et al.* 1994). The upper part of the Wentlooge Formation (at 5.5-6.0 m OD) is the Wentlooge palaeosol, composed of an 'upper pale horizon (0.15-0.30 m deep) and a lower, darker horizon (0.2-0.4 m deep)'. Within and below this surface, *Phragmites* roots and the meadow snail *Cepaea nemoralis* are found. The palaeosol contains Roman and medieval pottery, seals features of the Roman period, and is overlain by the post-medieval Rumney Formation (Allen and Fulford 1986, 95); it has been described in detail by Allen (1987, 163-165).

The slightly leached upper horizon is composed of siderite-mottled silty clays with root channels, preserving an organic lining. Small root channels are similar to saltmarsh grasses; larger channels are probably *Phragmites*. Invertebrate burrows are also present.

The lower horizon has evidence for churning and burrows, and *Phragmites* root hollows; corroded foraminifera and shells are present, as are insect remains.

The pale colour suggests that the upper horizon has been subject to limited organic input, and the colour change is therefore probably mineral in origin; Allen notes the presence of manganiferous concretions associated with root channels (1987, 165). The profile would therefore be similar to that seen at Goldcliff (pale horizon = A, dark horizon = G), but in which the accumulated organic material (L/F/H) on the surface which is not decaying because of a high water table (or acidity) has since been washed away or eroded. Soil ripening is implied by the widespread deposition of siderite in worm burrows.

The circumstances of the creation of the observed profile were probably very wet, with a high ground water level but with limited sediment accretion. This is compatible with the mainly pastoral plant macrofossil assemblage from the Roman ditch fills (Fulford *et al* 1994). Whether the reduction in sedimentation is due to deliberate reclamation and the construction of a sea defence and drainage system (as Allen and Fulford (1986) propose), or longer-term changes in the topography of the estuary and the resulting tidal flows, remains debatable.

The 'Wentlooge palaeosol' is localised to that particular part of the exposed Wentlooge Formation, and thus perhaps would be better termed the 'Rumney Great Wharf Wentlooge palaeosol'.

The Somerset Levels

Work on the Somerset Levels has demonstrated the presence of similar horizons (Rippon 1997a, 74-75). At Lakehouse Farm, Nash noted 'a black layer of (?) peat and/or old turf line and/or occupation debris', which sound similar to those noted at Rocklingham; at York Farm a buried soil was recorded as a 'grey-brown layer, 0.25m thick', perhaps similar to the Hallen Marsh horizon; several Roman soils have been recorded in the Burnham area (Rippon 1995).

Excavations at Waterloo Farm, Banwell, revealed two horizons: a Roman land surface, 0.1m thick, and a prehistoric surface, which appeared as a dark blue/black layer (Rippon 1997b); Mays Lane, Puxton has revealed a similar sequence (Rippon 1997b, 1998: see especially Rippon 1998, fig. 4); both have been subject to detailed analysis and dating.

Discussion (Figure 6)

When the soil horizons reported here began to be recognised, they were thought to be of particular significance because they were presumed to reflect periods of fully terrestrial conditions; although this is of ecological interest, there was also an important archaeological corollary, in affecting the perception of potential occupation, settlement and land-use.

In reviewing the examples, what has emerged is a fairly consistent picture of high groundwater levels and limited soil development. Thus although it is correct to see the horizons as marking stabilisations of the upper saltmarsh for decades or longer, they still lie firmly within the coastal margin environment. It is therefore not surprising to see that these stabilisations are often extremely localised in time and space, the product of minor shifts in the local topography, rather than providing continuous stratigraphic units across large parts of the Levels.

This recognition does nothing to diminish the significance of the cases where terrestrial conditions do seem to have occurred, at Hallen and perhaps

Redwick; quite the opposite: their rarity can now be used to demonstrate their special significance.

A typology of buried soils

Type 1: A/B soils

A horizon: mixed organic and mineral material, bioturbation, grassland molluscs, earthworm activity

B horizon: mineral layer with evidence for weathering

Examples: Hallen Marsh, ?Redwick, ?Wentloog Avenue

Environment: low water table, little sediment, established vegetation: dry land/reclaimed marshland

Type 2: O/A/G soils

O horizon: organic material deposited on mineral surface (may be eroded or minimal)

A horizon: mineral with some bioturbation but minimal organic content, weathered

G horizon: mineral horizon with concretions and mottling (evidence of ripening)

Examples: Rockingham Farm, Cabot Park (BARAS), Hill Farm Goldcliff, ?Rumney Great Wharf

Environment: high water table with intermittent drying out

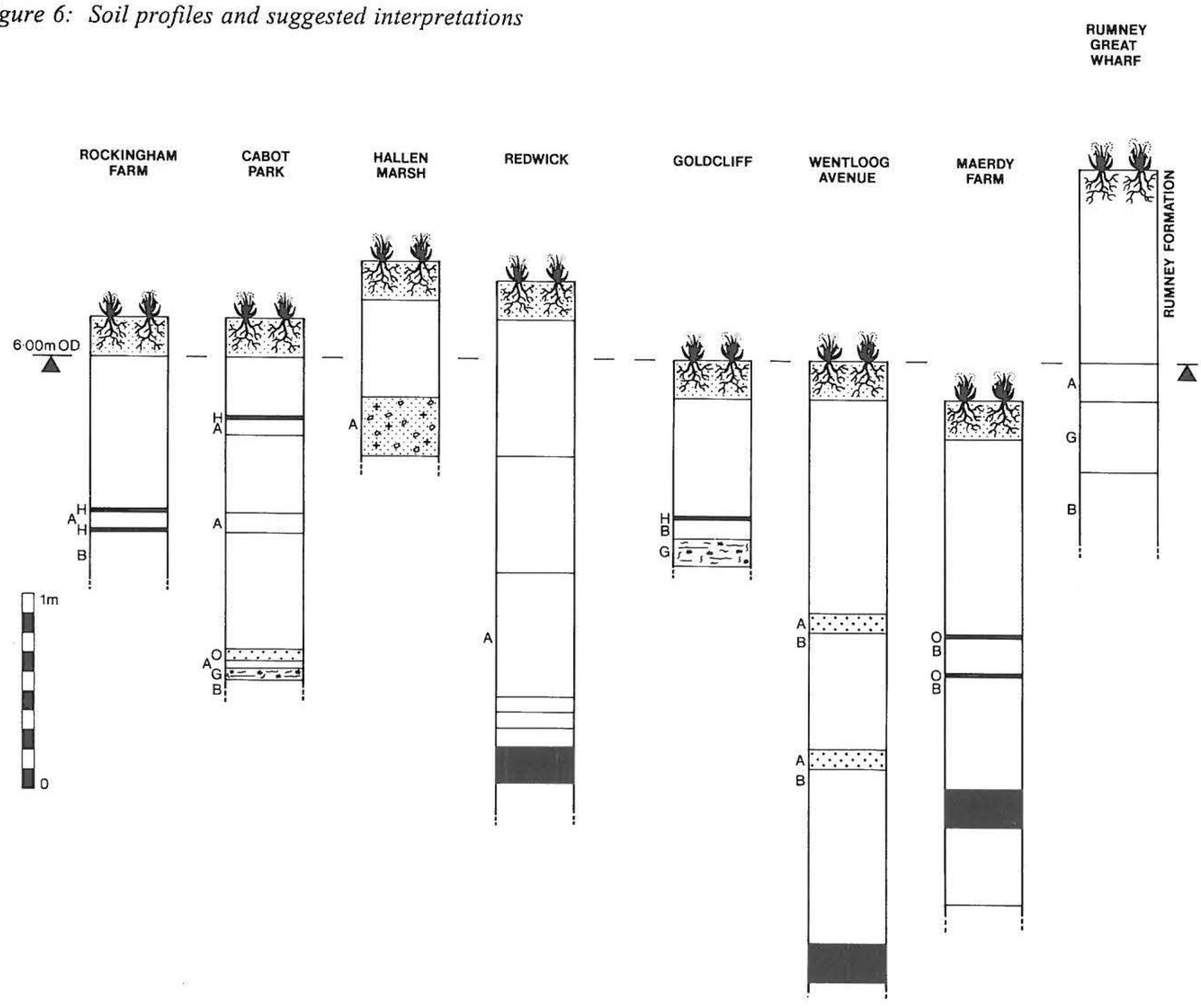
Type 3: O/A soils

As Type 2, but with no evidence of ripening.

Examples: peats in Wentlooge Formation

Environment: high water table without drying episodes

Figure 6: Soil profiles and suggested interpretations



Conclusions

This paper has attempted to classify some of the horizons noted by archaeologists over the last 10 years within the Wentlooge Formation. It will be apparent that the diagnostic evidence for their precise ecological implications almost always comes from detailed off-site analysis. The routine testing of such deposits for organic content would be a significant first step in building up a true picture of the development of the Levels.

Alongside this, soil micromorphology is a direct way of addressing these issues. In contrast, further work on the often sparse pollen, diatoms and foraminifera may add little to our understanding.

The basic methodological problem remains one of dating: with such low carbon levels, even AMS may produce unreliable dates. An unfortunate complication is the possibility that some of the organic material may have been in a mineral soil for some time, or even be derived from older peats. Unless we are fortunate to have good archaeological or dendrochronological dating of associated features, there seems to be little option but to expose as large areas as possible of these surfaces, with careful control of the precise units sampled.

With the recognition that soil horizons may be quite common but of only localised extent, the use of existing commercial borehole data to map their presence is perhaps dangerous, and opportunities to observe and sample the layers (by test pitting) may be more productive.

Acknowledgements

This paper draws on numerous discussions at various sites about the precise significance of the stratigraphy. I am particularly grateful to John Allen, Martin Bell, Alison Borthwick, Astrid Caseldine, John Crowther, Denise Druce, Naomi Earl, Jen Heathcote, Bob Jones, Richard Macphail, Mark Noël, Vanessa Straker, and Mike Walker, and to my colleagues Martin Lawler and Adam Yates. The figures were prepared by GGAT Illustration Department. I am grateful to Andrew Marvell and the external referee for their comments on the text: what is presented here is, of course, a personal view.

Bibliography

Allen, J.R.L. 1987 Late Flandrian shoreline oscillations in the Severn Estuary: The Rumney Formation at its typesite (Cardiff area). *Phil. Trans. Royal Soc., B.* **315**, 157-184.

Allen, J.R.L. and Fulford, M.G. 1986 The Wentlooge Level: a Romano-British saltmarsh reclamation in southeast Wales. *Britannia* **17**, 91-118.

Allen, J.R.L. and Rae, J. 1987 Late Flandrian shoreline oscillations in the Severn Estuary: a geomorphological and stratigraphical reconnaissance. *Phil. Trans. Royal Soc., B.* **315**, 185-230.

BARAS 1998 *Archaeological watching brief on the laying of an effluent pipeline between Avonmouth sewage works and Seabank power station, Severnside, Bristol.* BARAS report 265/1998 to Wessex Water (copy in Bristol SMR).

Bell, M. 1994 Field survey and excavation at Goldcliff, Gwent 1994. *Archaeology in the Severn Estuary* **5**, 115-144.

Bell, M. and Johnson, S. 1992 The molluscs. In Lawler *et al.* (ed.) 1992, 109-110.

Buol, S.W., Hole, F.D. and McCracken, R.J. 1980 *Soil Genesis and Classification.* Iowa State University Press, Ames (2nd ed: 1st ed 1973).

Clark, A.J. 1990 Palaeomagnetic dating column AJC-56. In Parkhouse, J. and Parry, S. 1990, 89-91.

Cornwall, I.W. 1958 *Soils for the Archaeologist.* London, Phoenix House.

Crowther, J. 1992 Laboratory report on the sediments. In Lawler *et al.* (ed.) 1992, 89-96.

Eyre, S.R. 1963 *Vegetation and Soils: a world picture.* London, Edward Arnold.

Fulford, M.G., Allen, J.R.L. and Rippon, S.J. 1994 The settlement and drainage of the Wentlooge Level, Gwent: excavation and survey at Rumney Great Wharf 1992. *Britannia* **25**, 175-212.

Graham, A.H. and Barnes, I. 1993 Excavations on the Iron Age site at Hallen. In Barnes, I. Second Severn Crossing English Approaches: an interim statement on the 1992/3 fieldwork. *Archaeology in the Severn Estuary* **4**, 5-31; 8-13.

Hodgson, J.M. 1976 *Soil Survey Field Handbook: describing and sampling soil profiles.* Harpenden, Soil Survey Technical Monograph **5**.

Jones, J. 1992 The macroscopic plant remains. In Lawler *et al.* (ed.) 1992, 103-106.

Limbrey, S. 1975 *Soil Science and Archaeology.* London, Academic Press.

Lawler, M., Parkhouse, J. and Straker, V. (ed.) 1992 *Archaeology of the Second Severn Crossing: Assessment and recommendations for the English Approaches.* Unnumbered GGAT report to Second Severn Crossing Group, Swansea (copy in Bristol and South Gloucestershire SMRs).

Locock, M. 1996. Hill Farm, Goldcliff: a field evaluation on the proposed Gwent Levels Nature Reserve, 1996. *Archaeology in the Severn Estuary* **7**, 59-66.

Locock, M. 1997a Gwent Levels Wetlands Reserve, Hill

Farm, Goldcliff: excavations 1997. *Archaeology in the Severn Estuary* **8**, 55-65.

Locock, M. 1997b Rockingham Farm, Avonmouth: moated enclosures on the North Avon Levels. *Archaeology in the Severn Estuary* **8**, 83-88.

Locock, M. 1997c The Goldcliff stone and Roman drainage on the Caldicot Level: an evaluation at Hill Farm, Goldcliff, 1996. *Britannia* **29**, 329-336.

Locock, M. 1998 Trowbridge, Wentloog Avenue. *Archaeology in Wales* **38**, 94.

Locock, M. and Lawler, M. in press Moated enclosures on the North Avon Level: survey and excavation at Rockingham Farm, Avonmouth, 1993-1997. Transactions of the Bristol & Gloucestershire Archaeological Society *118 (2000).*

Locock, M. and Walker, M. 1998 Hill Farm, Goldcliff: Middle Iron Age drainage on the Caldicot Level. *Archaeology in the Severn Estuary* **9**, 37-44.

Locock, M., Robinson, S. and Yates, A. 1998 Late Bronze Age sites at Cabot Park, Avonmouth. *Archaeology in the Severn Estuary* **9**, 31-36.

Parkhouse, J. and Parry, S.J. 1990 *Rumney Alternative Feeding Grounds: an archaeological assessment.* Unnumbered GGAT report to Cardiff Bay Development Corporation (copy in GGAT SMR).

Rippon, S. 1995 Roman settlement and salt production on the Somerset coast: the work of Samuel Nash. *Somerset Archaeology and Natural History* **139**, 99-117.

Rippon, S. 1997a *The Severn Estuary: landscape evolution and wetland reclamation.* Leicester, Leicester University Press.

Rippon, S. 1997b Roman and medieval settlement on the North Somerset Levels: the second season of survey and excavation at Banwell and Puxton, 1997. *Archaeology in the Severn Estuary* **8**, 41-54.

Rippon, S. 1998 Medieval settlement on the North Somerset Levels: the third season of survey and excavation at Puxton, 1998. *Archaeology in the Severn Estuary* **9**, 69-78.

Walker, M.J.C., Caseldine, A.E., Barrow, K., James, J.H., Cameron, N.G. and Kreiser, A. 1998a *Palaeo-environmental assessment of Late Flandrian sediments from Rockingham Farm, Avonmouth, near Bristol.* GGAT/Palaeoenvironmental Research Centre, University of Wales, Lampeter report to Burford Group PLC; GGAT report no. **98/058** (copy in Bristol SMR).

Walker, M.J.C., Caseldine, A.E., Cameron, N.G., James, J.H., Kreiser, A. and Barrow, K. 1998b *Palaeo-environmental assessment of Late Flandrian sediments from Hill Farm, Goldcliff, near Newport, South Wales.* GGAT/ Palaeoenvironmental Research Centre, University of Wales, Lampeter report to Cardiff Bay Development Corporation; GGAT report no. **98/048** (copy in Bristol SMR).

Walker, M.J.C., Caseldine, A.E., Barrow, K., Dobinson, S.J., James, J.H., Kreiser, A. and Macphail, R.I 1999a *Palaeoenvironmental assessment of Late Flandrian sediments from Cabot Park, Avonmouth, near Bristol. GGAT/* Palaeoenvironmental Research Centre, University of Wales, Lampeter report to Burford Group PLC; GGAT report **99/025** (copy in Bristol SMR).

Walker, M.J.C., Caseldine, A.E., Crowther, J. James, J.H. and Macphail, R.I. 1999b *Palaeoenvironmental assessment of Late Flandrian sediments from Kites Corner, Avonmouth, near Bristol.* Unnumbered GGAT/ Palaeoenvironmental Research Centre, University of Wales, Lampeter report to Burford Group PLC (copy in Bristol SMR).

Wessex Archaeology 1994 *The Second Severn Crossing: English Approaches, archaeological survey and landscape analysis, post-excavation assessment.* Wessex Archaeology report to Dept. of Transport.

Martin Locock
Glamorgan-Gwent Archaeological Trust,
Ferryside Warehouse,
Bath Lane,
Swansea
SA1 1RD