THE PHYSICAL EVOLUTION OF THE NORTH AVON LEVELS: SUMMARY RESULTS FROM THE SECOND SEVERN CROSSING ENGLISH APPROACHES PROJECT

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The construction of the new motorway links (the M4 and M49) for the Second Severn Crossing and the resultant infill and developments, which would come in their wake, provided the opportunity for a comprehensive programme of archaeological desk -based research, auger survey, building recording, excavation, and palaeo-environmental work (The Second Severn Crossing English Approaches Project). The defined area of study covered approximately 54 km², bounded respectively to the north and east by the M4 and M5 motorways, to the south by Bristol, and to the west by the Severn Estuary (GGAT 1992).

An interim report on the fieldwork was published in this journal in 1993 (Barnes 1993); fieldwork was completed in 1994, and an assessment report and proposals for publication (as a monograph) prepared (Wessex Archaeology 1994). In the event, the post-excavation programme was not commissioned until 2001 when the idea of a monograph was abandoned in favour of a series of related papers. The first of these, on the prehistoric archaeology of the Avon Levels, was published in the *Proceedings of the Prehistoric Society* (Gardiner *et al* 2002). The second, much longer, paper on the physical evolution of the levels, was also drafted in 2001 following discussions with a national journal. Unfortunately, that journal then underwent an editorial review and altered its remit to the extent that the paper was no longer deemed suitable for inclusion.

The length and complexity of the paper was such that it was difficult to identify another journal that could take it in its entirety, yet it was not an attractive proposition for a monograph. The text therefore languished while various proposals were discussed and, ultimately, dismissed. In the end it was decided that the strength of the paper was in the integration of the detailed analyses with wider thematic discussions and that its integrity would be unnecessarily compromised by various proposals to 'disaggregate' it that had been considered. The decision has therefore been taken to publish it in full, online, and it can be found at www.scribd.com / doc/ 36390693 /The -Physical -Evolution-of-the-North-Avon-Levels. A number of archaeological and/or sedimentary investigations have been undertaken since completion of the draft and further sea-level index points obtained. We are confident, however, that none of this will have substantially altered the arguments and conclusions presented though some refinements at the detailed level have certainly been achieved.

The paper presented here is the third of the intended series and represents a brief synopsis of the full paper (Allen and Scaife 2009). That paper deals with a series of major environmental sequences – mostly obtained 'off-site' from the archaeological deposits investigated during the English Approaches Project – and represents the most systematic investigation of the middle/upper Wentlooge Formation undertaken on the English side of the estuary (certainly up to 2001 and probably since). The sequences are described and discussed individually, followed by a detailed and wide-ranging discussion of the evolution of, and human interference in, the Avon Levels. Here we draw together the main strands of evidence and discussion to paint a brief portrait of this complex sedimentary landscape.

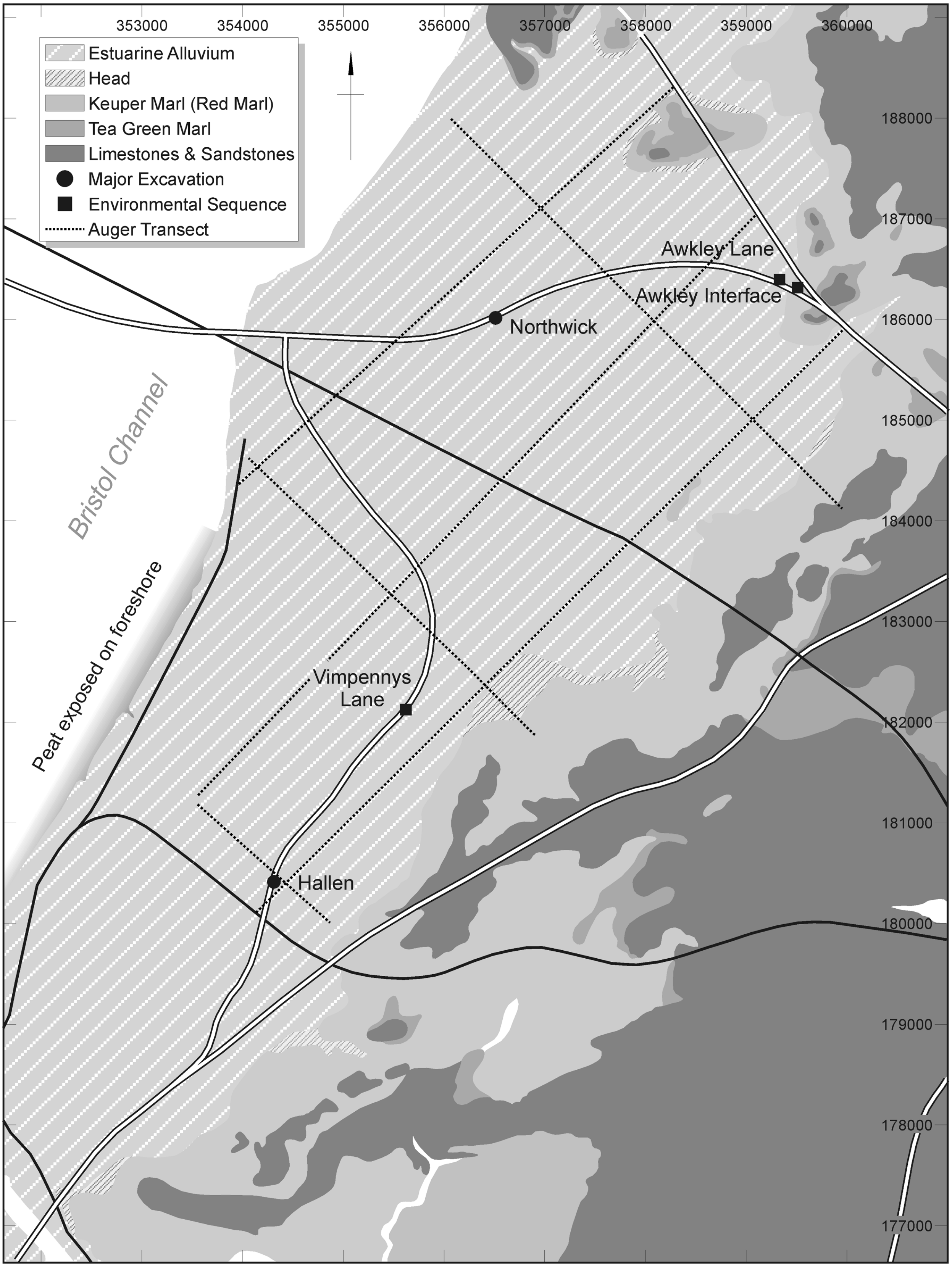

Figure 1 The geology of the Avon Levels showing the location of the archaeological and sedimentological investigations.

The English Approaches Project provided the first opportunity to present the detailed results of the palaeo-environmental analysis of the later Holocene sedimentary sequence of the region. These interpretations are of value in understanding the physical development and evolution of the Avon Levels and the wider Severn Estuary Levels. They also provide the foundation for wider discussion of the social development and patterns of human exploitation of the area, particular in later prehistory (Gardiner *et al* 2002).

Four main investigations of sediment profiles, up to 5m thick, were undertaken which were reviewed in relation to previous work and related spatially through a large-scale auger survey. The investigations were primarily concerned with the middle and upper Wentlooge Formations, the peat within which is dated in the Avon Levels from *c*.4500 CAL BC (5600 BP), interrupted by episodes of minerogenic sedimentation. Peats were succeeded by the upper Wentlooge clays at *c*.1500–500 CAL BC (see Table 1). The work did not deal with the later Rumney, Awre, and Northwick formations, which are restricted to the coastal margins and estuarine fringes seaward of the seabank (Allen and Rae 1987; Allen 1987; Allen 1988).

The importance of understanding the precise nature of the estuarine environment is that it allows us to visualise the Avon Levels and the Severn Estuary Levels as a whole. Sediment-ological and geoarchaeological approaches have tended to concentrate on defining the origin of the sediments (marine, fluvial, estuarine), on modelling sedimentation, accretion, and salt-marsh growth, and in examining changes in relative sea-level (RSL) and the effects of autocompaction (eg, Allen 1987; 1988; 1990; Allen and Rae 1987; Hibbert 1980).

Most of these studies define the nature of the developing landscape and surface morphology as either high intertidal zone environment (i.e. mudflat to salt-marsh) or freshwater fen. There is certainly a shallow gradient between mudflat and salt-marsh and the definition of each environment is not as significant in geomorphological terms as it is to archaeology. The precise nature and location of these types of habitat are directly pertinent to the exploitation, settlement, use, and longevity of human activity in prehistoric and historic times and the present.

Investigations which provide information relevant to the physical and social evolution of the Avon levels are the two deep sondages exposing long sediment sequences excavated at Awkley Lane (ST 5932 8638) and Vimpennys Lane (ST 5561 8211); two shallow sequences exposed in relation to excavations of archaeological sites at Hallen Marsh (ST 3543 1804) and Northwick (ST 565 86); and sequences on the wetland margins at the foot of Awkley Hill at Awkley Interface (ST 895 863) (Figure 1). At Hallen Marsh and Northwick, full-scale open-area archaeological excavation was conducted to reveal Iron Age and Romano-British activity in plan. Each was buried beneath relatively shallow (*c*.0.5m) alluvium (Gardiner *et al.* 2002). At Awkley Lane and Vimpennys Lane machine-excavated, 10m square stepped trenches were opened to investigate the middle and upper Wentlooge sequence (Figure 2). A series of machine-cut trenches at the foot of Awkley Hill revealed the alluvial-colluvial interface.

Figure 2 Awkley Lane excavation showing the fully excavated and exposed upper and middle Wentlooge sequence.

In most cases full suites of samples were taken for the investigation of pollen, diatoms, snails, waterlogged plant and insect remains and soils. Where archaeological activity was encountered this provided some chronology, sparse charred remains and discarded animal bones. Where organic and peat deposits were encountered samples were taken for radiocarbon dating. Samples were also taken through two sequences for archaeomagnetic dating of the fine-grained middle and upper Wentlooge sediments. Figure 3 presents a correlation of the sedimentary facies present in the five sequences. Full data tables, pollen and diatom diagrams and sedimentary descriptions can be found in Allen and Scaife (2009).

The combined pollen evidence from the five sequences indicates change in habitat types through the Awkley Lane (middle Wentlooge) peat sequence and evidence of regional variation at Vimpennys Lane. The vegetational sequence was greatly influenced by the effects of changes in RSL. Increasing RSL during the early Holocene and early middle Holocene periods was responsible for the deposition of the lower Wentlooge Series. Subsequent, negative changes in RSL resulted in coastal emergence and development of extensive fen carr and peat accumulation (middle Wentlooge) over these underlying clays. This can be clearly seen at Awkley Lane (Table 1), where the date for the bottom of the sequence is 4530–4350 CAL BC (5603±50 BP, NZA-12774; note that the radiocarbon dates have recently been recalibrated using Oxcal 4.1). Here, a lower peat horizon was dominated by an alder carr woodland with an undergrowth of wet/damp loving species. The middle peat horizon in this sequence, at 3640–3380 CAL BC (4745±50 BP, NZA-12529), showed that a tall herb fen/reed-swamp was the dominant vegetation with very little or no indication of woodland present within the local mire habitat. Fluctuations in ground water levels, possibly due to increased run-off resulting from clearance (see below), or through more regional change in RSL, resulted in disturbance to the fragile balance of alder carr and water table leading to this decline in woodland.

This was then followed by a change in vegetation to one dominated by *Sphagnum* moss with strong evidence of birch carr growing on and near the site by 3090–2700 CAL BC (4286±55 BP, NZA-12528). Although caution is needed in interpreting such a sequence, in general terms it can be said that a period of approximately 1500 years saw a vegetation change from an alder woodland to one dominated by *Sphagnum* moss at Awkley. By contrast, further out in the floodplain at Vimpennys Lane, such birch carr woodland was not present but, instead, a poor fen (reed-swamp) dominated by *Phragmites australis* was dominant and was, perhaps, periodically inundated by brackish water. In this interpretation, the pollen evidence is confirmed by the results of insect and diatom analyses (by M. Robinson and N. Cameron respectively). These data may be comparable with the Somerset levels (Godwin 1975, 31) where the development of ombrotrophic mire was often preceded by a stages of *Phragmites* and *Cladium* fen and fen carr woodland. At Meare Heath (Hibbert 1980) for example, a raised *Sphagnum* ombrogenous mire had developed and was inundated by estuarine conditions at *c.*910–760 CAL BC (2624±45 BP, SRR-914).

The radiocarbon date of 4530–4350 CAL BC places the base of the Awkley Lane sequence just before the ‘primary (Neolithic) elm decline’, which is reflected in the pollen record here. Typically, the woodland of this period comprised dominant oak, elm, lime, ash, and hazel woodland (Birks *et al* 1975) with alder growing on-site in carr woodland. The general under-representation of lime and ash in pollen spectra suggests that these were the most important elements of the woodland in spite of the small percentage representation.

Here, *Tilia* (*Tilia cordata*) was locally dominant on the nearby well-drained soils and was also present as plant macrofossils (fruits) in the sample column (ident. A. Clapham). This adds further to the now numerous data from southern Britain which have demonstrated that this was the dominant, or at least co-dominant, taxon (with oak and/or elm) at this time (eg Moore 1977; Scaife 1980; 1988; Waller 1994). Whilst *Tilia* has been recorded many times in studies of the Somerset Levels, at Awkley the proximity of the sample site to well-drained land recorded percentages to 33%. Given the very great under-representation of *Tilia* in pollen spectra generally (Andersen 1970; 1973) these values must be regarded as significant. This, plus the presence of the fruits, provided clear evidence for such domination on suitable soils of the interfluves and on the localised islands which occur on the floodplain.

Whilst *Tilia* was clearly the dominant woodland element, other tree and shrub taxa were also of importance in the local environment. It is possible that oak, ash, and hazel formed parts of the dry carr woodland or woodland fringing the edge of the mire – perhaps on the thicker, down-

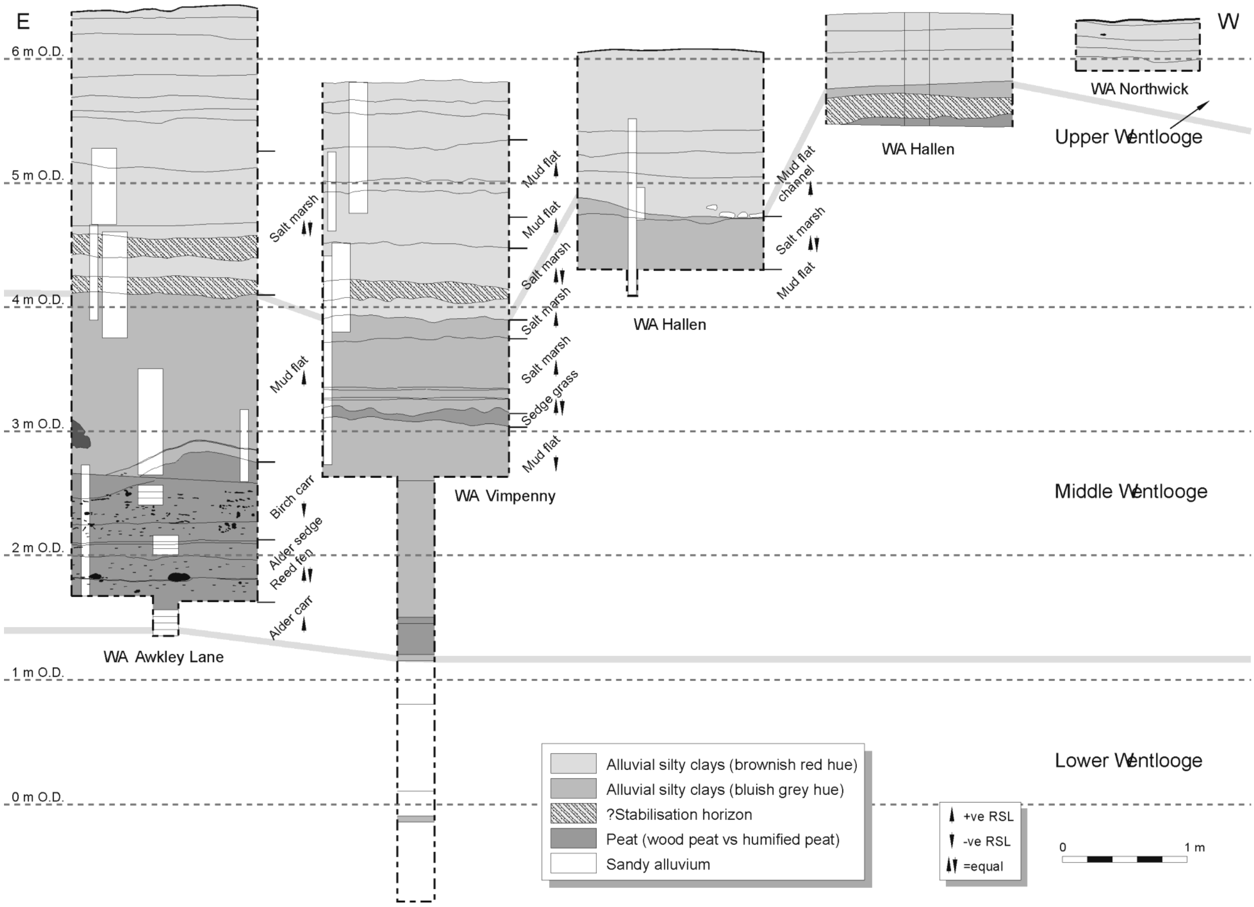

Figure 3 Correlation of the sedimentary facies from the reported sites.

slope soils. *Ilex aquifolium* (holly) was recorded at Awkley Lane. Like lime it is extremely poorly represented in pollen spectra so that the record here implies some importance.

The pollen data from Awkley Lane suggested a transition between pollen zones correlating with the early part of the prehistoric elm decline at *c.*5000 BP (or slightly later if dates for the Somerset Levels pertain). This was confirmed by the radiocarbon date of 3630–3360 CAL BC (4683±55 BP, NZA-12530) near the base of pollen zone AWK:2 (Allen and Scaife 2009, fig. 7**).** Further reduction in elm pollen at 1.86m AOD, and sharply expanding values of Poaceae (grasses) with sporadic occurrences of cereal type pollen, *Plantago lanceolata* (ribwort plantain), and peaks of other herbs including Asteraceae (*Bidens* type and *Aster* type), *Urtica* (nettle and pellitory) and Chenopodiaceae (goosefoots and oraches), are all indicative of changes in the local dry-land vegetation. An increase in herbs is strongly indicative of the first impact of human disturbance and agriculture on the environment though no archaeological evidence for Neolithic activity has so far been recorded in the Avon Levels (Bell 2007). Typically, there was evidence of a secondary, later Neolithic, regeneration of elm at Awkley as has similarly been recorded in other areas of southern England (Scaife 1988). Here, at *c.*2900–2800 CAL BC (4300–4200 BP), this was also associated with a regeneration of lime and ash. This may have resulted from changing agricultural practice to woodland-based pastoralism (Scaife 1980; 1988) though, again, there is no direct archaeological evidence.

After the Late Neolithic regeneration phase, there was progressive reduction in woodland which ultimately left oak and hazel as the principal arboreal constituents but with some remaining lime, ash, and beech. Evidence for these changes is complicated by the changing environment of deposition and thus sedimentology and pollen taphonomy. The next significant event was the widespread removal of lime woodland that may reflect the expansion of Bronze Age activity in the region. The non-synchronous decline in lime, from the Neolithic into the later Bronze Age, has been recognised at a number of

*Table 1 Radiocarbon determinations and calibrated results from the middle Wentlooge Formation at Awkley Lane and from detrital peat at Vimpennys Lane. * = GGAT 1992.*

Context	*Context type*	*Height AOD*	*Material*	*Lab no*	*δ C13‰*	*Result BP*	*Date Cal BC*
Awkley Lane							
110	bog oak	3.00	wood	NZA-12532	-25.7	3816±50	2460-2140
(111	peat band	2.92	humic acids	NZA-12590	-26.63	11,350±120	11,840-11,070)
111	peat band	2.92	plant matter	NZA-12754	-26.63	3991±55	2840-2310
GGAT	top of peat	2.62	peat	GU-3119	-28.3	4190±70	2910-2580*
GGAT	top of peat	2.62	wood alder	GU-3120	-28.3	4190±60	2900-2590*
113	top peat	2.78	peat	NZA-12533	-27.79	4044±50	2860-2470
113	peat	2.64	peat	NZA-12534	-27.48	3885±45	2470-2210
121	peat	2.42	wood alder	NZA-12528	-27.68	4286±55	3090-2700
120	band	2.14	wood peat	NZA-12529	-27.48	4745±50	3640-3380
117/8	top peat	1.82	twigs	NZA-12530	-26.78	4683±55	3630-3360
Elm decline *c*. 4800							
118	base of peat	1.44	female alder cones	NZA-12774	-26.57	5603±50	4530-4350
Vimpennys Lane							
211	?OLS	3.14	plant matter	NZA 12527	-25.98	4182± 55	2900-2620
GGAT		2.80		GU-3121	-27.2	4420± 90	3350-2900*

sites in southern England (eg Scaife 1980; Waton and Barber 1987; Waller 1993). Initially attributed by Godwin (1940; 1975) to climatic change, work by Turner (1962) has demonstrated a human cause and radiocarbon dating has now further demonstrated that the lime decline was asynchronous, with the majority of dates attributable to the Middle and Late Bronze Age. This decline in lime occurs in the sequences at Awkley Lane, Vimpennys Lane, and, to a lesser extent, at Hallen itself. At Awkley Lane there is also evidence of soil deterioration perhaps caused by such woodland clearance and subsequent acidification/podsolisation of the sandy soils of the fen islands. Whether or not clearance was the cause in the Avon Levels cannot yet be determined but the first clear archaeological evidence for human exploitation of the Levels occurs in the later Bronze Age, associated with clear stabilisation horizons.

All the analysed sequences show a clear stratigraphical boundary subsequent to the lime decline. The major episode of marine transgression that is apparent throughout the Severn Levels (eg Kidson and Heyworth 1976; Allen 1987a; Allen and Rae 1987; Hibbert 1980; Scaife and Long 1994) is clearly represented in the sequences discussed here. At Awkley Lane, the upper Wentlooge formation is characterised by estuarine silts resting on the middle Wentlooge peat. The upper Wentlooge transgressive event occurred here, as at Vimpennys Lane, at *c*.2550 CAL BC (4000 BP; Table 1). Palynologically these events seem to suggest that, at Awkley, the minerogenic sediments accreted initially in a mud-flat environment rather than salt-marsh. The sediment source was derived largely from rivers (Allen 1990; 1991) exiting and depositing their load into the now incumbent estuarine conditions. Such transported material is apparently better represented in the sediments of mud-flats. Thus, and unsurprisingly, there is evidence from the sites analysed of significant variations in the local character of the floodplain and estuarine environment with mud-flat, salt-marsh, and incised channels reflecting complex causes and responses to a range of controlling factors in estuarine environments/habitats (Long *et al* 2000).

At Hallen, although the lower levels are not clearly dated, they seem to correlate with the lower part of the upper Wentlooge Formation. As at Awkley, it appears that mud-flat developed into salt-marsh. Whether this was in response to positive or negative sea-level tendency is not clear but it seems more plausible that the on-site changes reflect a critical balance between sediment supply and vegetation dynamics.

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