APPENDICES

TOR CAIRN: SPECIALIST REPORTS

Appendix 1

Beaker sherds from Cairn ε Woodbury Common

Roger Taylor
Department of Geology, Royal Albert Memorial Museum, Exeter, UK

Fragments of Beaker pottery decorated with horizontal lines of impressions made with a bone comb; one plain sherd probably comes from the angle between the wall and the base. Very well made, which is typical of Beaker pottery. The silty clay of which they are made contains some quartz grains which derive from beach sand and some small fragments of chert. These components indicate a source from a coastal area in East Devon. It is usual for Beaker pottery to be made locally, within a few miles of its use or deposition. It is quite common for fragments of pottery to be buried in cairns at this time in Devon, rather than complete vessels.

Appendix 2

Charcoal analysis from central feature, Tor Cairn

Dana Challinor, MA (Oxon.), MSc

Thirty-four bags of charcoal were examined. All were from the same context (context 030), a small pyre deposited under a pebble cairn of Beaker date. The majority of the bags contained at least a few identifiable fragments of charcoal, which were identified in full using a Meiji incident light microscope at magnifications up to ×400 and with reference to appropriate identification keys and modern reference material. The material was assessed for suitability for radiocarbon dating and four samples were selected.

The preservation of the material was fair, but the anatomy was frequently obscured by sediment, and in some cases highly vitrified. The full results of the analysis are recorded in the archive, and a summary is presented below. Several of the oak fragments showed tyloses, indicating heartwood, but some small branchwood was also represented.

The results from the charcoal analysis are consistent with other Early Bronze cremation deposits across England in two respects: the

Table A2.1 Overall taxonomic composition of charcoal from central pyre context

Taxa	*Common name*	*Number of fragments*
Quercus sp.	oak	99 h, r
Betula sp.	birch	6
Corylus avellana	hazel	6 r
Betulaceae	–	2
Total	–	113

Key h= heartwood; r = roundwood.

assemblage is dominated by a single taxon, and that taxon is oak. The dominance of a single taxon in Bronze Age cremations has been attested at several sites, and linked to ritual selection (e.g. Challinor 2007). The use of oak in cremations may additionally have had more practical purposes: it provides a high calorific heat, necessary to cremate a body, and is suitable for pyre construction. The charcoal from other Late Neolithic/Early Bronze Age sites in the region (Cartwright 1988; Challinor forthcoming) indicates that the dominant environment of oak–hazel woodland was most commonly utilized for fuelwood.

References

Cartwright, C.R. 1988. 'The charcoal from Davidstow Moor', in Christie, P.M. 'A barrow cemetery on Davidstow Moor, Cornwall, wartime excavations by C.K. Croft Andrew', *Cornish Archaeology* 27: 27–169.

Challinor, D. 2007. 'The wood charcoal', in Timby, J., Brown, R., Biddulph, E., Hardy, A. and Powell, A. *A Slice of Rural Essex. Recent Archaeology along the A120 between Stansted and Braintree*. OWA Monograph 1. Oxford and Salisbury: Oxford Wessex Archaeology, CD-Rom.

Challinor, D. Forthcoming. 'The charcoal', in *Excavations on the A30 Bodmin to Indian Queens*. Oxford Archaeology.

Appendix 3
Phosphate analysis of samples from context 22 and control sample from TTC 09 level 6 square 4

Laboratory analysis by Antoním Majer, interpretation by Antoním Majer and Petr Pokorný*
Centre for Theoretical Study, Charles University, Prague, Czech Republic

1. Laboratory methods used

Phosphate analysis: relative method using extraction in 5 per cent acetic acid and subsequent photocolorimetric analysis.

Physical properties measurements: magnetic susceptibility, specific density, dielectric properties, analysis of paramagnetic properties in magnetic field much stronger than that of the Earth.

2. Results

Table A3.1 Phosphate analysis

Parameter measured	*Control sample TB09 square 4 level 6*	*Sample from context 22 for phosphate analysis*
Phosphates (mg P_2O_5/1 g)	0.0055	0.0035
Specific density (g/cm^3)	1.04	0.94
Magnetic susceptibility ($\times 10^{-6}$ SI)	8	32
Dielectric constant	2.42	3.13

Note:
Paramagnetic properties extremely low signal (below detection limit).

* Volyně, Palackého, 387 01, Czech Republic

3. Brief interpretation

Concentration of P_2O_5 (phosphate) is very low, both in the archaeological sample and in the reference sample. This finding excludes the possibility of the presence of bone materials (animal bones or human burial) and of organic waste rich in phosphates. All results of the physical property measurements exclude the influence of high temperatures (i.e. fire) in the genesis of both layers and in their post-depositional history. The lower specific density of the control sample is due to the content of organic (humic) substances.

Appendix 4

Results of pollen (and other microfossils) analyses

Petr Pokorný
Centre for Theoretical Study, Charles University, Prague, Czech Republic

Pollen analysis was undertaken of the same sample of the central area of Tor Cairn used for phosphate analysis from context 22.

Pollen slides preparation method

Standard acetolysis method according to Faegri and Iversen (1989) was applied to both analysed samples. This includes: treatment in 10 per cent KOH (boiling for 5 minutes); wet sieving; concentrated HF treatment (room temperature, 20 hours); acetolysis in mixture of anhydric acetic acid and H2SO4 (9:1, boiling for 3 minutes); staining by safranine. Pollen concentrates were mounted in 50 per cent glycerine.

This sample contains well-preserved pollen in rather low concentration (600 grains were counted on three 24 × 32 mm slides). Primary data are shown in Table A4.1. Nomenclature used follows Moore *et al.* 1991.

Table A4.1 Primary data

Trees	
Acer	22
Alnus glutinosa – type	34
Betula alba – type	78
Corylus avellana	58
Fraxinus	2

(continued)

Table A4.1 Continued

Ilex	13
Quercus	172
Tilia cordata	11
Ulmus	4
Arboreal pollen sum (AP)	394
Shrubs, dwarf shrubs	
Calluna vulgaris	15
Rosa – type	3
Rubus – type	1
Herbs (pollen and spores)	
Anthemis – type	1
Cannabis	6
Cruciferae	4
Cyperaceae	4
Gramineae	23
Helianthemum	3
Labiatae	12
Melampyrum	10
Mentha – type	2
Monolete spores (other than *Polypodium*)	11
Plantago lanceolata	2
Polypodium	103
Potentilla – type	3
Pteridium aquilinum	3
Ranunculus acris – type	1
Rumex acetosa – type	1
Rubiaceae	4
Umbelliferae	1
Non-arboreal pollen sum (NAP)	194
Undetermined pollen	13
Total pollen sum (AP + NAP)	601

Table A4.1 Continued

Other objects	
Charcoal particles (from 2 to 20 μm)	734
Hyalosphenia subflava (Rhizopoda)	7
Sphagnum	2

This pollen spectrum is clearly a woodland type. It shows few indicators of opened or deforested land (see AP/NAP ratio, about 2:1) and very little indication of human impact. No cereal pollen was found. The only cultivated taxon determined is *Cannabis* (hemp). Grazing indicators are present in low quantity – *Plantago lanceolata*, *Rumex acetosa* – type (grazed meadows) and *Melampyrum* (forest grazing). *Calluna vulgaris* may indicate nearby heaths, but its quantity is also low.

Local environmental conditions at the time of soil formation can be reconstructed as forest interior or a small glade within the forest. This was a natural ('primeval') broadleaf forest dominated by oak – see *Quercus* dominance in pollen spectrum. In the undergrowth, polypody (*Polypodium*) was common. This fern occurs in forest interiors, mostly on fallen trunks or on rocky ground. The sample contains some microscopic charcoal particles, but their concentration is very low. This result does not allow reconstruction of local fires at the time of sedimentation, nor post-depositional burning of sediment.

References

Faegri, K. and Iversen, J. 1989. *Textbook of Pollen Analysis* (4th edn, rev. Faegri, K., Kaland, P.E. and Krzywinski, K.). Chichester: John Wiley & Sons.

Moore, P.D., Webb, J.A. and Collinson, M.E. 1991. *Pollen Analysis* (2nd edn). Oxford: Blackwell Scientific.

Appendix 5
Soil micromorphology

Richard I. Macphail
Institute of Archaeology, University College London, UK

A single 14-cm-long thin section sample from the barrow-buried soil at Tor Cairn was received from Dr Mike Allen in order to examine the buried soil sequence and associated site formation processes.

Samples and methods

A single 14-cm-long thin section from the buried soil (Figure A5.2) was received (sample and thin section processed by Julie Boreham Earthslides) and analysed using a petrological microscope under plane polarized light (PPL), crossed polarized light (XPL), oblique incident light (OIL) and using fluorescent microscopy (blue light – BL), at magnifications ranging from 1 to 200–400. Thin sections were described, ascribed soil microfabric types (MFTs) and microfacies types (MFTs) (see Table A5.1 and archive), and counted according to established methods (Bullock *et al.* 1985; Courty 2001; Courty *et al.* 1989; Goldberg and Macphail 2006; Macphail and Cruise 2001; Stoops 2003).

Results and discussion

Results are presented in Table A5.1 and archive 2 and in Figures A5.2–A5.9 (additional photomicrographs present in archive and on CD-Rom). The thin section could be divided up into three layers. Twelve soil micromorphological characteristics were noted and counted.

Table A5.1 Tor Barrow: soil samples and micromorphology counts

Depth	*MFT*	*SMT*	*Percentage voids*	*Root trace*	*Gravel*	*Burned mineral*	*Charcoal*	*Clay*	*Sesqu.*	*Burrows*	*V. thin excr.*	*Thin excr.*
0–15mm	A2	1	35	–	ffff	–	–	–	aa	aaaa	aaa	a
15–100mm	B	2a 2b	45	aa	*	a–1	a(aaa)a)	–	–	aaa	(tot)al)	aa
100–135mm	Al	1(2) a)	30	a	ffff	–	a*	a*	aa	aaaa	aaa	–

Key
*– very few 0–5%; f – few 5–15%; ff – frequent 15–30%; fff – common 30–50%; ffff – dominant 50–70%; fffff – very dominant > 70%.
a – rare < 2% (a*, 1%; a-1, single occurrence); aa – occasional 2–5%; aaa – many 5–10%; aaaa – abundant 10–20%; aaaaa – very abundant > 20%.

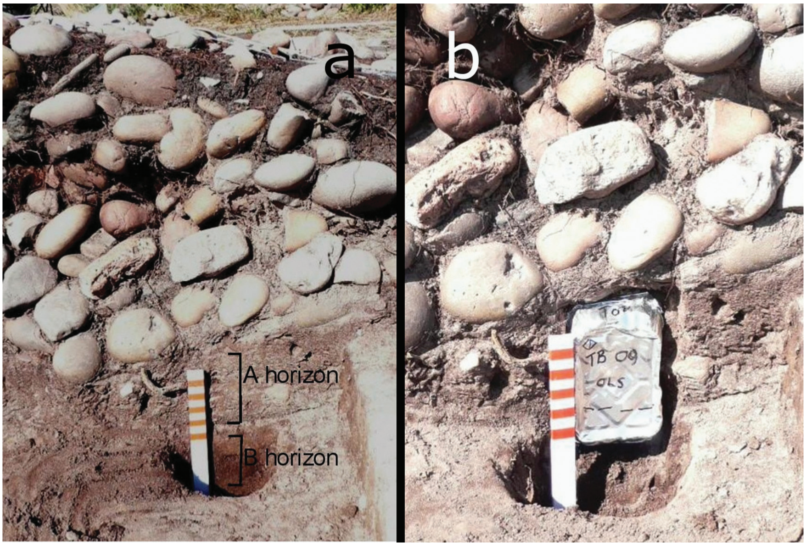


Figure A5.1 a) The truncated humic podzol beneath Tor cairn; b) The location of the Kubiena sample (Source: author)

Layer 3: 100–135 mm (truncated subsoil, below sharp horizontal boundary): This is a compact, massive, and very poorly sorted coarse mica-rich silt, with dominant sand and small stone size metamorphic rock fragments (quartzite and phyllite rocks)(Figure A5.2). This thinly burrowed, weakly humic and sesquioxidic stained soil is characterized by a thinly platy microfabric (at ~130–135 mm), burrows and root channels/root traces and very thin to thin organo-mineral excrements (Figures A5.3–A5.5). Trace amounts of very fine charcoal are present.

Layer 3 is a truncated subsoil B(hsx) horizon of original humo-ferric podzol formed in weathered pebble beds (Bunter sand), with relict periglacial microfabrics extant in base of thin section. Minor burrowing down from overlying turf layer occurred. This lower subsoil is thus a relict of last lateglacial pedogenesis and Holocene humo-ferric podzol formation (Findlay *et al.* 1983; Payton 1983; Smith *et al.* 1996). Buried soils in barrow cemeteries are often found to be truncated because turves have been used for earlier constructed barrows (cf. West Heath, Surrey, Drewett 1989).

Layer 2: 15–100 mm (turf layer at base of barrow): This is a very humic, coarse silt, which contains sand and very little gravel, and has a well-developed fine subangular blocky structure. Rare fine (1–2.5 mm), but abundant very fine charcoal occurs alongside possible rubefied angular rock fragment (6 mm) (Figures A5.2, A5.6–9). Occasional very thin

Figure A5.2 Scan of buried soil thin section 3) truncated stony (pebbles) B(hsx) horizon, 2) possibly inverted turf (arrowed burned stone) of barrow's turf base, 1) lowermost part of subsoil barrow make up. Length of scan ˜135mm (Source: author)

and thin roots, and a total biological microfabric, are recorded. Humic heterogeneous semi-layered fabric area is present at 90 mm (topmost layer of turf?).

This appears to be a probable single (trampled-inverted?) turf layer composed of humic topsoil formed in mainly aeolian drift (~loess). This acidic topsoil includes charcoal and probable burned rock evidence of long-term landscape management by fire. Such infertile parent materials can rapidly develop once woodland is cleared (Dimbleby 1962); turf was often inverted during barrow construction and as carried experimentally at Wareham, Dorset (Macphail et al. 2003).

Layer 1: 0–15 mm: The uppermost 15 mm of the thin section is composed of lower subsoil B(hsx) soil and stones.

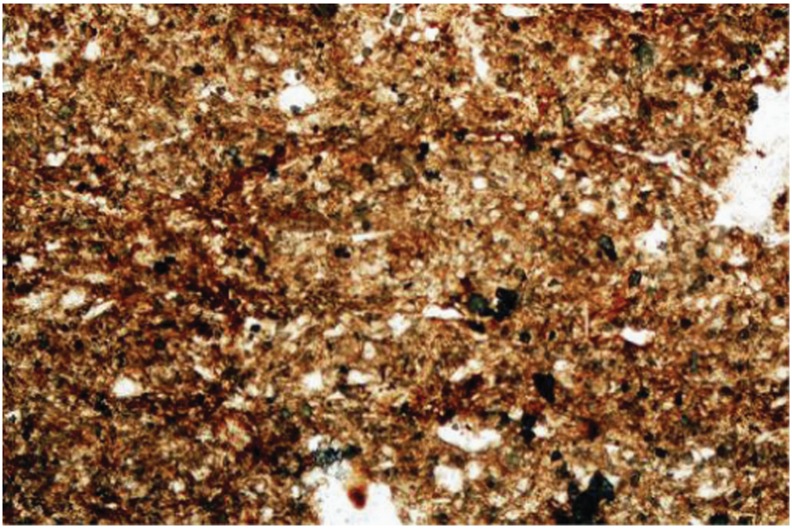


Figure A5.3 Photomicrograph of Layer 3; compact, relict periglacial thin platy structure. Plane polarised light (PPL), frame width is ˜2.38mm (Source: author)

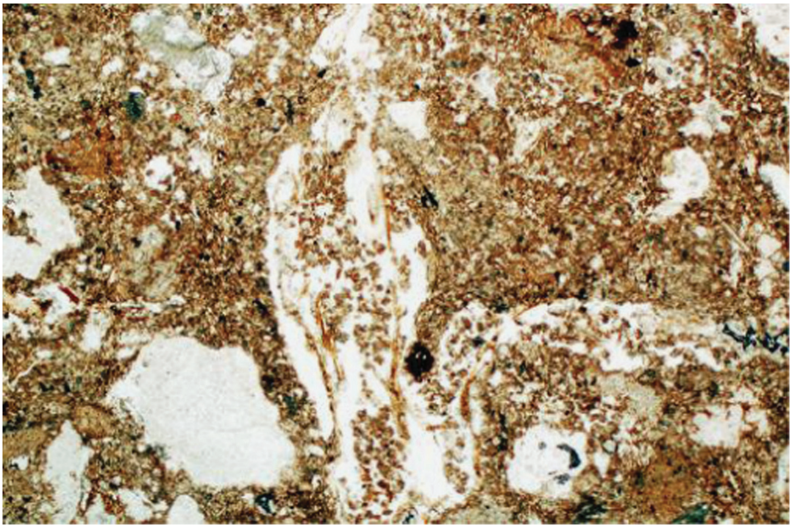


Figure A5.4 Layer 3; rooted B(hsx) horizon, with very thin and thin excrements of acidophyle mesofauna. PPL, frame width is ˜4.62mm (Source: author)

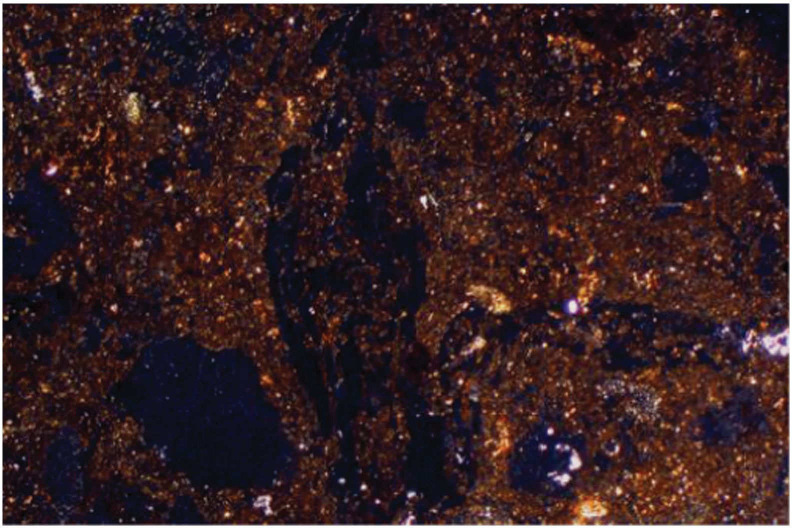


Figure A5.5 As Figure 6, under oblique incident light (OIL) (Source: author)

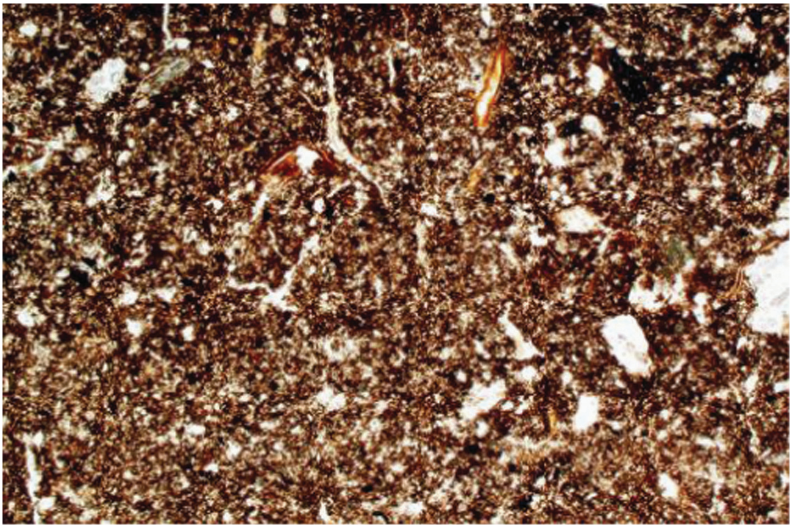


Figure A5.6 Layer 2; compact turf, with relict fine roots and thin burrows. PPL, frame width is ˜4.62mm (Source: author)

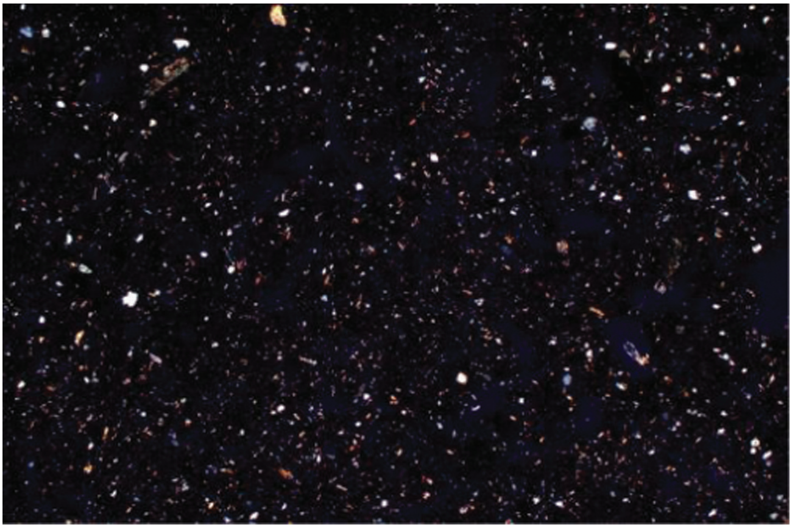


Figure A5.7 As Fig 8, under crossed polarised light (XPL); note silt mineralogy of aeolian drift origin (?) (Source: author)

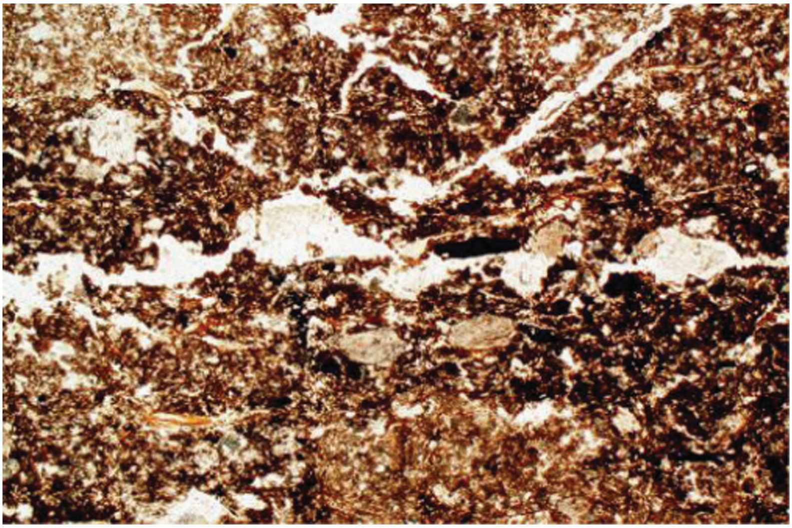


Figure A5.8 Layer 2; semi-laminated organic matter and charcoal at base of turf, thus suggesting the use of an inverted turf here. PPL, frame width is ˜4.62mm (Source: author)

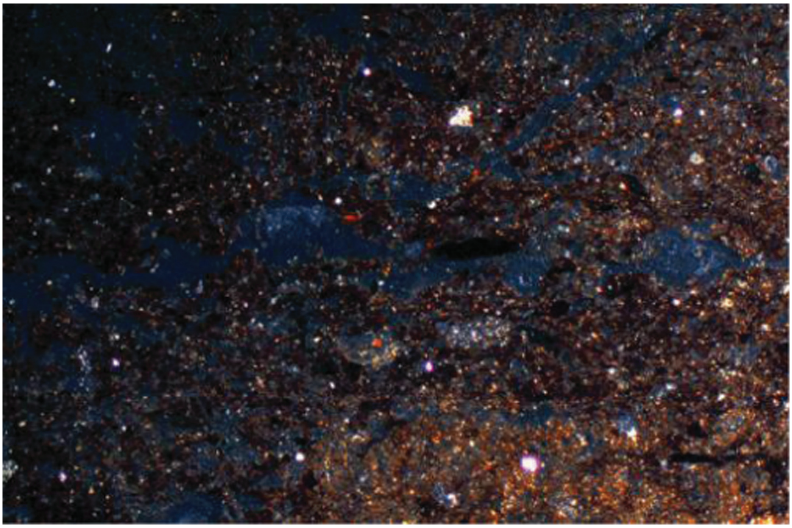


Figure A5.9 As Fig 10, under OIL; note high organic content; minerogenic soil fragment (bottom right) could have been trampled-in prior to use of this turf (Source: author)

Conclusion

Soil micromorphological analysis of a single 14-cm-long thin section sample from the soil below Tor Cairn found three layers: (1) the basal subsoil and pebble make-up of the barrow; (2) a turf base to this barrow; over (3), a truncated subsoil. The lower subsoil had a record of last lateglacial pedogenesis and acid soil formation and weak podzolization during the Holocene. The inverted turf is humic and contains much very fine charcoal testifying to management by fire.

Appendix 6

Pollen analysis of the sub-cairn buried soil

Rob Scaife
Department of Geography and the Environment, University of Southampton, UK

The buried palaeosol has been analysed for sub-fossil pollen and spores to provide information on the vegetation and environment in the period prior to construction of the cairn. Abundant pollen has been recovered which provides such useful palaeo-environmental data. As seen in Appendix 5, the upper portion of the sampled profile is an inverted turf, overlain on the humic podzol subsoil (Table A6.1). Overall, the evidence obtained is for a wooded environment which contrasts strongly with the heathland which exists today.

Pollen procedures

Samples of 1 cm width were provided by Dr Allen at 2 cm intervals; 0–10 cm being A horizon material and 10–14 cm being B horizon material.

Table A6.1 Concordance of soil records

Profile		*Soil micromorphology*			*Pollen*	
bA	37–51cm	0–14 cm (= 41–51 cm)	0–15 mm layer 1	Subsoil (Bhsx)	0–1 cm	bA
			15–100 mm layer 2	Inverted turf	2–3 cm 4–5 cm 6–7 cm 8–9 cm	
bB	51–60cm	14–18 cm (= 51–58 cm)	100–135 mm layer 3	Bhsx	10–11cm 12–13cm 14–15cm	bB

Sub-samples of 1.5 ml were processed using standard techniques for the extraction of the sub-fossil pollen and spores (Moore and Webb 1978; Moore *et al.* 1991). The sub-fossil pollen and spores were identified using an Olympus biological research microscope. Pollen sums of 500 grains per level were made except in two lower, subsoil levels where pollen was less abundant. Here, totals of 150 and 300 grains were identified and counted. In addition to pollen, spores of ferns were counted outside of the sum. A pollen diagram has been plotted using Tilia and Tilia Graph (Figure A6.1) with percentages calculated as follows:

Sum = % total dry land pollen (tdlp) Spores = % tdlp + sum of spores.

Taxonomy, in general, follows that of Moore and Webb 1978, modified according to Bennett *et al.* 1994 for pollen types and Stace 1991 for plant descriptions. These procedures were carried out in the Palaeoecology Laboratory of the School of Geography, University of Southampton.

Pollen data

Typical of buried soil pollen profiles, pollen is abundant here in the upper part of the, albeit inverted, turf of buried soil (bA), but is relatively sparse in the lower (subsoil bB) levels. Furthermore, and also commonly encountered in soils, is the strong differential preservation in favour of spores and those pollen taxa with more robust exine which have a longer residency time in the soil. Thus, interpretation of the subsoil levels is treated cautiously. Clearly, the most reliable data is derived from the turf horizon of the soil. Description of the soil by Dr M.J. Allen and soil micromorphology (Macphail, Appendix 5) suggests that some of some of the top of the A horizon (turf) may be absent. Thus, it is possible that if the environment changed from the woodland demonstrated here to a more open (e.g. agricultural) landscape, this may not have been represented in this pollen record.

Overall, the pollen spectra are dominated by trees and shrubs with a very restricted herbaceous diversity and small herb pollen numbers. With the exception of over-representation of differentially preserved spores of *Polypodium* the pollen assemblages are consistent/homogeneous throughout the soil.

The inverted turf

Trees and shrubs are most important, forming up to 95 per cent of the total pollen. *Quercus* (oak; to 29 per cent) and *Corylus avellana* type (most probably hazel; 55 per cent) are the dominant taxa with *Betula* (birch;

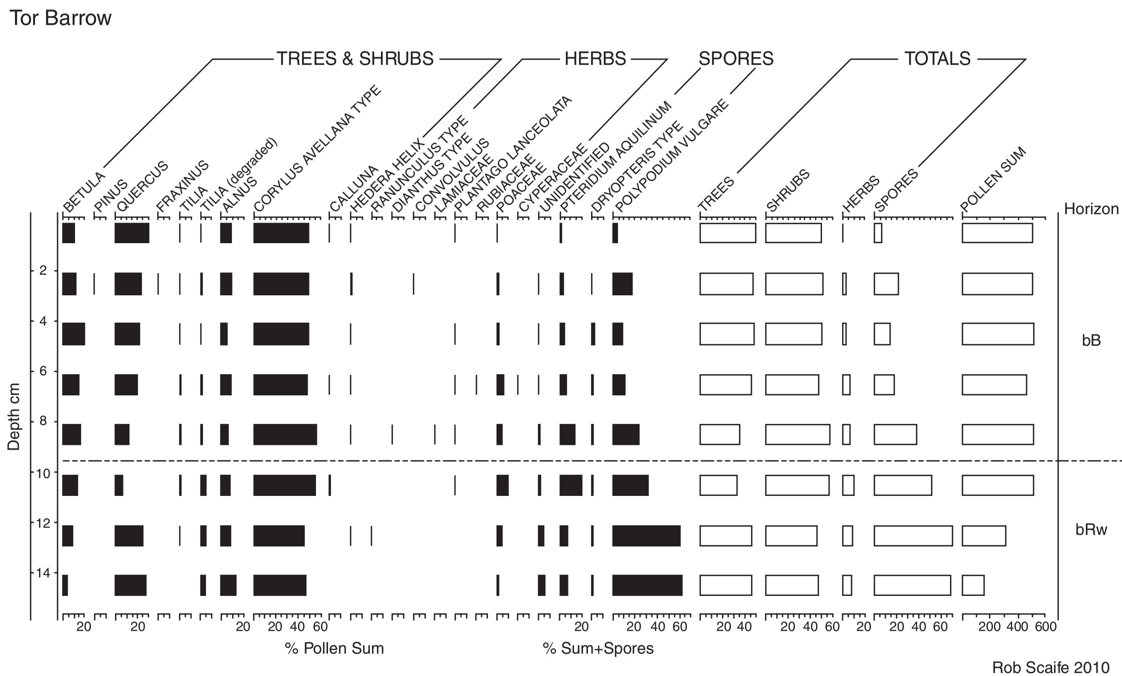


Figure A6.1 Pollen histogram from the buried soil beneath Big Tor Barrow

10–12 per cent), *Alnus* (alder; 5–10 per cent) and *Tilia* (lime/linden; 3–4 per cent). Small numbers of *Hedera helix* (ivy) are present throughout. Herb pollen percentages and diversity are small compared with trees and shrubs (average 7 per cent). Only eight herb taxa were recorded of which Poaceae (grasses; average 5 per cent) and *Plantago lanceolata* (ribwort plantain), the latter only sporadically, are most important. Spores of ferns decrease in number from *c*. 8 cm, the contact between the subsoil (bB) horizon to the better preservation in the inverted turf (A horizon). *Pteridium aquilinum* (bracken) and *Polypodium vulgare* (polypody fern) are most important, along with sporadically occurring *Dryopteris* type (monolete Pteropsida). Numbers of the former decline from the very high numbers of the bA horizon.

The subsoil (B) horizon

The pollen spectra of the lower B soil profile differs from the upper B horizon only in having much-reduced numbers of pollen and higher relative percentages of taxa with robust pollen/spore walls. The latter include predominantly *Polypodium*, which attains high values (65 per cent sum + spores) and *Pteridium aquilinum* at the bA–bB transition and degraded *Tilia*. Apart from Pteridophytes, the assemblages are dominated by trees and shrubs with few herbs. *Quercus* (to 28 per cent), *Corylus avellana* type (50 per cent), *Alnus* (13 per cent) and expanding *Betula* (expanding from 3 per cent to 15 per cent) are most important. Poaceae is the most important herb taxon, with highest values at the top of the bB and base of the turf horizons.

The vegetation and environment

As noted in the soil micromorphology the upper bA (turf) is an emplaced turf as such although the vegetation immediately prior to construction of the cairn may not be represented, which generally prior to construction is present. Pollen assemblages, however, are dominated by trees and shrubs with very few herbs and, as such, it appears that the pre-construction environment on site was predominantly wooded. There is, however, tentative evidence for some grassland as evidenced by some Poaceae (which could have derived from a great range of habitats) but primarily *Plantago lanceolata* (ribwort plantain).

Taking into account differential preservation, it appears that the local woodland was open oak (*Quercus*) with a hazel (*Corylus avellana*) shrub layer but also with some lime (*Tilia*). The latter is usually poorly represented in pollen assemblages due to its entomophily and production of less pollen than other taxa noted here. Furthermore, it flowers in summer, when trees are in full leaf, which further inhibits it dispersion. Thus, the numbers here probably belie its local importance. Slightly greater numbers of *Tilia* pollen in the lower profile are due to the differential preservation of its robust pollen form.

Dominance of oak and hazel is a ubiquitous characteristic of prehistoric woodland in the southwest of England and has been described from numerous sites, for example in Devon, e.g. by Fyfe *et al.* (2003a, 2003b). This differs from east, southeast and central southern England, which was in larger part dominated by lime with oak, elm and hazel from the start of the Middle Holocene. The importance here of *Polypodium* (common polypody fern) is due to its growth as a saprophytes growing on trees as well as in suitable ground habitats. As with lime pollen, the substantially higher numbers of P*olypodium* spores are due to its long residence in soils. It is attractive to consider this possible habitat as being similar to that of Wistman's Wood, which probably has the closest character to what would have been the native woodland of the region.

Other woodland elements noted include birch (*Betula*) and *Alnus* (alder). Both are anemophilous, produce copious quantities of pollen and, as such, tend to be over-represented in pollen spectra (Andersen 1970, 1973). Here, values are such that these trees were probably not abundant on or near the site but were probably locally present. The latter, alder, is likely to have been growing on wetter soils of the local river floodplain as carr woodland or as growth along riverbanks. There is some increase in importance of birch pollen up the soil profile. It is not clear whether this is caused by poor pollen preservation in the lower soil profile or whether other factors such as human disturbance may have caused increased growth of birch woodland, i.e. areas of secondary regeneration.

Human activity

There is little real evidence for human activity or agriculture. Grasses and ribwort plantain are usually regarded as indications of grassland and pasture. Given the age of this soil, it is very probable that there was grassland, probably pasture, in the vicinity. No evidence for arable agriculture was found; that is, cereal pollen or weeds of agriculture.

Heathland development

Today, the site lies within heathland. It will be clear from the above discussion that this contrasts with the strongly wooded habitat which existed prior to construction of the cairn. Only very occasional pollen grains (4) of *Calluna* (heath) were recorded in the analysis, which, if not contamination from recent levels through root channels, may indicate occasional plants growing locally on acid soil. However, the numbers are not regarded as significant. It is not clear whether there was a transition to heathland prior to cairn construction which might have been evidenced in the A horizon. It may, however, be postulated that the initial woodland clearance, which ultimately resulted in heathland genesis, may have occurred in preparation for construction of the cairns. That is, after woodland clearance and soil deterioration and acidification. It is most probable that transition from woodland to heathland occurred sometime after construction of the cairn and is not represented here.

Summary and conclusions

Sub-fossil pollen and spores have provided evidence of the vegetation and environment of the site prior to construction of the monument. The following principal findings have been made:

- Palynological data obtained from the buried soil underlying the cairn show that the monument was constructed on soils which had been predominantly wooded.
- That woodland consisted largely of oak and hazel with an element of lime. This is typical of the dominant natural woodland of south-west England for the prehistoric period.
- Because the upper turf horizon may be absent, it is possible that some changes in the vegetation had occurred immediately prior to construction of the cairn.
- Alder pollen indicates local floodplain carr woodland or from growth along riverbanks.
- The very substantial numbers of *Polypodium* spores derive from a number of growth niches but are also substantially over-represented due to differential preservation in the subsoil horizon.
- There are relatively few herbs and no indications of arable cultivation. Small numbers of ribwort plantain pollen and grasses are tentatively attributed to some local pasture outside of the woodland.
- Although the site today lies within heathland, this was not present at the site long prior to cairn construction.

Appendix 7
Geoarchaeology

Michael J. Allen
Environmental Archaeology and Visiting Research Fellow in Environmental Archaeology, University of Bournemouth, UK

In order to place some of the palaeo-environmental studies of the Tor Cairn buried soil into context in the valley to the south of Tor Cairn a series of 16 auger points were made, four of which are recorded in Appendix 2, and in a stream-filled valley to the north 21 points were augered along a 30-m transect.

The local valley to the west

A walkover survey of the local valley indicated possible wet contexts and valley bottom sedimentation. What was clear was that the cairns were not readily visible from the valley bottom. The valley contains only thin (*c*. 30 cm thick) humic rendzinas on the valley floor, probably as it is regularly flushed with water and sediment accumulation has not occurred. No peat deposits were present. At the footslope, immediately below the Tor Cairns slightly thicker humic soils occur but no colluvial deposits are present. Probabilistic augering indicated the presence of shallow, stony, non-organic and non-waterlogged deposits. The sediments were flushed, probably seasonally, with surface and subsurface water, but no peat was recovered. The depth of localized colluvium was seen to be up to 40 cm.

The stream valley to the east

A second area where peat was clearly present was augered with a gouge auger, assisted by Wayne Bennett. A transect of 21 points was made along a 30-m transect crossing the valley bottom. Here up to 1 m of soft humic peat sediments were present. The peat, however, was loose, unconsolidated and constantly flushed with water, making recovery on the gouge auger impossible. The valley was revisited where the ground-water table was lower and a full core recovered. Spot samples at 30 cm and 34 cm were taken and tested for pollen. Pollen was present in low numbers, and it was suggested poor preservation was possible a result of water flush. The deposits were shallow and largely recent, with no long stratified sequences. The sampled sequences are loose and regularly flushed with water and largely devoid of pollen. No long stratified sequences were present. A further 27 auger probes were conducted up and down the valley sides and valley floor in an attempt to isolate small pockets on deeper stratified sequences – none were located.

References for Appendices 5–7: Tor Cairn

Andersen, S.Th. 1970. 'The relative pollen productivity and pollen representation of North European trees, and correction factors for tree pollen spectra', *Danmarks Geologiske Undersogelse* Ser. II, 96: 1–99.

Anderson, S.Th. 1973. 'The differential pollen productivity of trees and its significance for the interpretation of a pollen diagram from a forested region', in Birks, H.J.B. and West, R.G. (eds) *Quaternary Plant Ecology*. Oxford: Blackwell, 109–115.

Bennett, K.D., Whittington, G. and Edwards, K.J. 1994. 'Recent plant nomenclatural changes and pollen morphology in the British Isles', *Quaternary Newsletter* 73: 1–6.

Bullock, P., Fedoroff, N., Jongerius, A., Stoops, G. and Tursina, T. 1985. *Handbook for Soil Thin Section Description*. Wolverhampton: Waine Research Publications.

Courty, M.A. 2001. 'Microfacies analysis assisting archaeological stratigraphy', in Goldberg, P., Holliday, V.T. and Ferring, C.R. (eds) *Earth Sciences and Archaeology*. New York: Kluwer, 205–39.

Courty, M.A., Goldberg, P. and Macphail, R.I. 1989. *Soils and Micromorphology in Archaeology* (1st edn). Cambridge: Cambridge University Press.

Dimbleby, G.W. 1962. *The Development of British Heathlands and their Soils*. Oxford: Clarendon Press.

Dimbleby, G.W. 1985. *The Palynology of Archaeological Sites*. London: Academic Press.

Drewett, P.L. 1989. 'Anthropogenic soil erosion in prehistoric Sussex: excavations at West Heath and Ferring, 1984', *Sussex Archaeological Collections* 127: 11–29.

Findlay, D.C., Colbourne, G.J.N., Cope, D.W., Harrod, T.R., Hogan, D.V. and Staines, S.J. 1983. *Soils of England and Wales. Sheet 5, South West England*. Southampton: Ordnance Survey.

Fyfe, R.M., Brown, A.G. and Coles, B.J. 2003a 'Mesolithic to Bronze Age vegetation change and human activity in the Exe valley, Devon, U.K.', *Proceedings of the Prehistoric Society* 69: 161–81.

Fyfe, R.M., Brown, A.G. and Rippon, S.J. 2003b. 'Mid- to late-Holocene history of Greater Exmoor, U.K.: estimating the spatial extent of human-induced vegetation change', *Vegetation History and Archaeobotany* 12: 215–32.

Goldberg, P. and Macphail, R.I. 2006. *Practical and Theoretical Geoarchaeology*. Oxford: Blackwell Publishing.

Macphail, R.I. and Cruise, G.M. 2001. 'The soil micromorphologist as team player: a multianalytical approach to the study of European microstratigraphy', in Goldberg, P., Holliday, V.T. & Ferring, R. (eds) *Earth Science and Archaeology*. New York: Kluwer Academic/Plenum Publishers, 241–67.

Macphail, R.I., Crowther, J., Acott, T.G., Bell, M.G. and Cruise, G.M. 2003. 'The Experimental Earthwork at Wareham, Dorset after 33 years: changes to the buried LFH and Ah horizon', *Journal of Archaeological Science* 30: 77–93.

Moore, P.D. and Webb, J.A. 1978. *An Illustrated Guide to Pollen Analysis*. London: Hodder and Stoughton.

Moore, P.D., Webb, J.A. and Collinson, M.E. 1991. *Pollen Analysis* (2nd edn). Oxford: Blackwell Scientific.

Payton, R.W. 1983. 'The micromorphology of some fragipans and related horizons in British soils with particular reference to their consistence characteristics', in Bullock, P. and Murphy, C.P. (eds) *Soil Micromorphology*, vol. 1, *Techniques and Applications*. Berkhamsted: A B Academic Publishers, 317–36.

Smith, G., Macphail, R.I., Mays, S.A., Nowakowski, J., Rose, P., Scaife, R.G., Sharpe, A., Tomalin, D.J. and Williams, D.F. 1996. 'Archaeology and environment of a Bronze Age cairn and Romano-British field system at Chysauster, Gulval, near Penzance, Cornwall', *Proceedings of the Prehistoric Society* 62: 167–219.

Stace, C. 1991. *New Flora of the British Isles*. Cambridge: Cambridge University Press.

Stoops, G. 2003. *Guidelines for Analysis and Description of Soil and Regolith Thin Sections*. Madison, WI: Soil Science Society of America.

LITTLE TOR CAIRN: SPECIALIST REPORT

Appendix 8
Little Tor Cairn (LTC10): Wood charcoal

Dana Challinor, MA (Oxon.), MSc

Thirty-six samples were submitted for identification. Most of these were single fragments of charcoal, hand-collected on site, although a few contained up to five fragments. It was not clear whether this was the result of breakage post-excavation or represented separate fragments. Many of the samples were full of sediment, with only unidentifiable flecks of charcoal present. Table A8.1 provides the results from the 24 samples which produced identifiable material – the full record is recorded in an Excel file.

The condition of the charcoal was fairly poor, with many fragments infused or covered with sediment. Oak (*Quercus* sp.) was overwhelmingly dominant in the assemblages, including several heartwood fragments. No roundwood was noted and this material would not be recommended for radiocarbon dating. The only material possibly suitable for dating was a single fragment of alder or hazel (*Alnus/Corylus*) from L5, N2; 15.9. The fragment crumbled and was very small, but the genera was suitable for dating, if enough carbon can be extracted.

Table A8.1 Results of the charcoal analysis from Little Tor Cairn

Sample no.	*Context no.*	*Coordinates and depth (in metres)*	*Identification*	*Notes*
L3	N2	–	*Quercus* x 1	Slow, vitrified
L4	N2 15.9	2.72/1.87/ 0.66	*Quercus* x 1	–
L4	N2 15.9	3.03/1.92/ 0.75	*Quercus* h-w x 1	–
L4	N2 15.9	2.95/1.81/ 0.69	*Quercus* x 1	–
L4	N2 15.9	2.60/1.29/ 0.73	*Quercus*	Sediment
L5	N2 15.9	3.33/1.85/ 0.75	*Quercus* x 1	–
L5	N2 15.9	2.95/2.05/ 0.75	*Alnus/Corylus* x 1	Very small and crumbled; C14?
L5	N2 15.9	3.15/1.37/ 0.77	*Quercus* x 1	Sediment
L5	S2	3.49/2.45/ 0.78	*Quercus* x 2	–
L5	S2	3.67/3.15/ 0.85	*Quercus* x 1	Pores filled
L5	S2 15.9	3.01/3.35/ 0.83	*Quercus* x 2	Sediment
L5	S2 15.9	3.04/2.30/ 0.78	*Quercus* x 1	–
L5	S2 15.9	3.48/2.27/ 0.76	*Quercus* x 1	Sediment. Charcoal flecks
L6	N2 15.7	2.83/2.95/ 0.83	*Quercus* x 2	Sediment. 1 x slow
L6	N2 15.7	3.24/2.45/ 0.84	*Quercus* x 1	–
L6	N2 15.7	3.10/2.90/ 0.87	*Quercus* h-w x 1	–

(continued)

Table A8.1 Continued

Sample no.	*Context no.*	*Coordinates and depth (in metres)*	*Identification*	*Notes*
L6	N2 15.7	2.99/3.10/ 0.86	*Quercus* x 1	Probably h-w. Large fragment, full of stuff
L6	N2 15.7	3.06/2.72/ 0.85	*Quercus* x 5	Distorted
L7	Middle 15.9	2.88/2.30/ 0.83	*Quercus* h-w x 1	Very infused
L7	Middle 15.9	2.85/2.47/ 2.86	*Quercus* x 3	Too infused to determine maturity
L8	Middle 15.9	2.34/2.75/ 0.85	*Quercus* x 1	Sediment
L8	Middle 15.9	2.92/2.70/ 0.86	*Quercus* h-w x 1	–
L8	Middle 15.9	2.23/2.79/ 0.82	*Quercus* h-w x 1	–
L8	Middle 15.9	2.88/2.13/ 0.85	*Quercus* x 2 (1 x h-w)	–

TWIN CAIRN A: SPECIALIST REPORTS

Appendix 9
Twin Cairn A 2011: Charcoal from pebble cairn

Dana Challinor, MA (Oxon.), MSc

Excavations on a small pebble cairn of presumed Early Bronze Age date resulted in 30 samples for examination. The samples were hand-collected and unprocessed. The aim of the analysis was to provide some species identifications and assess the potential of the material for radiocarbon dating.

Condition and methodology

Most of the samples comprised sediment and/or fibrous, organic material. It was apparent that in some cases the charcoal was very degraded and held together only by the sediment. There were even rootlets growing through the larger pores. For these reasons, it was considered that any flotation would have increased fragmentation and not be useful. Consequently the material was examined without further processing, which has the disadvantages that smaller fragments of charcoal contained within the sediment could be missed, and some anatomical characteristics were obscured by dirt.

The samples were gently sieved to 2 mm to remove small sediment particles and scanned at low magnification (up to ×45). The identification of *Quercus* sp. (oak) is possible at this level, but any diffuse porous taxa were additionally examined at high magnification (up to ×400).

Results

Several of the samples contained only sediment, or sediment with unidentifiable flecks of charcoal and these have been excluded from the results presented in Table A9.1. The full results are recorded in the archive. Most of the samples contained only small quantities of identifiable charcoal, which was all *Quercus* sp. (oak). In many cases it was not possible to determine the maturity of the oak, due to the condition of the pieces, but where visible, the fragments exhibited tyloses, which indicate heartwood. There were also several fragments which exhibited very slow growth with some larger pieces of 20-plus rings and minimal ring curvature.

Given the amount of heartwood noted in the samples, and the condition which prohibited the secure identification of sapwood, the majority of samples have no potential for reliable radiocarbon dating. Non-oak charcoal was only recorded in one sample (23), which contained a few fragments of *Alnus/Corylus* (alder or hazel) type charcoal. One roundwood piece was selected for radiocarbon dating and the identification confirmed as *Corylus avellana* (hazel). Most of the remaining charcoal in this sample appeared to be oak. Oak also dominated the more abundant samples (22, 24, 34, 35), for which *c*. 20 fragments were checked. It is possible that these samples contain fragments of oak sapwood, or even small non-oak taxa, which would be suitable for dating. Consequently these samples have been given for dating, but it would be time-consuming to examine further, with no guarantee of useful results.

Table A9.1 Results of the charcoal analysis

Context no.	*Quantity*	*Identification*	*Notes*	*C14*
3	+	*Quercus*	Sediment. *Quercus* fragmented	–
4	+	*Quercus*	Indeterminate maturity	–
5	+	*Quercus*	Small pieces. Sediment	–
6	+	*Quercus*	*Quercus* small. Sediment	–
7	+	*Quercus* (h-w)	Very slow grown	–
8	+	*Quercus* (h-w)	Very slow. 24 years+. Large fragment > 10 mm	–
9	+	*Quercus*	Very soft and organic. Crumbled. sediment	–

(continued)

Table A9.1 Continued

Context no.	*Quantity*	*Identification*	*Notes*	*C14*
10	+	*Quercus*	Heavily degraded and soft. *Quercus* fragmented	–
11	+	*Quercus*	Heavily degraded – held together by sediment	–
12	+	*Quercus*	Heavily degraded- held together by sediment. Vitrified but fragmented	–
13	+	*Quercus* (h-w)	Quite large and firm	–
17	+	*Quercus*	Quercus moderate ring curve. Some h-w	–
18	++	*Quercus* (h-w)	Large sample – mostly fibrous, peaty material. *Quercus* h-w; some very large fragments, very slow 20+ years, as well as more degraded and smaller fragments	–
19	++	*Quercus* (h-w)	Mid-sized fragments. Some slow, some h-w	–
20	+	*Quercus* (h-w)	–	–
21	++	*Quercus* (h-w)	Some with roots growing through pores	–
22	+++	*Quercus* (h-w)	Lots of charcoal – looks like all *Quercus,* some h-w. Slow	?
23	+++	*Quercus* (h-w), *Alnus/ Corylus* r-w	C14 sample; *Corylus avellana* r-w x 1	Yes

Table A9.1 Continued

Context no.	*Quantity*	*Identification*	*Notes*	*C14*
24	++++	*Quercus* (h-w)	Slow. Faint curve. *C.* 20 examined – looks like all *Quercus*	?
26	++	*Quercus* (h-w)	Infused with sediment. Some slow	–
27	+	*Quercus*	Infused	–
33	+	*Quercus*	Very small	–
34	++++	*Quercus* (h-w)	Some largish fragments	?
35	+++	*Quercus* (h-w)	Large fragments. 30 years+. Slow	?

Key + = up to 5 fragments; ++ = 5–25; +++ = up to 100;++++ = > 100; h-w = heartwood; r-w = roundwood.

Conclusions

Two levels of burning were identified in the excavations, from which the richer samples presumably derive. It is clear from this analysis that oak was the primary fuelwood used. The oak came from the trunks of mature trees, which had laid down heartwood. There was little ring curvature to indicate branches. The growth rates suggest that the trees grew in a heavily wooded and competitive environment, and did not come from managed woodland (which usually exhibits fast growth rates). Finally, the small quantity of hazel wood in one sample did show evidence of strong ring curvature and is likely to have derived from small-diameter branch wood (or coppiced stems).

Appendix 10

Twin Cairn A, central section, sample 42 results and interpretation: Pollen (and other microfossils) analyses

Petr Pokorný
Centre for Theoretical Study, Charles University, Prague, Czech Republic

This sample does not contain enough pollen to be seriously analysed. In three slides only three *Polypodium* spores were found, together with one *Corylus avellana* and one *Quercus* pollen grains. Microscopic charcoal particles are present, but not extraordinarily abundant. What is quite remarkable is the enormous quantity of fungal filaments (*hyphae*) and roundish fungal spores present in this sample. Although determination of such fungal remains is practically impossible, this at least shows either local growth of fungal mycelium on some organic matter (wood, litter, soil humus, etc.), or even content of collected fungi (their fruit bodies, respectively). Nevertheless, the last interpretation shall be considered as very preliminary.

Appendix 11
Report on the micromorphological analysis from Twin Cairn A

Lisá Lenka
Institute of Geology, Czech Republic

Introduction

During the archaeological investigations of Twin Cairn A (Pebblebeds Research, Professor Chris Tilley, UK) a sample for micromorphological investigation was taken. The localization of excavations is Colaton Raleigh Common, GPS: 50°40′56″ N and 3°20′21″ W. The main aim of this investigation is to describe in detail the composition of macroscopically divided layers 5 and 4 (Figure A11.1) and to discuss the possible ways of its origin and intensity of postsedimentary changes.

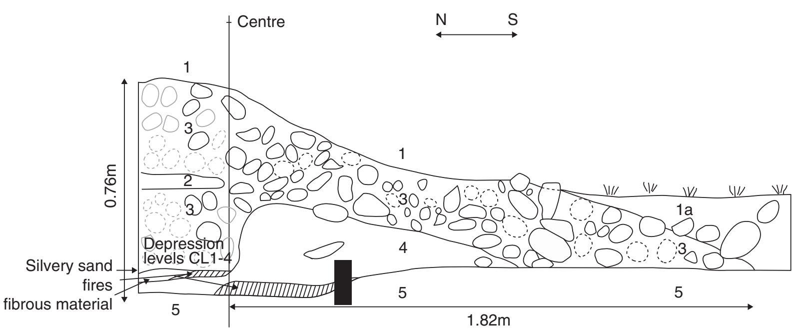


Figure A11.1 Draft of section with the location of sample (marked by black square)

Sampling and proceeding

In situ sample taken by K. Pauknerová into metal Kubiena box was slowly dried and impregnated by resin mixed with acetone in vacuum chamber. Samples were cured for six weeks and then thin sectioned in the laboratory of Julie Boreham in Reach (www.earthslides.com) The micromorphological descriptions and interpretations followed mainly Stoops 2003 and Stoops *et al*. 2010.

Results

The thin section studied covers macroscopically described layers 5 and 4 (Figure A11.1). Using the approach of micromorphology in archaeological context, four facial types were divided, marked as A, B, C and D (Figure A11.2). The first facial type marked A correspond to layer 5 (Figure A11.1) and is composed of the anthropogenically influenced type of luvisol, i.e. Ah horizon of luvisol with partly preserved turf. Most of the O soil horizon is obviously missing and in spite of it a thin layer of charcoal and microcharcoal mixed with mineral components appears. This layer corresponds to the second facial type marked B.

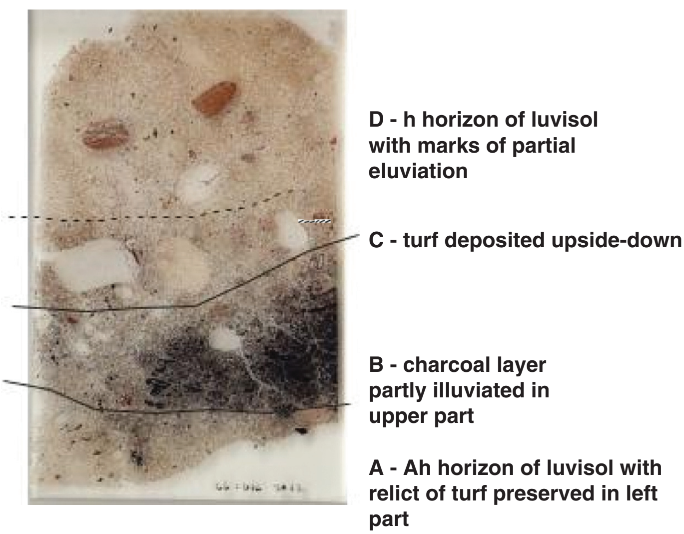


Figure A11.2 Scan of thin section with divided layers A, B, C, D; thin section is 4.5 × 7 cm (Source: author)

The uppermost part of the charcoal layer is illuviated, which probably corresponds to the fact that at the time of charcoal deposition the site was left uncovered for a while. Macroscopically this part of layer B is silvery. The anthropogenically divided layer 4 situated above corresponds to the third to fifth facial types described as C and D and is composed of non-burned turf (Olfh – organic litter fermentation humic) and Ah horizon, deposited upside-down, so the soil layer corresponding to turf and Ah horizon with the light marks of eluviation (Ahe horizon) composes the final episode of sedimentation observed in the thin section studied.

Facial type A

The facial type marked as A (Figure A11.2) has a vughy microstructure. Prevailing types of pores are vughs, but their occurrence is quite rare (up to 5 per cent). Grain size is sandy loam with porphyric C/F distribution; C/F $_{200\ \mu m}$ = 30:70; C/F $_{20\ \mu m}$ = 70:30. The coarse fraction is represented mainly by the angular to subangular quartz grains. Organic matter is presented in a decomposed state and of black and brown colour. The occurrence of black organic matter is less than 3 per cent, size is approximately 30–50 µm. The occurrence of brown decomposed organic matter

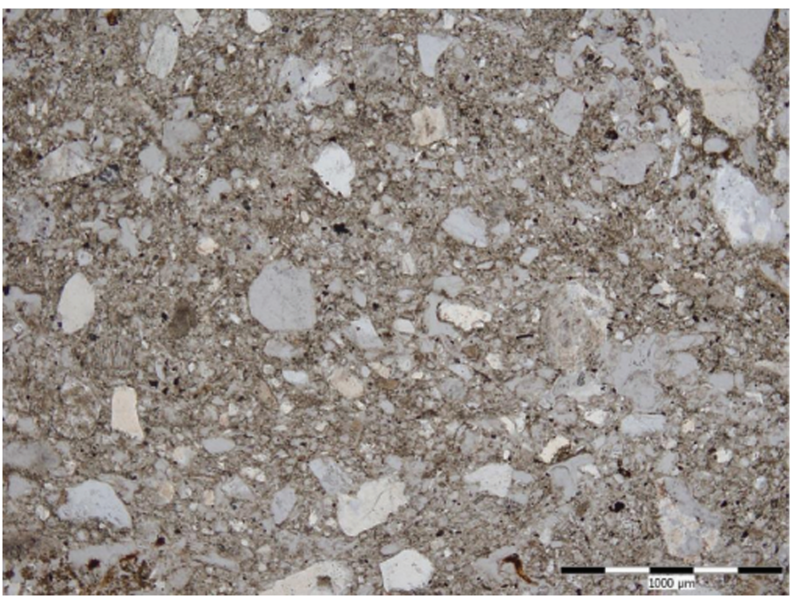


Figure A11.3 Facial type A (PPL) (Source: author)

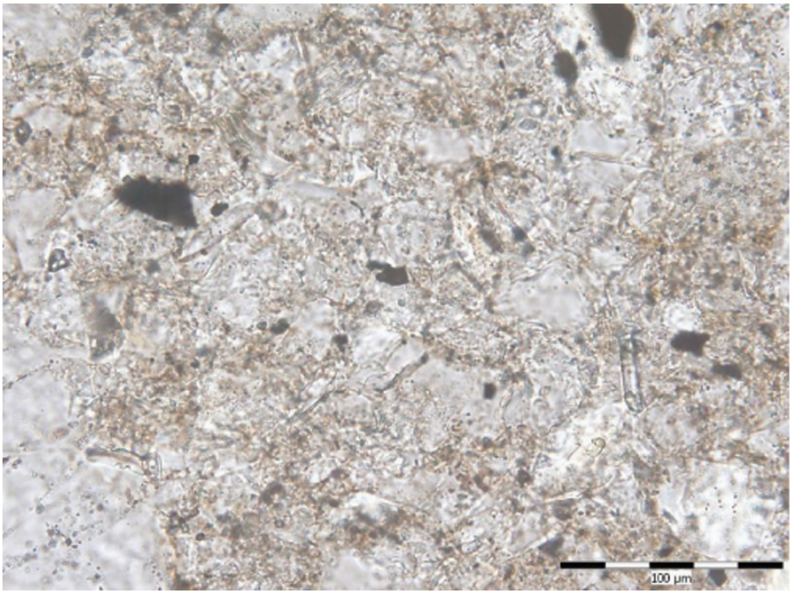


Figure A11.4 Preserved phytoliths in facial type A (PPL) (Source: author)

is between 20 and 40 per cent. The matrix is light brown with undifferentiated birefringence. Coating of grains was not observed nor the presence of accumulations. Phytoliths were present but their occurrence is quite rare, up to 3 per cent.

Facial type B

The facial type marked as B (Figure A11.2) has a granular and cracked microstructure. Prevailing types of pores are compound packing voids and their occurrence is up to 50 per cent. Cracks are rare but present. Grain size is sandy loam with porphyric C/F distribution; $C/F_{200\ \mu m} = 30:70$; $C/F_{20\ \mu m} = 50:50$. The coarse fraction is represented mainly by angular to subangular quartz grains. Organic matter is presented in burned state – charcoal and rarely also partly decomposed organic matter (up to 3 per cent). Charcoal occurrence is very common, but ranges from 50 up to 95 per cent. The matrix is black with undifferentiated birefringence. Coating of grains was not observed nor the presence of accumulations. Phytoliths were not observed. The upper part of the layer is illuviated, so the fine-grained charcoal was removed and the material is composed mainly of angular to subangular quartz grains.

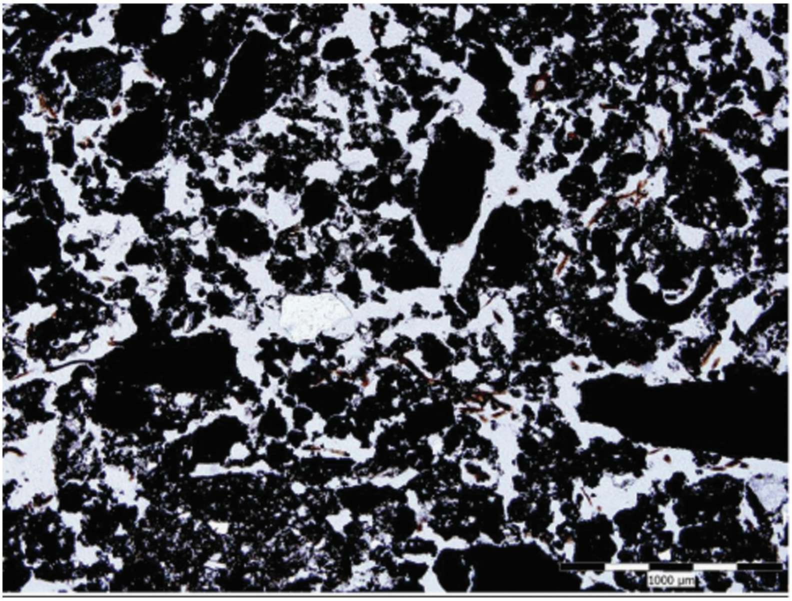


Figure A11.5 Facial type B (PPL) (Source: author)

Facial type C

The facial type marked as C (Figure A11.2) has a granular microstructure. Prevailing types of pores are compound-packing voids, and their occurrence is 50 per cent. Grain size is sandy loam with porphyric C/F distribution; C/F $_{200\ \mu m}$ = 30:70; C/F $_{20\ \mu m}$ = 70:30. The coarse fraction is represented mainly by angular to subangular quartz grains. Organic matter is present in decomposed, partly decomposed and non-decomposed state and is of brown colour. Its abundance is 80 per cent, the size of non-decomposed organic matter is approximately 1 mm. It is usually present as a cross-section of roots or thin grass roots. The matrix is brown with undifferentiated birefringence. Coating of grains was not observed nor the presence of accumulations. Single phytoliths were present but their occurrence is quite rare, up to 3 per cent.

Facial type D

The facial type marked D (Figure A11.2) has a vughy microstructure. Prevailing types of pores are vughs, but their occurrence is quite rare (up to 5 per cent). Grain size is sandy loam with porphyric C/F distribution; C/F $_{200\ \mu m}$ = 30:70; C/F $_{20\ \mu m}$ = 70:30. The coarse fraction is represented

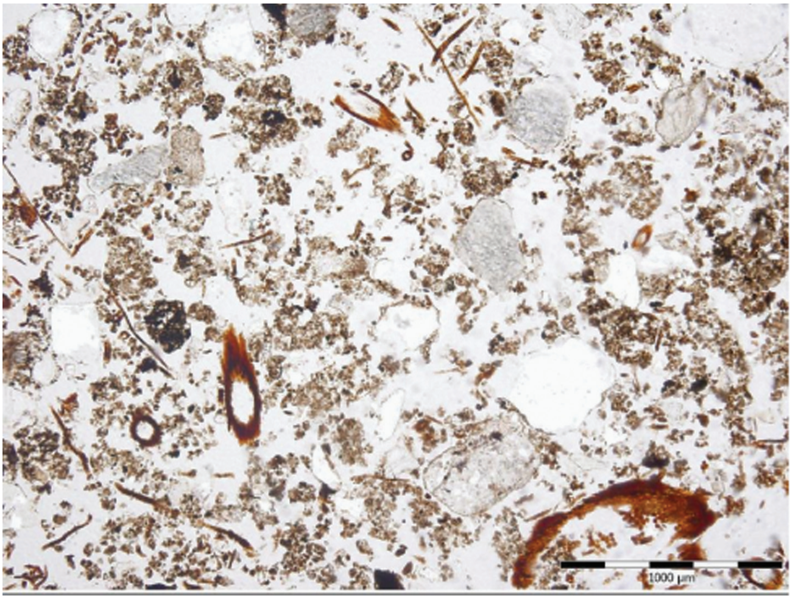


Figure A11.6 Facial type C (PPL) (Source: author)

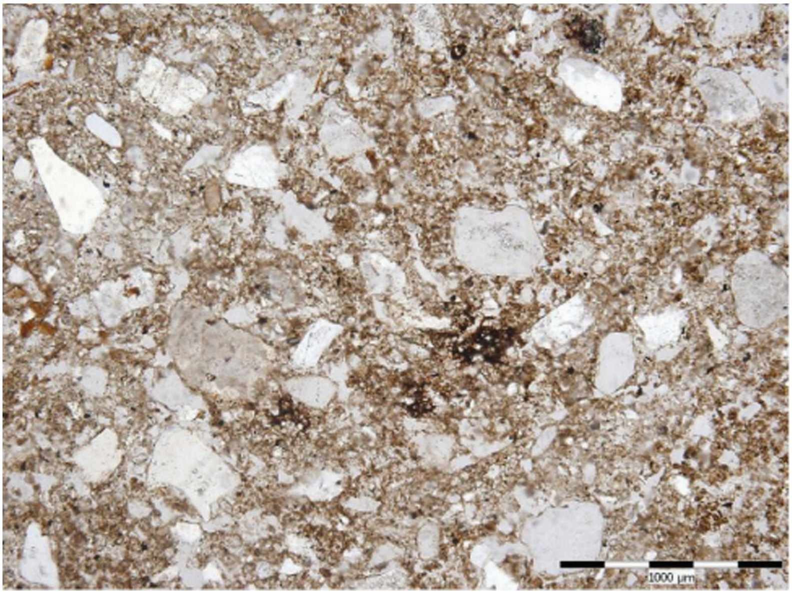


Figure A11.7 Facial type D with buried De nodule (PPL) (Source: author) mainly by angular to subangular quartz grains. Organic matter is present in a decomposed state and is of brown colour. Its abundance is more than 50 per cent, size is approximately 30–50 μm. The matrix is brown with undifferentiated birefringence. Coating of grains was not observed nor the presence of accumulations. Phytoliths were present but their occurrence is quite rare, up to 3 per cent, as well as the presence of Fe nodules. Those are formed by burial. Very common are humic and organomineral excrements.

Discussion

Charcoal concentration in facial type B

Archaeological layer 4 visibly contained the accumulation of charcoal described on the spot as a fireplace. The charcoal accumulation does not show any signs of redeposition and in the lower part and upper part is partly mixed with quartz fraction, which might be the result of natural processes after the burial. The uppermost part of the charcoal layer looks macroscopically silvery; in thin section leaching is visible which reflects the fact that the site was left open for some time after the fire. During the investigations of experimental burial in Wareham, a concentration of charcoal along the 'old land surface' was also found (Goldberg and Macphail, 2006). This concentration was produced by periodic heath fires and is now found within the 70-mm-thick LFH. Such a concentration results from the fact that charcoal is more stable compared to other forms of organic matter. A concentration of charcoal along an old ground surface, when found under an archaeological monument, could easily be interpreted as indicating pre-construction clearance. The results from the experiment at Wareham now point to the possibility that a 'taphonomic' concentration of charcoal has to be considered at some sites.

Turf deposited upside-down in facial type B

Turf in archaeological context is usually used as construction material. It is generally mineralogenic topsoil covered by the living grass and grass-rooted mull humus ('prairie') Ah soil horizon (Goldberg and Macphail 2006). In the case of Twin Barrow turf was identified redeposited upside-down in layer 5 and described as facial types C and D. Turf can be recognized from its relatively high organic content and its topsoil biological microfabric – roots, root channels, excrements of mesofauna (Babel

1975; Bal 1982), although these can be altered through burial and ageing processes.

At Overton Down (excavated 1992) the thickness of the Ah horizon had decreased from *c.* 180 to 90–100 mm; this took place in part through organic matter loss (*c.* 11.0 per cent to 7.59–7.88 per cent organic C) (Crowther *et al.* 1996). An open microfabric characterized by 55 per cent void space (Figures A12.2–A12.3) that shows signs of earthworm-working and grass rooting had become compacted (minimum 14 per cent void space at 1 cm depth). Moderately broad mamillated earthworm excrements were replaced by aggregated excrements and a spongy microfabric composed of thin cylindrical organo-mineral excrements. Where the soil was buried by chalk rubble the soil became more alkaline (pH 7.9), because here earthworms mixed the buried soil with the overlying chalk. Lycopodium spores (which had been laid on the old ground surface at the time of monument construction) were mixed 90 mm upward into the overlying chalk bank.

Ferrum nodules in facial type D

The appearance of Fe nodules in archaeological context similar to Twin Barrow A was described for the experimental burial at Overton Down (Goldberg and Macphail 2006). The formation of iron pans and pseudomorphic iron-replacement of plant material are both manifestations typical of buried soils that result from localized gleying; in the case of Twin Barrow these were described in facial type D as a quite rare feature. They were also noted at the 500,000-year-old Boxgrove, UK (Crowther *et al.* 1996; Limbrey 1975; Macphail 1999). Similar features were recognized also in the buried soil at the Neolithic (e.g. *c.* 3400–3600 cal. BC) long barrow at Easton Down (8.5 km distant from Overton Down) (Whittle *et al.* 1993). This showed how quickly long-lasting changes may occur once the soil is buried. Changes that began over the first 32 years after burial are clearly recognized in soils about 5,000 years old.

Conclusions

At the base of the cairn a charcoal layer was identified and sampled for micromorphology with the aim to identify the deposition processes. Four facial types were divided. The first facial type (A) corresponds to layer 5 (background) and is composed of the anthropogenically influenced type of luvisol, i.e. Ah horizon of luvisol with partly preserved turf.

Most of the O soil horizon is obviously missing, despite which a thin layer of charcoal and microcharcoal mixed with mineral components appears. The uppermost part of the charcoal layer is illuviated, which probably corresponds to the fact that the site was left uncovered for a while at the time of charcoal deposition. The material described above the charcoal layer is composed of non-burned turf (Olfh – organic litter fermentation humic) and Ah horizon, deposited upside-down, so the soil layer corresponding to turf and Ah horizon with light marks of eluviation (Ahe horizon) composes the final episode of sedimentation observed in the thin section studied.

References

Babel, U. 1975. 'Micromorphology of soil organic matter', in Giesking, J.E. (ed.) *Soil Components: Organic Components.* New York: Springer-Verlag, vol. 1, 369–473.

Bal, L. 1982. 'Zoological ripening of soils'. Agricultural Research Report. Centre for Agricultural Publishing and Documentation, Wageningen.

Crowther, J. 1996. 'Soil chemistry', in Bell, M., Fowler, P.J. and. Hillson, S.W (eds) *The Experimental Earthwork Project 1960–1992.* Research Report 100. York: Council for British Archaeology, 107–18.

Goldberg P. and Macphail, R. 2006. *Practical and Theoretical Geoarchaeology*. Oxford: Blackwell Publishing.

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

Macphail, R.I. 1999. 'Sediment micromorphology', in Roberts, M.B. and Parfitt, S.A. (eds) *Boxgrove, a Middle Pleistocene Hominid Site at Eartham Quarry, Boxgrove, West Sussex*. Archaeological Report 17. London: English Heritage, 118–48.

Stoops, G. 2003. *Guidelines for Analysis and Description of Soil and Regolith Thin Sections*. Madison, WI: Soil Science Society of America.

Stoops G., Marcelino V. and Mees F. 2010. *Interpretation of Micromorphological Features of Soils and Regoliths*. Dordrecht: Elsevier.

Whittle, A., Rouse, A.J. and Evans, J.G. 1993. 'A Neolithic downland monument in its environment: excavations at the Easton Down Long Barrow, Bishops Canning, North Wiltshire', *Proceedings of the Prehistoric Society* 59: 197–239.

JACOB'S WELL: SPECIALIST REPORTS

Appendix 12
Jacob's Well, Woodbury Common, Devon: Pollen analysis report

C.R. Batchelor
Quaternary Scientific (QUEST), School of Human and Environmental Sciences, University of Reading, UK

Introduction

This report summarizes the findings arising out of the pollen analysis undertaken on samples from a horizon of organic-rich material beneath a burnt mound at Jacob's Well, Woodbury Common, Devon. Jacob's Well is a Bronze Age water shrine on Woodbury Common, an area of common land that is predominantly heathland, adjacent to the village of Woodbury, Devon. Nineteen samples from Jacob's Well were taken from the organic-rich horizon for pollen analysis. This horizon has been described as a natural level of peat with sandy dark-brown material (totalling 17 cm in thickness) with large pebbles and on the top residues of wood (interpreted as a possible branch wood platform during the excavation stage). The horizon was split into three units (top to base) as follows:

3–5 cm	lighter colour, interpreted as possibly burned
5–7 cm	irregular band of tar
7–17 cm	dark-brown.

The overarching aim of this investigation was to reconstruct the vegetation history of the site and its environs, and to quantify evidence of human activities during the formation of the organic-rich horizon.

Methods

Pollen assessment and analysis

Nineteen pollen samples were extracted as follows: (1) sampling a standard volume of air-dried sediment (4 grams dry weight); (2) addition of four *Lycopodium* tablets to enable calculation of pollen concentrations; (3) deflocculation of the sample in 1 per cent Sodium pyrophosphate; (4) sieving of the sample to remove coarse mineral and organic fractions (> 125 μm); (5) acetolysis; (6) removal of finer minerogenic fraction using Sodium polytungstate (specific gravity of 2.0 g/cm^3); (7) mounting of the sample in glycerol jelly stained with safranin. Each stage of the procedure was preceded and followed by thorough sample cleaning in filtered distilled water. Quality control is maintained by periodic checking of residues, and assembling sample batches from various depths to test for systematic laboratory effects. Pollen grains and spores were identified using the University of Reading pollen type collection and the following sources of keys and photographs: Moore *et al.* 1991; Reille 1992. Plant nomenclature follows the *Flora Europaea* as summarized in Stace 1997. The assessment procedure consisted of scanning the prepared slides, recording the concentration and preservation of pollen grains and spores and the principle taxa on four transects (10 per cent of the slide). The analysis procedure consisted of counting the prepared slides to a minimum of 300 terrestrial land pollen species per level. Pollen percentages are calculated based on terrestrial plants. Aquatic and fern spores are calculated as a percentage of terrestrial pollen plus the sum of the component taxa within the respective category. The results are displayed in Figure A12.1.

Results, interpretation and discussion of the pollen analysis

Results of the Jacob's Well pollen analysis

The results of pollen analysis are presented as a percentage pollen diagram (Figure A12.1). Pollen concentration and preservation was extremely high in all samples, and a count of 300 terrestrial pollen grains was always achieved. The pollen diagram was divided into three local pollen assemblage zones (LPAZs) as follows:

Local Pollen Assemblage Zone J1 Alnus – Quercus – Corylus type – Poaceae.

The zone is characterized by high values of arboreal pollen; *Alnus* (30–40 per cent) and *Quercus* (20–30per cent) dominate with *Betula*, *Tilia*, *Ulmus*, *Pinus* and *Fraxinus* (all generally < 5 per cent). *Pinus* declined to absence towards the top of the zone. Shrub pollen is dominated by *Corylus* type

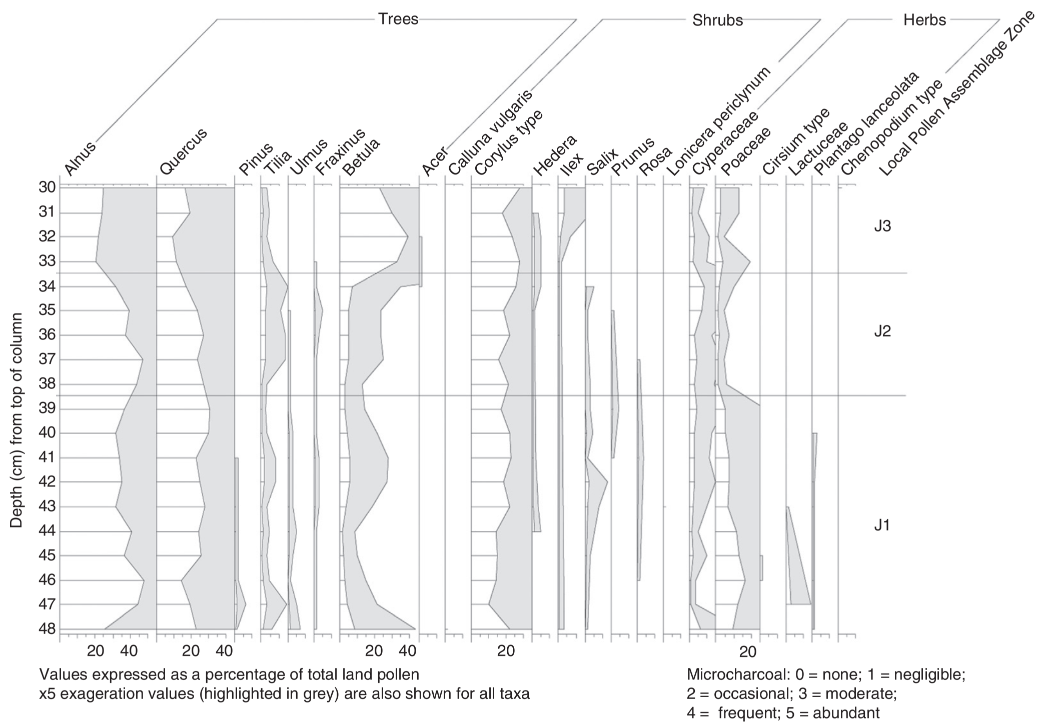
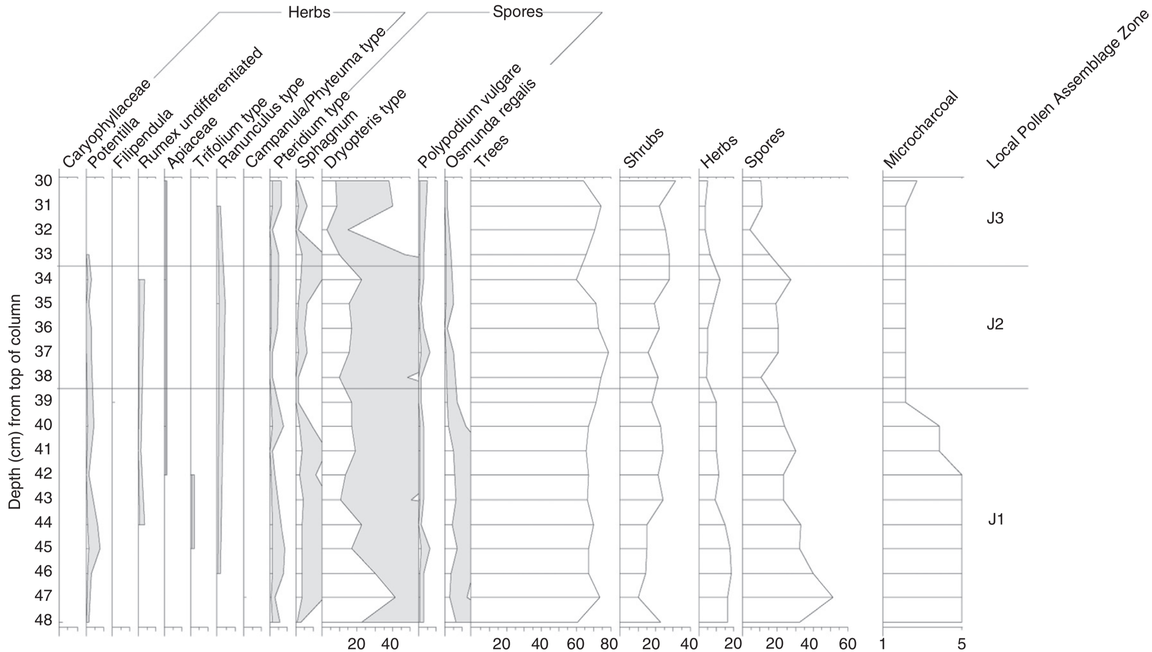


Figure A12.1 Percentage pollen diagram from Jacob's Well, Woodbury Common, Devon



Values expressed as a percentage of total land pollen
x5 exageration values (highlighted in grey) are also shown for all taxa

Microcharcoal: 0 = none; 1 = negligible;
2 = occasional; 3 = moderate;
4 = frequent; 5 = abundant

Figure A12.1 (*cont.*)

(*c*. 20 per cent) with low values of *Hedera*, *Ilex*, *Salix*, *Prunus*, *Rosa* and *Lonicera periclynum*. Herb pollen values are dominated by Poaceae (up to 10 per cent) with a range of other taxa including Cyperaceae, *Potentilla*, *Ranunculus* type and *Plantago lanceolata*, all present in very low concentrations. Aquatic pollen percentages were not recorded. Spore taxa were dominated by *Dryopteris* type (averaging 20 per cent) with *Sphagnum*, *Osmunda regalis*, *Pteridium aquilinum* and *Polypodium vulgare* (all < 10 per cent). Microcharcoal was abundant through most of the zone, but declined to become only occasional towards the very top.

Local Pollen Assemblage Zone J2   Alnus – Quercus – Corylus type

This zone is characterized by the decline of Poaceae to percentages < 5 per cent, and small increase in Cyperaceae (to < 10 per cent). *Osmunda regalis* (spore) and microcharcoal values remained low in comparison to LPAZ J1, but the rest of the pollen assemblage remained largely unchanged.

Local Pollen Assemblage Zone J3   Betula – Corylus type – Alnus

This zone is characterized by changes in arboreal pollen percentage values: *Alnus* and *Quercus* both declined (to *c*. 20 per cent and 15 per cent respectively), and rise to dominance of *Betula* pollen. *Ilex* pollen also increased slightly, whilst *Dryopteris* type declined to < 10 per cent). Otherwise, all other taxa pollen percentages remained largely unchanged from the previous two zones.

Interpretation and discussion of the Jacob's Well pollen analysis

Local pollen assemblage zone J1

The results of the pollen-stratigraphical analysis indicate that during LPAZ J1 *Alnus* (*Alnus glutinosa* – common alder) dominated the wetland environment, with an understorey comprising *Corylus* type (e.g. hazel), *Salix* (willow), *Hedera* (ivy), and *Ilex* (holly). Poaceae (grass family) and Cyperaceae (sedge family), dominated the ground flora with the occurrence of other herbs such as *Ranunculus* type (buttercup), *Potentilla* type (cinquefoil), *Plantago lanceolata* (ribwort plantain), *Rumex* undifferentiated (docks/sorrel) and Apiaceae (carrot family). Ferns and moss were also common including *Dryopteris* (buckler ferns), *Polypodium vulgare* (polypody), *Osmunda regalis* (royal fern) and Sphagnum. These taxa indicate the presence of damp alder-dominated woodland, growing within fen carr and/or on the margins of a river or stream with flowing water; it is noticeable, however, that no aquatic pollen taxa were recorded, perhaps suggesting a relatively dry surface. *Quercus* (oak), *Fraxinus* (ash), *Ulmus* (elm) and *Betula* (birch) may have also been a component of the wetland woodland with alder. However, these taxa may also have occurred on the dryland forming a mosaic of mixed deciduous woodland with *Tilia* (e.g. *T. cordata* – small-leaved lime).

The strongest evidence for the local occurrence of human activity is recorded in this local pollen assemblage, represented by the abundant concentrations of microscopic charred particles.

Local pollen assemblage zones J2 and J3

The results of the pollen stratigraphic analysis indicate that during LPAZ J2, Poaceae declined and Cyperaceae increased. In LPAZ J3, this was followed by the increase of *Betula* to dominance in the wetland woodland cover with *Alnus*. The transition in pollen assemblage through LPAZs 1 to 3 is interpreted as a gradual change from wetter to drier conditions on the peat surface.

It is also during this LPAZs 2 and 3 that the concentration of microcharcoal declines, suggesting a decrease in the influence of human activity at the site. It is of note that this occurrence does not correlate with the findings of the archaeological excavation, in which the horizon of tar was recorded. It is difficult to explain the reason for this occurrence, although one possibility is that the microcharcoal has been washed through the peat profile to the bottom of the section.

References

Moore, P.D., Webb, J.A. and Collinson, M.E. 1991. *Pollen Analysis* (2nd edn). Oxford: Blackwell Scientific.

Reille, M. 1992. *Pollen et spores d'Europe et d'Afrique du Nord*. Marseilles: Laboratoire de botanique historique et palynologie.

Stace, C. 1997. *New Flora of the British Isles* (2nd edn). Cambridge: Cambridge University Press.

Appendix 13
Jacob's Well (JW10) wood charcoal

Dana Challinor, MA (Oxon.), MSc

Seven samples relating to a burnt mound were submitted for identification of suitable material for radiocarbon dating. The material had been collected on site and was unwashed. The larger samples were gently floated onto a fine mesh and air-dried prior to examination. The charcoal was then scanned at low magnification (×7 to ×45), with only the fragments selected for dating being fully identified at high magnification. All of the samples produced relatively short-lived taxa, appropriate for dating, from which a single fragment was separated out and bagged separately. Some roundwood was noted, but there were no complete stems.

All of the samples contained charcoal of *Alnus* (alder) or *Corylus* (hazel) type. All of the fragments examined at high magnification were confirmed as *Alnus*. There is some potential, especially in the larger samples L7 and L14 (12.9), for further analysis. These samples produced diverse assemblages, and further analysis would confirm the identifications and extend the taxon list to provide a basis for the interpretation of fuelwood use and utilization of local resources.

Table A13.1 Jacob's Well wood charcoal

Context	*Quantity*	*Provisional identifications*	*Notes*	*C14 sample*
L7	+++	*Quercus, Alnus/Corylus, Fraxinus, Salix/Populus*	Quite mixed assemblage	*Alnus glutinosa* x 1
L8 (dug)	+	*Alnus/Corylus*		*Alnus glutinosa* x 1
L8 (sieved)	++	*Alnus/Corylus,* Maloideae	Faint ring curvature	Maloideae r-w x 1
L14	++/+	*Alnus/Corylus* r-w, *Quercus*	Mostly *Alnus/Corylus*, faint to moderate ring curvature	*Alnus glutinosa* x 1
12.1 peat level	++	*Alnus/Corylus*		*Alnus glutinosa* x 1
Peat level	++++	*Betula, Alnus/Corylus*	Some large fragments	*Betula* sp. x 1
12.9 L14	++++	*Quercus* r-w, *Alnus/Corylus* r-w, Maloideae r-w	Mostly *Alnus/Corylus*, some very large fragments	Maloideae r-w x 1

Key

+ = up to 5 fragments; ++ = up to 25; +++ = up to 100; ++++ = >100; r-w = roundwood.

AYLESBEARE COMMON PEBBLE PLATFORMS: SPECIALIST REPORT

Appendix 14
Specialist report, Aylesbeare pebble platforms: Micromorphology analysis

R.Y. Banerjea
Quaternary Scientific, School of Human and Environmental Sciences, University of Reading, UK

Introduction

This report summarizes the findings arising out of the micromorphological analysis undertaken by Quaternary Scientific (QUEST), University of Reading, in connection with ARCA, University of Winchester, on samples collected during archaeological excavations undertaken at Aylesbeare, Devon, where pebble platforms were discovered. The pebbles are considered to have been deliberately placed during the Bronze Age. However, C14 dates on charcoal from below the pebbles of platform 1 have produced dates that vary from the Bronze Age, through the medieval period to Napoleonic times (when the area to the north of them was used for a militia encampment when it was thought that the French would invade).

The aim of the micromorphological analysis was to gain more information about formation processes and evolution of the pebble platforms and in particular:

1. Are the strata below the pebble platforms palaeosols and if so which parts?
2. Have the strata been biologically reworked?
3. Have they been mixed any other way?
4. In light of 1–3 above, how likely is it that the strata are an *in situ* land surface from which meaningful palynological data might be obtained?

In order to answer these questions, two micromorphological slides, collected from deposits below two pebblebed platforms (platform 1, sample

Figure A14.1 Platform 1 and the sampling location of AB11 -2 <1> (Source: author)

Figure A14.2 Platform 2 and the location of AB11 -1 <2> (Source: author)

AB11 -2 <1>, Figure A14.1 and platform 2, sample AB11 -1 <2>, Figure A14.2) have been prepared and analysed to determine and compare their composition.

Methods

Two samples (AB11 -2 <1> and AB11 -1 <2>) were sampled in the field using Kubiena tins. According to the field description, sample AB11 -2 <1> has been taken through context 2, described as 'orange clay and pebbles set in it', and context 3, described as 'brown fine clay'.

Sample AB11 -1 <2> has been taken through context 2, described as 'brown sandy deposit and pebbles set in it', and context 3, described as 'red-brown sandy clay'.

Sample preparation

The procedure followed is the University of Reading standard protocol for thin section preparation. Samples were dried to remove all moisture and then impregnated with epoxy resin while under vacuum. The impregnated samples are then left overnight so that the resin can enter all of the pores. The samples then are placed in oven to dry for 18 hours at 70°C before they are clamped and cut to create a 1-cm slice through the sample. The surface of the 1-cm slice is flattened and polished by grinding on the Brot. The prepared surface of the 1-cm slice is then mounted onto a frosted slide and left to cure. This is followed by cutting off the excess sample, so the sample is down to a thickness of 1 or 2 mm. The sample, which is now mounted to the glass slide and has been reduced to 1 or 2 mm thick, is taken back to the Brot and ground down to approximately 100 µm. This 100-µm section is then further thinned by lapping it on a Logitech LP30 precision lapping machine to the standard geological thickness of 30 µm. The samples are then cover slipped ready for analysis.

Sample description

Micromorphological investigation was carried out using a Leica DMEP polarizing microscope at magnifications of ×40–×400 under Plane Polarized Light (PPL), Crossed Polarized Light (XPL), and Oblique Incident Light (OIL). Thin-section description was conducted using the identification and quantification criteria set out by Bullock *et al.* 1985 and Stoops 2003, with reference to Courty *et al.* 1989 for the related distribution and microstructure, Mackenzie and Adams 1994 and Mackenzie and Guilford 1980 for rock and mineral identification, and Fitzpatrick 1993 for further identification of clay coatings. Tables of results use the descriptions, inclusions and interpretations format used by Matthews 2000 and Simpson 1998. Micropictographs were taken using a Leica camera attached to the Leica DMEP microscope.

Micromorphology enables the following properties to be examined at magnifications of ×40–×400 under PPL and XPL: thickness, bedding, particle size, sorting, coarse:fine ratio, composition of the fine material, groundmass, colour, related distribution, microstructure, orientation and distribution of inclusions, and finally the inclusions to be identified and quantified. In addition, post-depositional alterations can be identified and quantified, such as: effects on the microstructure by mesofaunal bioturbation and cracking due to shrink/swell of clays or trampling; translocation of clays and iron; chemical alteration such as the neoformation of minerals such as vivianite and manganese; organic staining as a result of decayed plant material; and excremental pedofeatures such as insect casts and earthworm granules. In order to characterize depositional processes, deposit types are classified according to sediment attributes such as bedding, particle size, the related distribution and the orientation and distribution of inclusions.

Results and interpretation

Micromorphology descriptions for each deposit are recorded in Table A14.1, the frequency and types of inclusions within these deposits are recorded in Table A14.2 and the abundance of post-depositional alterations and pedofeatures within the deposits is recorded in Table A14.3. To determine the deposit type classification, each unit was grouped using the following diagnostic sedimentary attributes and inclusions, which provide crucial information concerning the origin of inclusions, transportation mechanisms of particles and the deposition processes. To ascertain the origin of sediment components descriptions were made of particle size, shape and the composition of the coarse and fine fraction, particularly the frequency of rock, minerals and anthropogenic inclusions (Table A14.2). The depositional events are characterized by the following sedimentary attributes: sorting, related distribution, orientation and distribution of the inclusions and bedding structure (Table A14.1). Understanding the formation processes for deposits is crucial

Table A14.1 Micromorphology descriptions for each deposit (AB11 -2 <1> and AB11 -1 <2>), Aylesbeare, Devon

Deposit type	*Sample number*	*Context number*	*Building/ feature*	*Particle size*	*Sorting*
Levelling	AB11 -2 <1>	2	Sub-platform	Sandy clay/ sandy clay loam	Bimodal: moderately sorted silt and unsorted sand
Mixed topsoil	AB11 -2 <1>	1	Sub-platform	Loamy sand	Bimodal: moderately sorted silt and poorly sorted sand
Palaeosol: buried soil	AB11 -1 <2>	3	Sub-platform	Sandy silt loam/ loamy sand	Bimodal: moderately sorted silt and poorly sorted sand
	AB11 -2 <1>	3	Sub-platform	Sandy clay loam	Bimodal: well-sorted silt and unsorted sand

Fine material	*Groundmass*	*Colour*	*Related distribution*	*Microstructure*	*Inclusions: orientation and distribution*
Mineral and organic	Crystallitic	PPL: Light orange-brown; XPL: Mid orange-greyish brown	Embedded – very occasionally linked and coated around a channel	Channels 30%; chambers 5%	Unoriented and unrelated; random and unreferred
Mineral and organic	Crystallitic and isotropic	PPL: Mid/ orangey-brown; XPL: dark/ dark reddy-brown	Intergrain aggregate and linked and coated	Compound packing voids 40%	Unoriented and unrelated; random and unreferred
Mineral and organic	Crystallitic and isotropic	PPL: Dark brown; XPL: very dark brown	Intergrain aggregate and linked and coated	Channels 30%; Compound packing voids 20%	Unoriented and unrelated; random and unreferred
Mineral and organic	Crystallitic	PPL: Dark brown; XPL: very dark brown	Embedded and linked and coated around root channels	Channels 20%	Unoriented and unrelated; random and unreferred

Table A14.2 Frequency and types of inclusions present (AB11 -2 <1> and AB11 -1 <2>), Aylesbeare, Devon

Deposit type	*Sample number*	*Context number*	*Thickness (cm)*	*Bedding*	*Rock fragments*		*Minerals*	
					Flint	*Sand-stone*	*Quartz*	*Mica*
Levelling	AB11 -2 <1>		2	2.0–3.0	Massive	**	**	****
Mixed topsoil	AB11 -2 <1>		1	0.1–0.5	Massive	*	–	***
Palaeosol: buried soil	AB11 -1 <2>		3	6.0	Massive	**	**	****
	AB11 -2 <1>		3	3.5–4.0	Massive	–	**	****

Note
See Excel file for a complete list of inclusion possibly present in micromorphological samples.
Key
****** = > 70%; ***** = 50–70%; **** = 30–50%; *** = 15–30%; ** = 5–15%; * = < 5%.

		Building materials and sediment aggregates	Micro-artefacts	Organic/plant remains			
Glauconite	*Manganese*	*Sediment aggregate*	*Copper oxide fragments*	*Charred wood*	*Plant tissue ferruginous*		*Plant tissue (with cellulose)*
*	**	*	–	***	*	**	**
*	–	–	*	–	–	***	***
*	–	*	–	*	**	*	***
*	*	**	–	***	**	***	**

Table A14.3 Abundance of post-depositional alterations and pedofeatures (AB11 -2 <1> and AB11 -1 <2>), Aylesbeare, Devon

Deposit type	*Sample number*	*Context number*	*Weathering*						
			Translocation					*Chemical alteration*	
			Dusty impure clay coatings: unlaminated	*Silty clay coatings: moderately/ strongly orientated unlaminated*	*Silty clay coatings: micro-laminated*	*Dusty impure clay coatings: micro-laminated*	*Iron*	*Vivianite neomineral formation*	*Manganese neomineral formation*
Levelling	AB11 -2 <1>	2	–	●●	●●	–	●●●	–	●●
Mixed Topsoil	AB11 -2 <1>	1	–	–	–	–	●●●●	–	–
Palaeosol: Buried Soil	AB11 -1 <2>	3	–	–	–	–	●●●	–	●●
	AB11 -2 <1>	3	–	–	–	–	●●●	–	●●●

Key

●●●●● = > 20%; ●●●● = 10–20%; ●●● = 5–10%; ●● = 2–5%; ● = < 2%.

Decay		*Trampling*		*Bioturbation*			
Organic staining	*Spherical fungal spores*	*Related distribution*	*Cracks*	*Microstructure effects*	*Excremental pedofeatures*		
				Mesofaunal/root bioturbation	*Mesofauna cast*	*Organic/ organo-mineral*	*Earthworm granule*
●●	–	–	–	●●●●●	–	●●	–
●●●	–	–	–	–	–	●●●	–
●●●	–	–	–	●●●●●	–	●●●●	–
●●●	–	–	–	●●●●	–	●●●●	–

to interpreting the depositional pathways of rock fragments and minerals, anthropogenic debris such as charred wood and artefacts and other types of plant remains and microfossils (Schiffer 1987; Matthews 2010). Analysis of post-depositional features provides crucial information concerning the effects of weathering, preservation conditions (Brady and Weil 2002; Breuning-Madsen *et al.* 2003; Canti 1999; Courty *et al.* 1989) and stratigraphic integrity of the deposit (Canti 2003, 2007; Courty et al. 1989).

Deposit types and formation processes

The deposits below pebble platforms 1 and 2 (Figures A14.1 and A14.2) have been classified as (see Appendix 1): palaeosol, specifically a buried soil; levelling material; and mixed topsoil. These classifications enable the formation processes to be better understood.

Palaeosol: buried soil

Context 3, the basal deposit in sample AB11 -2 <1> and the only deposit in sample AB11 -1 <2> have both been classified as palaeosols, specifically buried soils. Palaeosols are soils with features representing conditions which no longer exist today, and there are three main types: relict palaeosols; buried soils; and exhumed palaeosols (French 2003). When describing archaeological deposits, the term buried soil is generally used to refer to former soils preserved beneath upstanding monuments and/or more recent erosion deposits (French 2003).

Both deposits are similar in origin, comprising sand-sized rock and mineral components, a moderately to well-sorted quartz silt component (Table A14.1), charred wood and fragments of plant material (Table A14.2) such as roots which are decaying in their channels (Figure A14.3 a and b) and present as vascular bundles (Figure A14.4), stems (Figure A14.4) and epidermal tissue (Figure A14.5 a and b). Both buried soil deposits (Table A14.2) contained 'modern' (with cellulose) and ferruginous plant remains (Figure A14.6 a and b), however, sample AB11 -2 <1> contains more ferruginous plant remains than sample AB11 -1 <2>, and sample AB11 -1 <2> contains more 'modern' plant remains than sample AB11 -2 <1>. In addition, the buried soil contained possible metal fragments of copper oxide (Table A14.2), although these fragments occurred more frequently in sample AB11 -2 <1>, 15–30 per cent, rather than < 5 per cent in sample AB11 -1 <2>.

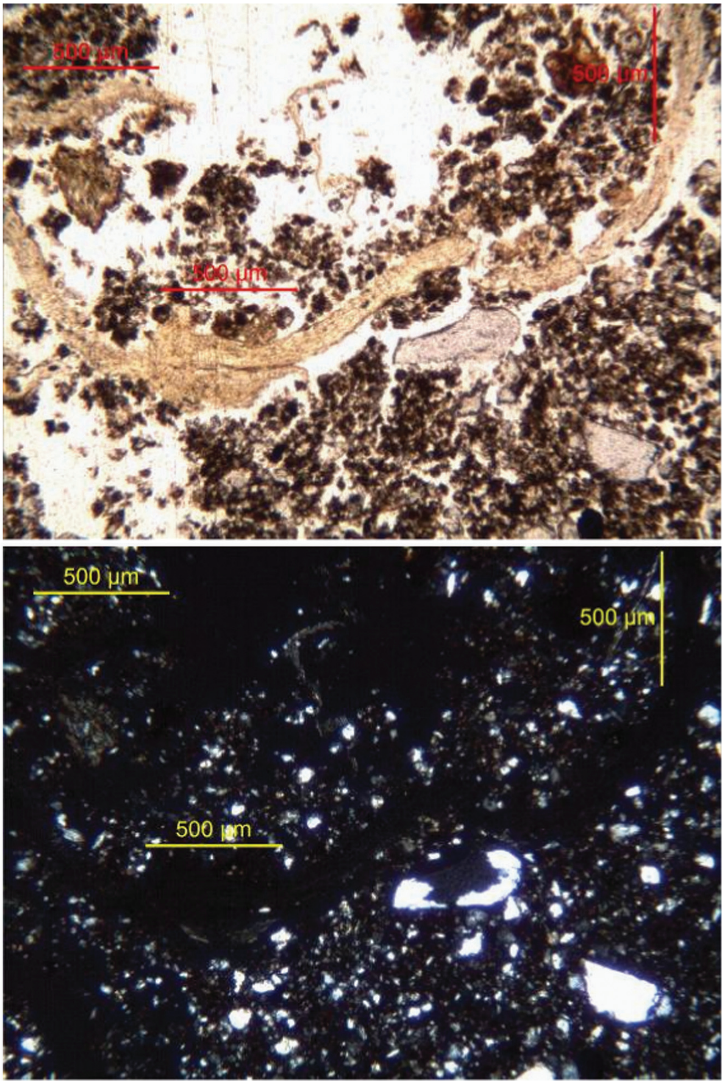


Figure A14.3 Pictures showing a root in channel, base context, sample AB11 -2 <1>, Aylesbeare, Devon; (a) root in channel in PPL, (b) root in channel now isotropic in XPL (Source: author)

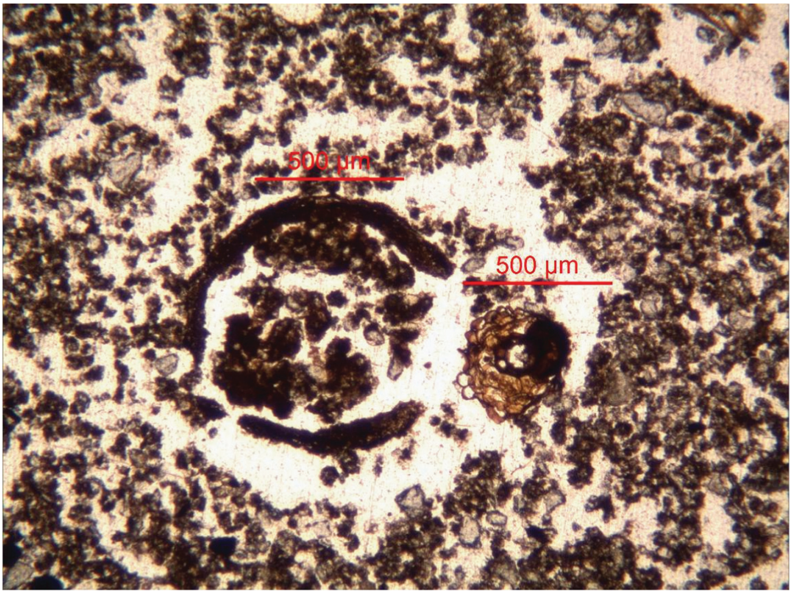


Figure A14.4 Picture showing a root (vascular bundle) and stem in PPL, base context, sample AB11 -2 <1>, Aylesbeare, Devon (Source: author)

The sediment attributes in each buried soil deposit share similarities and also have differences between them: the colour and the orientation and distribution of inclusions are the same in each palaeosol (Table A14.1); however, particle size, sorting and related distribution differ between the two samples (Table A14.1). The palaeosol deposits in samples AB11 -2 <1> and AB11 -1 <2> have similar particle sizes, although there a greater, finer, clay component in sample AB11 -2 <1>. Both palaeosol deposits have bimodal sorting although the silt component in AB11 -2 <1> is well sorted rather than moderately sorted. These sediment attributes may be features of an earthworm-sorted horizon in a buried soil (Banerjea 2011a; Bell 2009).

Sample AB11 -2 <1> is more compacted than sample AB11 -1 <2>, evident by an embedded, and linked and coated around root channels (20 per cent), related distribution; whereas sample AB11 -1 <2> has a more disaggregated intergrain aggregate and linked and coated related distribution, which is probably caused by a greater amount of modern root disturbance in sample AB11 -1 <2> (30 per cent channels). Compaction is a feature of palaeosols. As a result of burial open

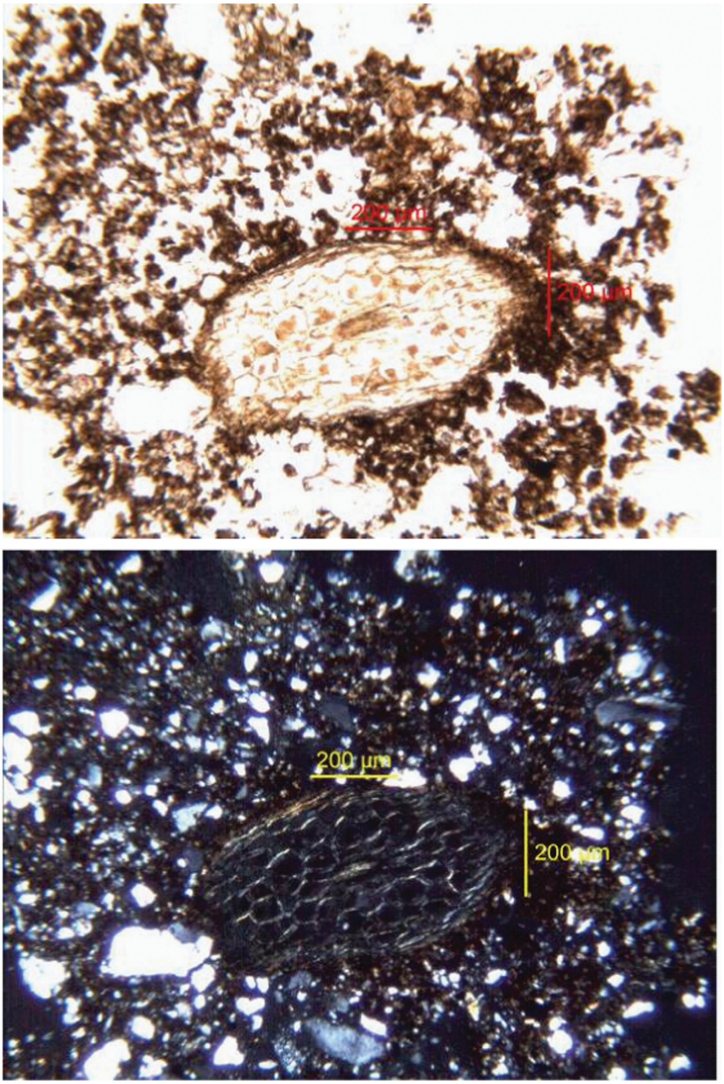


Figure A14.5 Pictures showing an epidermal tissue, sample AB11 - 1 <2>, Aylesbeare, Devon; (a) epidermal tissue in PPL, (b) epidermal tissue in XPL, note 'golden' colour of cellulose (Source: author)

(a)

(b)

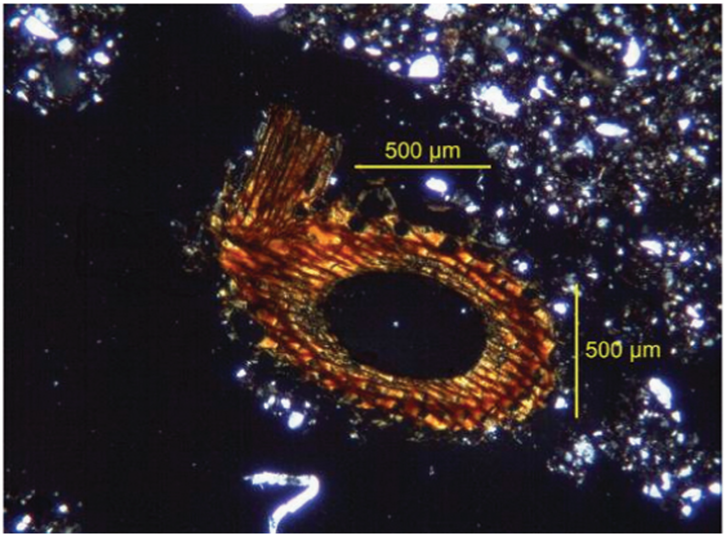


Figure A14.6 Pictures showing a ferruginous plant remains, sample AB11 -1 <2>, Aylesbeare, Devon; (a) ferruginous plant remains in PPL, (b) ferruginous plant remains in XPL (Source: author) void spaces can be crushed out of existence by compaction (Retallack 2001). Soils buried by archaeological features such as earthworks can also be affected by compaction (Bell 2009; French 2003; Macphail and Crowther 1996). The greater frequency of root disturbance in sample AB11 -1 <2> may have partially destroyed sediment attributes, such as well-sorted material and increased fine material, which would indicate a buried soil.

Levelling

Context 2, the middle deposit in sample AB11 -2 <1>, has been interpreted as levelling material as it seals the buried soil (palaeosol) and lies directly below the pebbled surface as if to create a level surface. It is not present in sample AB11 -1 <2>, which may suggest that this area did not require levelling. Levelling material has a massive bedding structure which can indicate a single depositional event (Banerjea 2011a, 2011b; Goldberg and Macphail 2006), rather than laminations of sediment that have accumulated through time.

The embedded related distribution (Table A14.1) may indicate that the levelling material has been compacted, perhaps during deposition to form a flat surface. Rock and mineral components (Table A14.2) most probably reflect the local geology, which would indicate a local source of the material. Eight bits of charcoal found were recovered from context 2 during excavation (Professor Chris Tilley pers. comm.). Micromorphology shows that this levelling deposit contained very few, < 5 per cent, microscopic or macroscopic charcoal fragments, which is less than the buried soils. Possible metal fragments of copper oxide occurred in the levelling material at a frequency of 15–30 per cent.

Mixed topsoil

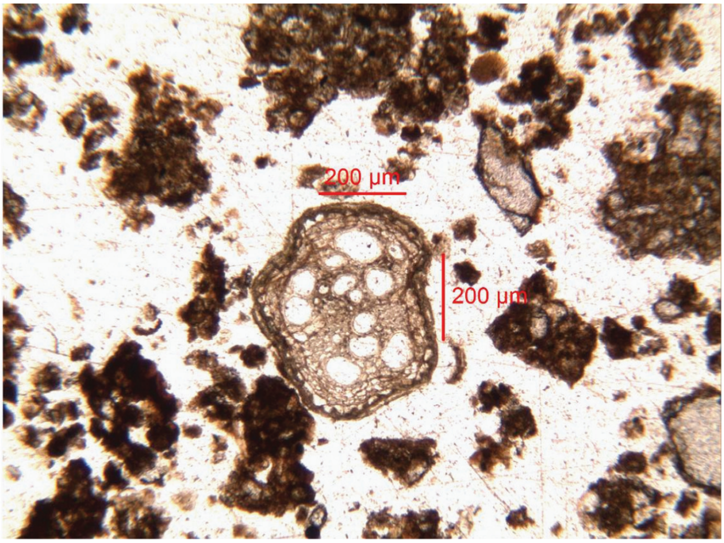
In thin section, this deposit is < 0.5 cm in depth (Table A14.2), as the entire deposit was not sampled. It shares similar sediment attributes with the palaeosol deposits in samples AB11 -2 <1> and AB11 -1 <2> (Table A14.1). It has a loamy sand particle size, and bimodal sorting with a moderately sorted quartz silt component. The colour, mid/orange-brown (PPL) and dark/dark-reddish-brown (XPL), highlights a mixture of sediment which has been redeposited from the two deposits below: the orange-brown levelling deposit and dark-brown buried soil palaeosol (middle and basal deposits) in sample AB11 -2 <1>. Sediment aggregates formed from the fabric of the sediment below (Sample AB11 -2 <1>, middle layer) occur.

As this surface deposit in sample AB11 -2 <1> contains sediment similar to both the underlying layers, it is possible that the sediment has been transported up the profile by mesofaunal activity, evident by the occurrence of organo-mineral excremental pedofeatures (Table A14.3); however, as the field image (Figure A14. 1) shows, some sediment may have fallen through the overlying pebbles and accumulated in between and below them. This deposit also shares a similar range of inclusions (Table A14.2) with the levelling and palaeosol deposits, particularly with the palaeosol in sample AB11 -2 <1>. There are both 'modern' (Figure A14.7 a and b) and ferruginous plant remains within the buried soil (Table A14.2).

Cultural residues

Fragments of charred wood occur in both buried soil palaeosol deposits (samples AB11 -2 <1> and AB11 -1 <2>). As evident in Figure A14.8 and Figure A14.9, these fragments sometimes occur in void spaces created by bioturbation, suggesting that some of the charred wood may have been transported by root or mesofaunal activity from elsewhere in the profile. Charcoal fragments within the levelling deposit are also located within void spaces (Figure A14.9), suggesting that they are intrusive, perhaps brought down by a root, as well as embedded in the sediment matrix (Figure A14.10), suggesting that they were present at the time of deposition. Possible metal, copper oxide, fragments (Figure A14.11 and Figure A14.12) which were identified using OIL occur in all deposits except the mixed topsoil in sample AB11 -2 <1> (Table A14.2); however, these fragments require further analysis to confirm what they are. These possible metal inclusions occur in a greater frequency in sample AB11 -2 <1> (15–30 per cent) than in sample AB11 -1 <2> (< 5 per cent). It is possible that they were included, either accidentally or deliberately, in the levelling material at the time the levelling material was prepared. Micromorphological analysis from urban occupation deposits has shown that levelling deposits contain cultural inclusions that are representative of the surrounding activities and/or building materials (Banerjea 2011 a, 2011b). Not enough of the mixed topsoil deposit is present in sample AB11 -2 <1> to state conclusively that these inclusions do not occur in the topsoil.

(a)



(b)

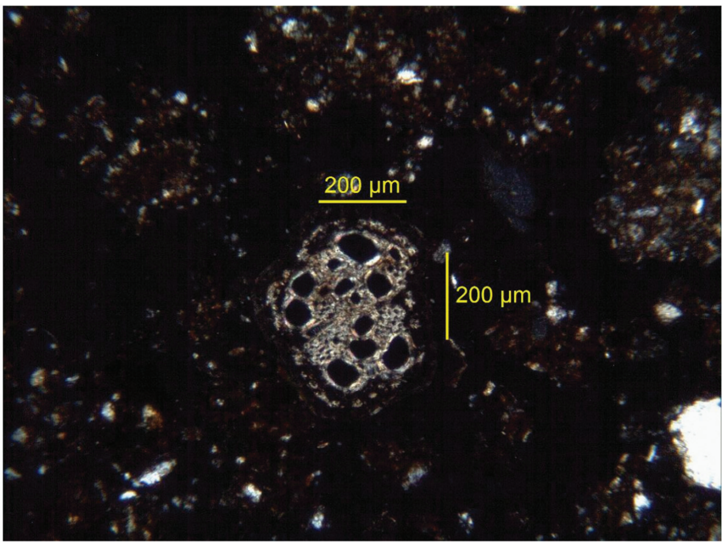


Figure A14.7 Pictures showing a vascular bundle from root or stem, surface context, sample AB11 -2 <1>, Aylesbeare, Devon; (a) vascular bundle from root or stem in PPL, (b) vascular bundle from root or stem in XPL, note 'golden' colour of cellulose (Source: author)

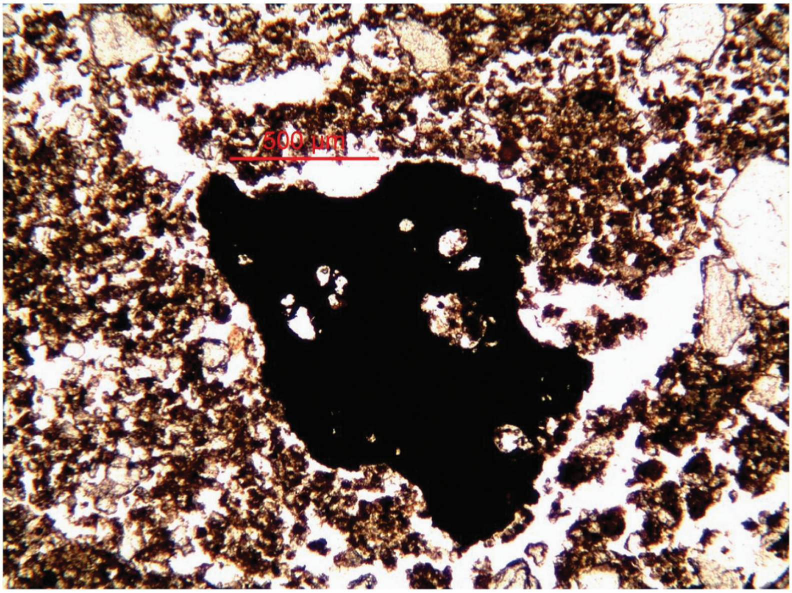


Figure A14.8 Picture showing charred wood in PPL, base context, sample AB11 -2 <1>, Aylesbeare, Devon (Source: author)

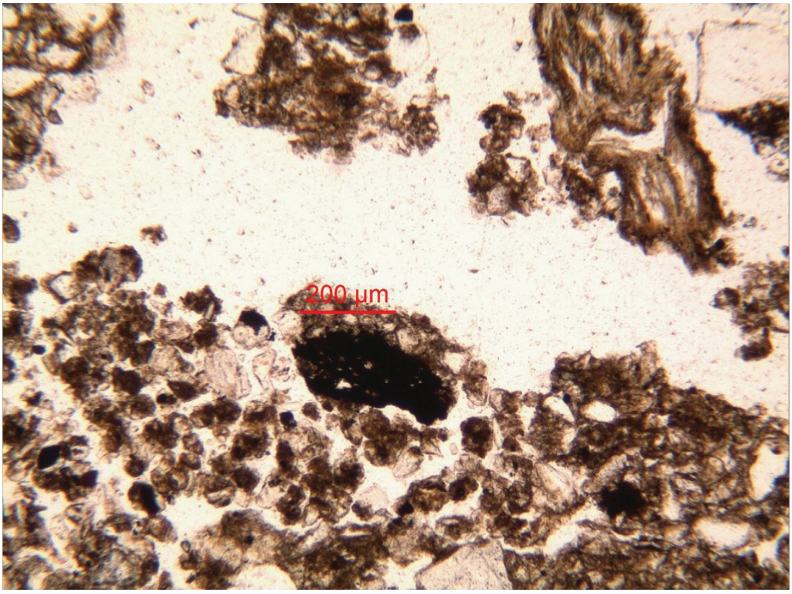


Figure A14.9 Picture showing a charcoal fragment in root channel in PPL, sample AB11 -2 <1>, Aylesbeare, Devon (Source: author)

Figure A14.10 Picture showing charcoal embedded in deposit in PPL, sample AB11 -2 <1>, Aylesbeare, Devon (Source: author)

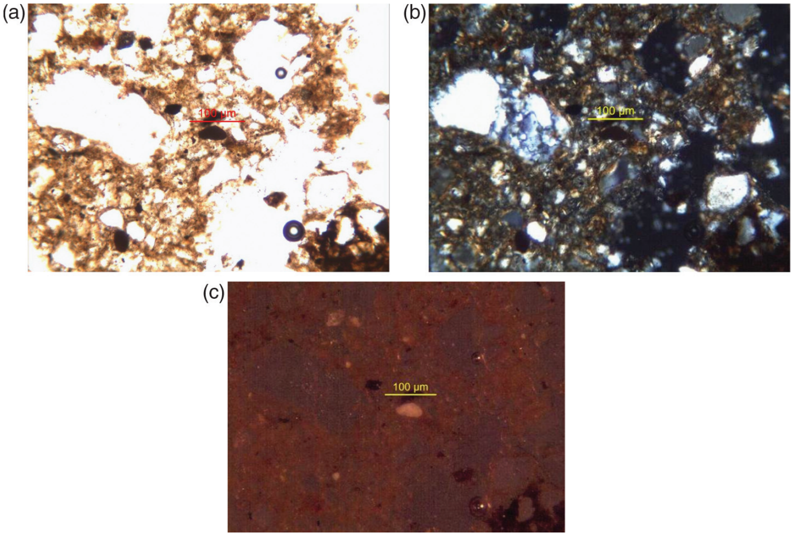


Figure A14.11 Pictures showing a possible metal fragment, levelling deposit, sample AB11 -2 <1>, Aylesbeare, Devon; (a) possible metal fragment in PPL, (b) possible metal fragment in XPL; (c) possible metal fragment in OIL (Source: author)

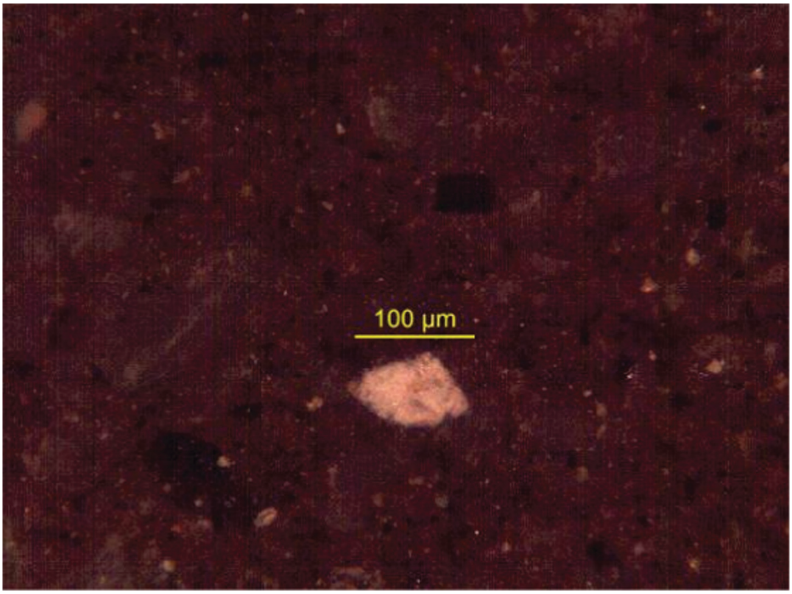


Figure A14.12 Picture showing a possible metal fragment in OIL, buried soil, sample AB11 -2 <1>, Aylesbeare, Devon (Source: author)

Post-depositional alterations

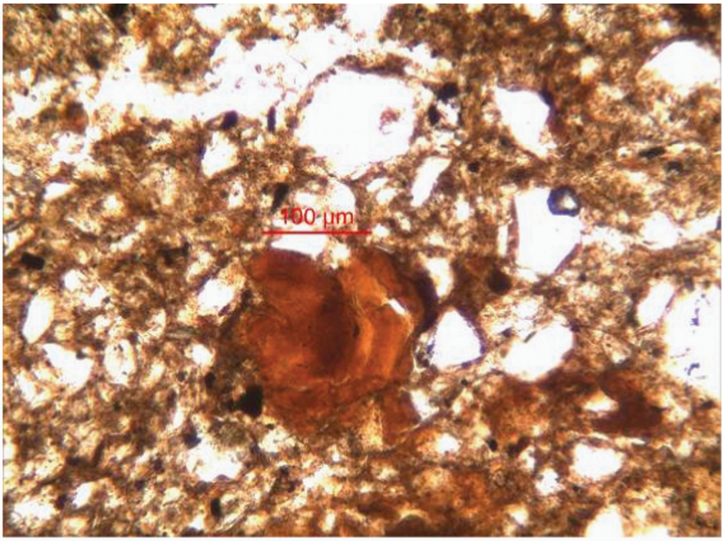
Both samples show substantial disturbance by weathering and mesofaunal and root bioturbation (Table A14.3). These post-depositional processes affect the preservation of palynological data and the stratigraphic integrity of the sequence for radiocarbon dating.

Weathering

Both samples show evidence of weathering and reduced conditions as indicated by the translocation of clay, in the levelling deposit, and iron, and manganese neomineral formation in all deposits, with the exception of the absence of manganese in the mixed topsoil (Table A14.3).

The levelling deposit contains 2–5 per cent iron-impregnated unlaminated and microlaminated silty clay coatings (Figure A14.13 a and b). Microlaminated clay/silty clay coatings exhibiting regular lamination and high birefringence indicate good orientation of fine particles as a result of slow aqueous deposition under calm conditions (Courty *et al.* 1989). Unlaminated and microlaminated moderately/strongly silty clay and clay occur in all deposits and may represent clay that has been washed through the profile.

(a)



(b)

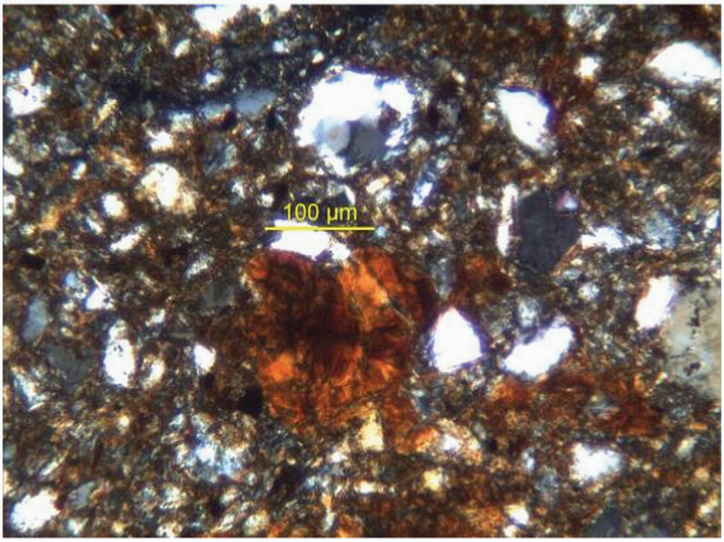


Figure A14.13 Pictures showing iron-impregnated microlam silty clay coating, levelling deposit, sample AB11 -2 <1>, Aylesbeare, Devon; (a) iron-impregnated microlam silty clay coating in PPL, (b) iron-impregnated microlam silty clay coating in XPL (Source: author)

Iron staining occurs in all deposits, although most abundantly in the mixed topsoil (Table A14.3). Free iron is highly mobile only when present in the ferrous state which occurs under anaerobic conditions (Courty *et al.* 1989). Iron has impregnated clay coatings (Figure A14.13 a and b) and begun to replace decaying roots (Figure A14.6 a and b). Manganese neomineral formation also occurs within all deposits except the mixed topsoil (Table A14.3). Manganese may accumulate at the top of either the water table or the capillary fringe (Bartlett 1988; Rapp and Hill 1998). Fluctuating water tables lead to alterations of reducing and oxidizing conditions (Brammer 1971; Brown 1997; French 2003). Manganese neomineral formation is more likely to be due to the association of manganese with decaying organic matter. Organic matter becomes oxidized as Mn(III) accepts electrons to become Mn(II). The pH rises and the rate of redox is slowed. As organic matter is lost by oxidation, black precipitated MnO_2 will become evident.

Most critical redox happenings occur in areas where the O_2 supply is partially restricted either by limited aeration or a predominating electron supply. Most of these regions are redox interfaces, such as: meeting points between roots or microbial surfaces and the soil surface; aggregates and soil pores; sediments and free water; the boundary between organic and a mineral horizon (Bartlett 1988). Darkening in colour, known as organic staining, is observed in thin section from the decomposition of organic matter (Courty *et al.* 1989) and occurs here in all deposits (Table A14.3).

Bioturbation

Palaeosols that are buried by later features are not strictly ‘fossilized’ as they continue to undergo pedogenic processes after burial (French 2003). Both samples show evidence of bioturbation in the microstructure and/or by the presence of mesofaunal excremental pedofeatures (Table A14.3). Bioturbation has resulted in the reworking of the deposits causing material to be moved up and down through the profile, evident by material being deposited in voids (Figure A14.8, Figure A14.9 and Figure A14.14). Root activity is clear as fragments of roots are clearly visible in some of the channels (for example Figure A14.3 a and b).

Discussion and conclusions

In conclusion, the basal deposit in sample AB11 -2 <1> and the entire deposit in sample AB11 -1 <2> are buried soil palaeosols.

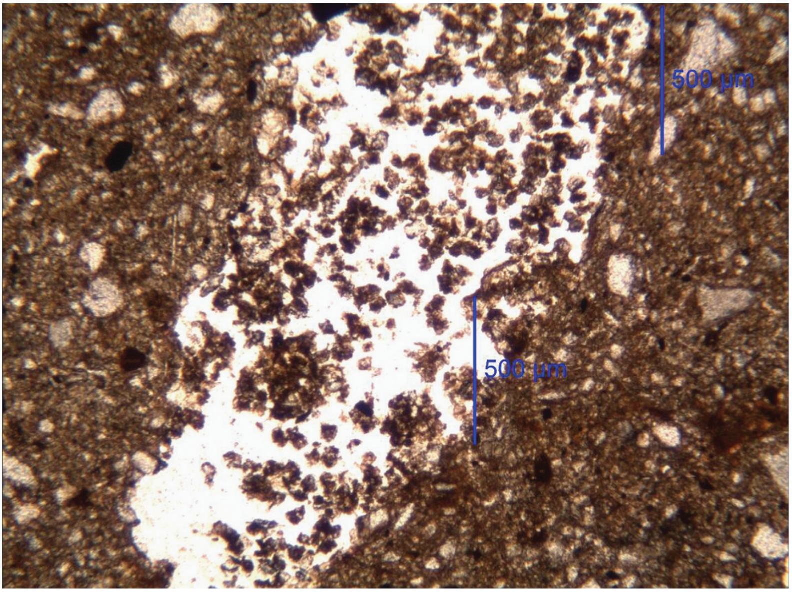


Figure A14.14 Picture showing an organo-mineral material from deposit below within this void by mesofaunal activity, levelling deposit, sample AB11 -2 <1>, Aylesbeare, Devon (Source: author)

The moderately/well-sorted silt component may be attributes of an earthworm-sorted horizon in a buried soil (Banerjea 2011a; Bell 2009). The middle deposit is a levelling deposit in which charcoal and possible fragments of metal were embedded at the time of deposition. A mixed topsoil deposit was identified on the surface of the levelling material, although the full thickness of this deposit was not evident in thin-section.

The strata have been chemically weathered, leading to fluctuating redox conditions, and significantly biologically reworked by root and mesofaunal activity. The levelling material in sample AB11 -2 <1> highlights the level of disturbance as charcoal fragments are both embedded within the sediment, as if included at the time of deposition, and present in voids created by root channels, and so probably pushed down through the profile by root activity. In addition, organo-mineral excremental pedofeatures are present within void spaces created by mesofaunal activity.

The bioturbation has led to the mixing of deposits which means that palynological data has been moved down through the profile and possibly been moved up though the profile by mesofaunal agents as well. It is possible that charcoal producing a Bronze Age date relates to the buried soil and the later dates relate to the construction of the pebble platform; however, micromorphology shows significant bioturbation in these samples.

References

Banerjea, R.Y. 2011a. 'The changing use of internal urban space: a microscopic perspective from mid-Roman timber building 1', in Fulford, M.G. and Clarke, A.S. (eds) *Silchester: City in Transition. The Mid-Roman Occupation of Insula IX, c. AD125–250/300. A Report on Excavations Undertaken since 1997.* Britannia Monograph 25. London: Society for the Promotion of Roman Studies.

Banerjea, R.Y. 2011b. 'Characterising urban space: a case study from Insula IX, Silchester, Hants, UK'. University of Reading, unpublished PhD thesis.

Bartlett, R.J. 1988. 'Manganese redox reactions and organic interactions in soils', in Graham, R.D., Hannam, R. J. and Uren, N.C. (eds) *Manganese in Soils and Plants: Proceedings of the International Symposium on Manganese in Soils and Plants Held at the Waite Agricultural Research Institute, the University of Adelaide, Glen Osmond, South Australia, August 22–26, 1988, as an Australian Bicentennial Event.* Dordrecht: Kluwer Academic Publishers.

Bell, M. 2009. 'Experimental archaeology: changing science agendas and perceptual perspectives', in Allen, M.J., Sharples, N. and O'Connor, T. (eds) *Land and People: Papers in Memory of John G. Evans.* Oxford: Oxbow, 31–45.

Brady, N.C. and Weil, R. R. 2002. *The Nature and Properties of Soils.* Upper Saddle River, NJ: Prentice Hall.

Brammer, H. 1971. 'Coatings in seasonally flooded soils', *Geoderma* 6: 5–16.

Breuning-Madsen, H., Holst, M.K., Rasmussen, M. and Elberling, B. 2003. 'Preservation within long coffins before and after barrow construction', *Journal of Archaeological Science* 30: 343–50.

Brown, A.G. 1997. *Alluvial Geoarchaeology: Flood Plain Archaeology and Environmental Change*. Cambridge: Cambridge University Press.

Bullock, P, Fedoroff, N., Jongerius, A., Stoops, G. and Tursina, T. 1985. *Handbook for Thin Section Description.* Wolverhampton: Waine Research Publications.

Canti, M.G. 1999. 'The production and preservation of faecal spherulites: animals, environment and taphonomy', *Journal of Archaeological Science* 26: 251–8.

Canti, M.G. 2003. 'Earthworm activity and archaeological stratigraphy: a review of products and processes', *Journal of Archaeological Science* 30: 135–48.

Canti, M. G 2007. 'Deposition and taphonomy of earthworm granules in relation to their interpretive potential in Quaternary stratigraphy', *Journal of Quaternary Science* 22(2): 111–18.

Courty, M.A., Goldberg, P. and Macphail, R. 1989. *Soils and Micromorphology in Archaeology.* Cambridge: Cambridge University Press.

FitzPatrick, E.A. 1993. *Soil Microscopy and Micromorphology*. Chichester: Wiley.

French, C. 2003. *Geoarchaeology in Action.* New York and Oxford: Routledge.

Goldberg, P. and Macphail, R.I. (with Matthews, M.) 2006. *Practical and Theoretical Geoarchaeology.* Malden, MA, Oxford and Victoria: Blackwell Publishing.

Mackenzie, W.S. and Adams, A.E. 1994. *A Colour Atlas of Rocks and Minerals in Thin Section.* New York: John Wiley and Sons.

Mackenzie, W.S. and Guilford, C. 1980. *Atlas of Rock Forming Minerals.* Harlow: Longman.

Macphail, R. I. and Crowther, J. 1996. 'Short-term, post-burial change in a humic rendzina soil, Overton-Down Experimental Earthwork, Wiltshire, England', *Geoarchaeology* 11(2): 95–117.

Matthews, W. 1995. 'Micromorphological characteristics of occupation deposits and microstratigraphic sequences at Abu Salabikh, Southern Iraq', in Barnham, A.J. and Macphail, R.I. (eds) *Archaeological Sediments and Soils: Analysis, Interpretation and Management*. London: Institute of Archaeology, University College, 41–76.

Matthews, W. 2000. 'Micromorphology of occupation sequences', in Matthews, R. and Postgate, J.N. *Contextual Analysis of Use of Space at Two Bronze Age Sites.* http://ads.ahds.ac.uk/catalogue.

Matthews, W. 2010. 'Geoarchaeology and taphonomy of plant remains and microarchaeological residues in early urban environments in the Ancient Near East', *Quaternary International* 214: 98–113.

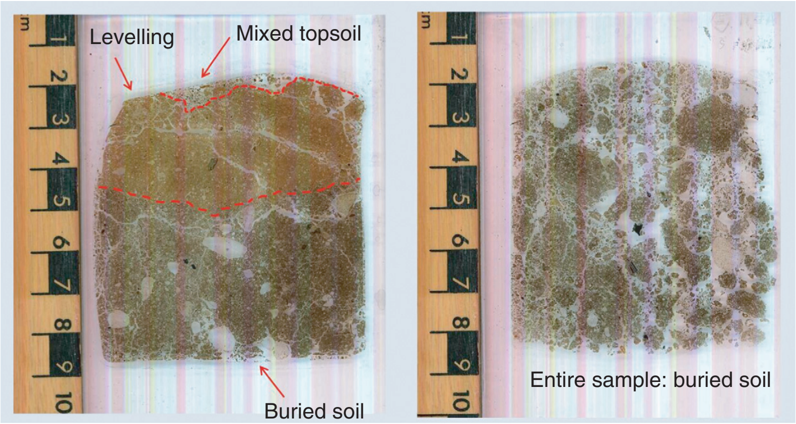
Rapp, Jr, G. and Hill, C.L. 1998. *Geoarchaeology: The Earth-Science Approach to Archaeological Excavation.* New Haven, CT and London: Yale University Press.

Retallack, G.J. 2001. *Soils of the Past: An Introduction to Paleopedology.* Oxford: Blackwell Science.

Schiffer, M.B. 1987. *Formation Processes of the Archaeological Record.* Salt lake City: University of Utah Press.

Simpson, I. 1998. 'Early land management at Tofts Ness, Sanday, Orkney: the evidence of thin section micromorphology', in Mills, C.M. and Coles, G. (eds) *Life on the Edge: Human Settlement and Marginality.* Oxford: Oxbow.

Stoops, G. 2003. *Guidelines for Analysis and Description of Soil Thin Sections.* Madison, WI: Soil Science Society of America.



Appendix: figure 1 Deposits beneath the pebble platforms AB11-2 and AB11-1 (Source: author)

AYLESBEARE COMMON BOG BARROW: SPECIALIST REPORT

Appendix 15
Aylesbeare, Bog Barrow (ABB10): Wood charcoal

Dana Challinor, MA (Oxon.), MSc

Thirty samples were submitted for identification. The material had been collected on site and was unwashed. Many samples appeared to be pure sediment with little or no identifiable charcoal. Others contained a few identifiable fragments, which were identified in full. The remaining samples were of greater interest as 20-plus fragments were noted; these were not fully identified but scanned to explore the diversity of the assemblages. The condition of the material – unwashed and damp – hindered this assessment and some of the larger sediment samples were dried. Table A15.1 provides the results from samples which produced identifiable material – the full record is recorded in an Excel file.

The majority of the samples produced oak (*Quercus* sp.) charcoal, though much of this came from relatively small diameter roundwood, some of which is suitable for dating. Two samples (20 and 25) contained some heather/ling (Ericaceae) charcoal roundwood and sample 18 was of particular interest as it produced a quantity of alder/hazel (*Alnus/Corylus*) charcoal. One fragment for dating was confirmed at high magnification as that of hazel. This sample would have the potential for further identifications but the data from Bog Barrow as a whole is of modest interpretative value owing to the low quantities of charcoal and limited taxonomic diversity.

Table A15.1 Results of the charcoal analysis from Bog Barrow 2010

Sample no.	*Quantity*	*Identification*	*Notes*	*C14 potential*
5	–	*Quercus* x 1	Sediment	–
6	–	*Quercus* x 1	–	–
7	–	*Quercus* x 1	–	–
9	–	*Quercus* x 1	–	–
13	–	*Quercus* x 4	Could be r-w but unclear	–
14	–	*Quercus* r-w x 2	–	*Quercus* r-w. Slow so difficult to age
15	–	*Quercus* r-w x 3	–	*Quercus* r-w (incomplete)
16	++	*Quercus* r-w	Lots sediment	*Quercus* r-w (incomplete)
17	++	*Quercus* r-w	–	–
18	++/+	*Alnus/Corylus* r-w, *Quercus* h-w	Lots *A/C* r-w. Potential for further ids but would need washing and drying	*Corylus avellana* r-w
20	++	*Quercus* r-w, Ericaceae r-w	Mostly sediment	Ericaceae r-w, could be root
21	++	*Quercus* r-w	–	*Quercus* r-w, 8 years
24		*Quercus* x 4	–	–
25	++	*Quercus* r-w, cf Ericaceae r-w	–	Cf. Ericaceae r-w, 3–7 years
26		*Quercus* x 3	Largish fragments	–
27		*Quercus* r-w x 1, *Quercus* x 1	–	*Quercus* r-w
28	++	*Quercus* r-w	–	*Quercus* r-w (incomplete)

Table A15.1 Continued

Sample no.	*Quantity*	*Identification*	*Notes*	*C14 potential*
29		*Quercus* x 1	Very slow. Sediment	–
30	++	*Quercus* r-w	–	*Quercus* r-w 5 years
32	++/+	*Quercus* r-w, possible h-w	Fissured	*Quercus* r-w, 9 years
33	–	*Quercus* h-w x 4	Distorted and fissured	–

Key
++ = up to 25 fragments; +++ = up to 100.

LONGO BOTTOM: SPECIALIST REPORT

Appendix 16

Longo Bottom: Pollen analysis report

C.R. Batchelor
Quaternary Scientific (QUEST), School of Human and Environmental Sciences, University of Reading, UK

Introduction

This report summarizes the findings arising out of the pollen assessment undertaken by Quaternary Scientific (QUEST), University of Reading, on one borehole core sample (BH2) taken from Longo Bottom, which forms part of the Pebblebeds project. The core sample was taken by ARCA, University of Winchester, using a Russian Corer and measured 0.43 m in length. The stratigraphy comprised the following:

0–0.09 m	root mat
0.09–0.15 m	organic mud/highly humified peat
0.15–0.30 m	moderately humified peat with granular-sized plant macrofossils
0.30–0.31 m	coarse sand
0.31–0.43 m	organic mud with discontinuous laminae of coarse sand. The latter increase in size downwards.

An AMS radiocarbon date taken from the base of the BH2 sequence (SY 05070 87057) at 0.38 to 0.39 m on well-humified clay/peat provided an age of 4826 +/− 25 BP; 3660–3530 cal. BC (WK 30631) equating to the Neolithic cultural period. A pollen assessment of samples taken from the borehole indicated an excellent concentration and preservation of pollen typical of carr woodland and mixed deciduous dryland woodland. In addition, the abundance of *Sphagnum* midway through the sequence, and presence of heather (*Calluna vulgaris*) towards the top were suggestive of changes in vegetation throughout the period of deposition. As a consequence of these findings, analysis was recommended in order to provide a detailed reconstruction of the vegetation history of the site and its environs.

Methods

Pollen assessment

Eleven sub-samples were extracted for the analysis of pollen content from borehole BH2. The pollen was extracted as follows: (1) sampling a standard volume of sediment (1 ml); (2) deflocculation of the sample in 1 per cent Sodium pyrophosphate; (3) sieving of the sample to remove coarse mineral and organic fractions (> 125 μ); (4) acetolysis; (5) removal of finer minerogenic fraction using Sodium polytungstate (specific gravity of 2.0 g/cm^3); (6) mounting of the sample in glycerol jelly. Each stage of the procedure was preceded and followed by thorough sample cleaning in filtered distilled water. Quality control is maintained by periodic checking of residues, and assembling sample batches from various depths to test for systematic laboratory effects. Pollen grains and spores were identified using the University of Reading pollen type collection and the following sources of keys and photographs: Moore et al. 1991; Reille 1992. Plant nomenclature follows the *Flora Europaea* as summarized in Stace 1997. The analysis procedure consisted of scanning the prepared slides until a count of > 400 Total Land Pollen was reached (trees, shrubs and herbs; aquatic and spore taxa were recorded in addition). The results of the analysis are recorded in Figure A16.1.

Results, interpretation and discussion of the pollen assessment

Results of the pollen analysis

The results of the pollen analysis are displayed in Figure A16.1. The diagram has been divided into two local pollen assemblage zones (LPAZs) according to variations in the pollen content.

LPAZ LB1; 0.30 to 0.48 m BGL; Corylus *type,* Alnus, Poaceae

This zone is characterized by high values of tree (40 per cent) and shrub (40 per cent) pollen. *Corylus* type dominates (40 per cent) with *Alnus* (20 per cent), *Quercus, Betula* (both 10 per cent), *Pinus, Calluna vulgaris*

Table A16.1 Results of the pollen-stratigraphic assessment, Longo Bottom

Depth (m OD)		Main pollen taxa			*Concentration 0–5*	*Concentration grains/cm3*	*Preservation 0–5*	*Microcharcoal 0–5*
From	*To*	*Latin name*	*Common name*	*Number*				
BH1								
0.15	0.16	*Alnus*	alder	15	5	323144	3–4	5
		Quercus	oak	4				
		Tilia	lime	1				
		Corylus type	e.g. hazel	8				
		Poaceae	grass family	1				
		Cyperaceae	sedge family	2				
		Dryopteris type	buckler fern	high				
		Sphagnum	sphagnum moss	2				
0.38	0.39	*Alnus*	alder	7	5	1542752	4	2–3
		Quercus	oak	11				
		Pinus	pine	2				
		Betula	birch	1				
		Ulmus	elm	1				
		Corylus type	e.g. hazel	7				
		Poaceae	grass family	3				
		Cyperaceae	sedge family	4				
		Filipendula type	meadowsweet	1				
		Dryopteris type	buckler fern	4				
		Sphagnum	sphagnum moss	1				
		Pteridium aquilinum	bracken	2				

BH2								
0.03	0.04	*Alnus*	alder	3	5	258515	4	2–3
		Quercus	oak	4				
		Betula	birch	5				
		Pinus	pine	3				
		Corylus type	e.g. hazel	6				
		Calluna vulgaris	heather	1				
		Erica spp.	heath	2				
		Poaceae	grass family	6				
		Cyperaceae	sedge family	1				
		Sparganium type	bur-reed	3				
		Dryopteris type	buckler fern	5				
0.11	0.12	*Alnus*	alder	8	5	1334272	4	3–4
		Quercus	oak	5				
		Betula	birch	2				
		Tilia	lime	2				
		Corylus type	e.g. hazel	10				
		cf *Lonicera periclymenum*	honeysuckle	1				
		Poaceae	grass family	3				
		Cyperaceae	sedge family	1				
		Dryopteris type	buckler fern	22				
		Polypodium vulgare	polypody fern	1				
		cf *Osmunda regalis*	royal fern	1				

Table A16.1 Continued

Depth (m OD)		Main pollen taxa			Concentration 0–5	Concentration grains/cm3	Preservation 0–5	Microcharcoal 0–5
From	*To*	*Latin name*	*Common name*	*Number*				
0.18	0.19	*Alnus* *Quercus* *Tilia* *Betula* *Corylus* type Cyperaceae *Dryopteris* type Sphagnum	alder oak lime birch e.g. hazel sedge family buckler fern sphagnum moss	9 6 1 4 8 5 35 1	5	1375968	4	3–4
0.29	0.30	*Alnus* *Quercus* *Pinus* *Corylus* type Poaceae Cyperaceae *Dryopteris* type *Polypodium* type Sphagnum	alder oak pine e.g. hazel grass family sedge family buckler fern polypody fern sphagnum moss	1 2 2 15 3 7 4 1 70	5	312720	3–4	1

0.39	0.40	*Alnus* *Quercus* *Pinus* *Betula* *Corylus* type *Hedera* Poaceae Cyperaceae *Dryopteris* type Sphagnum	alder oak pine birch e.g. haze livy grass family sedge family buckler fern sphagnum moss	5 5 1 4 13 1 4 4 13 7	5	1542752	3	3
0.48	0.49	*Alnus* *Quercus* *Betula* *Corylus* type Poaceae Cyperaceae *Dryopteris* type *Polypodium vulgare*	alder oak birch e.g. hazel grass family sedge family buckler fern polypody fern	7 4 1 15 5 3 20 1	5	1459360	4–5	2

Key
Concentration: 0 = 0 grains; 1 = 1–75 grains; 2 = 76–150 grains; 3 = 151–225 grains; 4 = 226–300 grains; 5 = 300+ grains per slide.
Preservation: 0 = none; 1 = very poor; 2 = poor; 3 = moderate; 4 = good; 5 = excellent.
Charcoal: 0 = none; 1 = negligible; 2 = occasional; 3 = moderate; 4 = frequent; 5 = abundant.

(5 per cent), *Tilia, Ulmus* (both < 5 per cent) and sporadic occurrences of *Fraxinus, Erica* sp., *Ilex, Hedera, Salix* and *Frangula alnus* (all < 5 per cent). Herb pollen is dominated by Poaceae (up to 40 per cent at 0.42 m BGL) with Cyperaceae and sporadic occurrences including *Cirsium* type, *Artemisia, Anthemis* type, Lactuceae, *Plantago lanceolata, Potentilla* and *Ranunculus* type. Aquatic pollen was limited to a single occurrence of *Sparganium* type. Spores were dominated by *Dryopteris* type (50 per cent), with *Pteridium aquilinum*, *Polypodium vulgare*, Sphagnum and *Osmunda regalis*. Total pollen concentration was variable, but very high throughout the zone.

LPAZ LB2; 0.03 to 0.30 m BGL; Corylus *type,* Alnus, Quercus, Sphagnum

This zone is characterized by high values of Sphagnum, particularly towards the base (*c*. 175 per cent TLP). Tree (50 per cent) and shrub (40 per cent) values remain very high, dominated by *Corylus* type (40 per cent) with *Alnus* (20 per cent), *Quercus* (10 per cent), *Betula* (< 20 per cent), *Pinus*, (5 per cent), *Fraxinus*, Tilia, Ulmus, *Ilex*, *Salix*, *Calluna vulgaris, Erica* sp. (all < 5 per cent) and sporadic occurrences of *Juniperus* and *Acer* (all < 3 per cent). Herbaceous pollen is dominated by Cyperaceae (10 per cent) and Poaceae (< 5 per cent, increasing to *c*. 30 per cent at the top of the zone), Asteraceae, *Cirsium* type, Apiaceae (all < 3 per cent) and sporadic occurrences of Lactuceae, *Plantago lanceolata*, *Chenopodium* type and *Ranunculus* type. Aquatic pollen comprised *Typha latifolia*, *Myriophyllum* type, *Sparganium* type and cf. *Utricularia*. Spores other than Sphagnum included *Dryopteris* type (50 per cent), *Polypodium vulgare* (< 10 per cent) and *Osmunda regalis* (< 2 per cent). Total pollen concentration was very high throughout the zone.

Interpretation of the pollen analysis

The results of the pollen-stratigraphic analysis indicate that during LPAZ LB-1, the wetland surface comprised alder (*Alnus*), willow (*Salix*), alder buckthorn (*Frangula alnus*) and a mixture of herbs, aquatics and ferns including grasses (Poaceae), sedges (Cyperaceae), buttercups (*Ranunculus* type), meadowsweet (*Potentilla* type), dandelions (Lactuceae), ribwort plantain (*Plantago lanceolata*), daisies (Asteraceae), thistles (*Cirsium* type), bur-reed (*Sparganium* type), buckler ferns (*Dryopteris* type), polypody (*Polypodium vulgare*) and royal fern (*Osmunda regalis*). Hazel (*Corylus* type), the most dominant component of the local vegetation, may also have grown with alder, but was probably mainly located towards the margins of the wetland and beyond forming a mixed deciduous woodland with oak (*Quercus*), lime (*Tilia*), birch (*Betula*) and possibly pine (*Pinus*). However, the dominance of hazel also suggests that this woodland was relatively open in nature. Furthermore, the presence of heather (*Calluna vulgaris/Erica* sp.) suggests some nearby heathland, or possibly the presence of nearby bog or acidic soils. No definitive indications of anthropogenic activity were recorded within this zone, which is not unsurprising considering the Neolithic age of these sediments.

The transition into LPAZ LB-2 coincides with the transition from organic mud and coarse sand into moderately humified peat with granular-sized plant macrofossils at 0.30 m BGL. The transition is accompanied by a large spike in *Sphagnum* (peat moss) and an increase in sedges and bulrush (*Typha latifolia*), whilst alder declines. The remaining herbaceous and fern assemblage remains much unchanged from LPAZ LB-1, incorporating grasses, plantains, dandelions, thistles and daisies, together with goosefoot taxa (e.g. fat hen – *Chenopodium* type) and marsh valerian (*Valeriana* type) This assemblage is suggestive of the development of a very wet peat surface, with alder retreating to more stable areas of the wetland. Immediately above this, however, *Sphagnum* values decline and alder values increase, indicating the development of a drier peat surface and the natural response of vegetation to these conditions.

Throughout this part of LPAZ LB-2, the concentration of those taxa that were probably growing on the margins of the wetland and beyond (e.g. hazel, oak, lime, elm, birch) remained unchanged, suggesting the unaffected growth of woodland. The exception to this was a peak in pine values towards the base of the zone. However, pine pollen grains are well known for travelling long distances, and this peak is thought more likely to reflect the development of more open and wetter conditions on the peat surface (and therefore the input of such grains), as opposed to an actual nearby increase in pine woodland. In addition, the limited quantity of *Calluna vulgaris* pollen declined to near absence at the base of the zone, suggesting the retreat of the environmental conditions supporting these heathland plants. Similarly to LPAZ LB-1, no definitive evidence of anthropogenic activity was recorded.

The final change in vegetation is recorded towards the very top of LPAZ-1, and is characterized by a small decline in hazel and expansion of birch, heather, juniper (*Juniperus* type), cranberry/crowberry (*Vaccinium* type/*Empetrum*), grasses and possibly pine. Several of these taxa have either a preference for or can cope with acidic soils (e.g.

cranberry/crowberry, heather, pine, birch), suggesting the start of a transition towards such conditions. This is coincidental with a change from in the stratigraphy from organic mud/highly humified peat to root mat around 0.09 m BGL. This also indicates a very dry peat potentially developing towards acidic conditions. However, the continuing moderate values of alder combined with the range of mixed herbs and aquatics, including buttercups, daisies, dandelions, bladderworts (*Utricularia*), bulrush, bur-reed and water-milfoil (*Myriophyllum* type) suggests the persistent growth of wetland plants. During this latter period, the vegetation growing at/beyond the wetland margin remains unchanged with no definitive evidence for human activity.

Conclusions

The results of the pollen analysis have provided a reconstruction of vegetation history for the Longo Bottom site. This reconstruction indicates the growth of relatively open mixed deciduous woodland dominated by hazel and oak growing at and beyond the margins of the wetland throughout the period of deposition. On the wetland itself, alder, willow and various herbs, aquatics and ferns grew prior to the development of moderately humified peat at 0.30 m BGL. This peat surface was initially very wet, supporting the growth of peat mosses, sedges and bulrush. However, as the peat surface developed it became drier, causing peat moss to decline and allowing alder to expand. Finally, the stratigraphic and pollen record shows signs of the development of acidic conditions including the growth of trees and shrubs such as birch, heather, crowberry/cranberry and possibly pine. Many wetland plants continued to grow during this latter period.

During the course of the assessment, the results indicated the possible development of some heathland within the uppermost samples, due to the presence of *Calluna vulgaris* and *Erica* spp. pollen. This occurred contemporaneously with apparent changes on the wetland surface as indicated in a decline in alder and increase in bur-reed pollen values. The results of the analysis however, indicate that a limited quantity of heather grew throughout the sampled period, although small peaks were noted in LPAZ LB-1 and at the top of LPAZ LB-2. In addition, whilst microscopic charred particles were noted through the sequence, no other definitive pollen indicators of anthropogenic activity were recorded.

References

Moore, P.D., Webb, J.A. and Collinson, M.E. 1991. *Pollen Analysis* (2nd edn). Oxford: Blackwell Scientific.

Reille, M. 1992. *Pollen et spores d'Europe et d'Afrique du Nord*. Marseilles: Laboratoire de botanique historique et palynologie.

Stace, C. 1997. *New Flora of the British Isles* (2nd edn). Cambridge: Cambridge University Press.