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RESEARCH ARTICLE

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Analysis of prehistoric brown earth paleosols under the podzol soils of Exmoor, UK

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Abstract

The deforestation of the upland landscapes in southwest Britain during prehistory is an established archaeological narrative, documenting human impacts on the environment and questioning the relationship of prehistoric societies to the upland landscapes they inhabited. Allied to the paleoenvironmental analyses of pollen sequences, which have provided the evidence of this change, there has been some investigation of prehistoric paleosols fossilized under principally Bronze Age archaeological monuments. These analyses identified brown earth soils that were originally associated with temperate deciduous woodland, on occasion showing evidence of human impacts such as tilling. However, the number of analyses of these paleosols has been limited. This study presents the first analysis of a series of pre-podzol brown earth paleosols on Exmoor, UK, two of which are associated with colluvial soil erosion sediments before the formation of peat. This study indicates these paleosols are spatially extensive and have considerable potential to inform a more nuanced understanding of prehistoric human impacts on the upland environments of the early-mid Holocene and assess human agency in driving ecosystem change.

KEYWORDS
brown earth, paleosol, podzol, sediment analysis, soil micromorphology

1 | INTRODUCTION

Exmoor is an upland region in the southwest peninsula of Britain, designated a National Park in recognition of its outstanding landscape, rich in ecological and archaeological resources (Figure 1). Of the upland areas in southwest England, the archaeological record of Exmoor has arguably received less investigation (Riley & Wilson-North, 2001, VIII) in comparison with the granite uplands of Dartmoor (Newman, 2016) and Bodmin Moor (Johnson, Bonney, & Rose, 2008). In contrast to Dartmoor and Bodmin Moor, Exmoor is not a granitic upland, but an area of semi-metamorphosed, uplifted sedimentary bedrock, composed of Hangman Grits, Ilfracombe Beds, Lynton Beds, Morte Slates, Pickwell Down Beds, and Baggy and Marwood Beds (Edmonds, Mckeown, & Williams, 1975). All the upland areas of the southwest are now associated with peat mires and bogs caused by the development of podzol soils during the mid Holocene, which were preceded by brown earth soils that supported temperate deciduous woodland (Roberts, 2008, p. 228).

The prehistoric archaeological record of Exmoor is distinct from that of the other southwestern uplands. Dartmoor and Bodmin Moor both contain numerous standing stones, stone circles, and rows

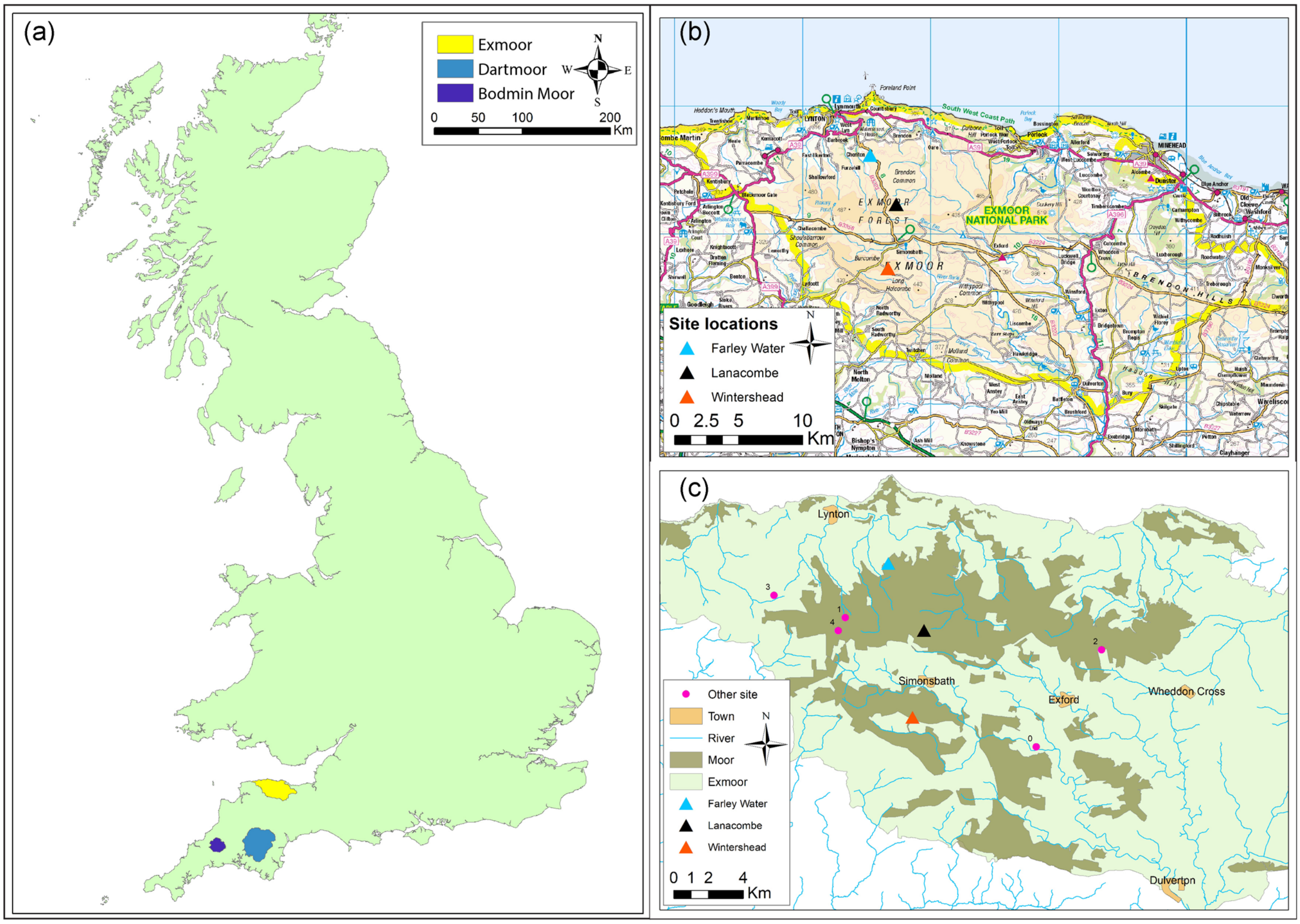


FIGURE 1 The location of Exmoor National Park at national (a) and regional (b) scales, with the three study sites highlighted and additional sites mentioned in the text (c; 0 = Brightworthy, 1 = Spooners, 2 = Pinkery Canal, 3 = The Chains, 4 = Codsend Moor, and 5 = Holworthy hillslope enclosure) [Color figure can be viewed at wileyonlinelibrary.com]

primarily composed of granite (Johnson et al., 2008; Newman, 2016). In comparison, Exmoor contains relatively few stone monuments, which are composed of nongranitic, smaller (<0.5 m) stones, known as "miniliths" (Gillings, Pollard, & Taylor, 2010). Likewise, the archaeological record of both Dartmoor and Bodmin Moor contains numerous Early Bronze Age barrows and cairns, Middle Bronze Age land divisions (reaves), Middle Bronze Age enclosures, some containing multiple roundhouses, and later prehistoric enclosures, such as hillforts (Johnson et al., 2008; Newman, 2016). Early Bronze Age barrows and cairns are also found on Exmoor, such as the Chapman Barrows and cairn groups, for example, Robin and Joaney How (Riley & Wilson-North, 2001, pp. 32–40). In contrast, Exmoor has a relative lack of surviving prehistoric land divisions, although some are suspected at Codsend Moor (Francis & Slater, 1992), Hoar Moor (Francis & Slater, 1990), and Chetsford Water (Riley & Wilson-North, 2001, p. 54). Evidence for prehistoric settlement is present on Exmoor, first in the form of house platforms and several hut circles which, although currently undated, may be analogous to those shown to be of Middle Bronze Age date on Dartmoor and Bodmin Moor. Settlement also occurred in the form of small enclosures (<1 ha), some of which are likely to be Iron Age, although others as at Holworthy (Green, 2009) may have Bronze Age origins. Iron Age activity on Exmoor is also demonstrated by seven hillforts located on the edge of the moor overlooking river valleys (Riley & Wilson-North, 2001, pp. 56–64).

The disparity in the visibility of the archaeological records between Exmoor and the other upland areas of the southwest peninsula has led to a difference in their investigation, which also extends to the study of their paleoenvironmental and geoarchaeological contexts. On Dartmoor, the field systems associated with prehistoric enclosures and houses were extensively mapped (Fleming, 2008), with some allied geoarchaeological and paleoenvironmental investigations (Balaam, Smith, & Wainwright, 1982). Detailed paleoenvironmental analysis has been undertaken on Dartmoor demonstrating some use of fire in the Mesolithic period for vegetation clearance and a late Mesolithic oak, elm, and hazel dominated woodland. It was previously interpreted that significant woodland clearance occurred during the late Neolithic–Early Bronze Age, with a largely cleared landscape established by the time of reave construction during the Middle Bronze Age between 1700 and 1300 BC (Caseldine, 1999; Caseldine & Hatton, 1996; Wilkinson &

Straker, 2007). However, more recent paleoenvironmental research on Dartmoor has suggested a greater persistence of woodland on the northern moor of Dartmoor until 450–150 cal BC, with significant change in land use during the late Iron Age (Fyfe & Woodbridge, 2012). At Shovel Down, northeast Dartmoor, a peat sequence closely associated with archaeological remains from the Middle Bronze Age, showed a significant shift to grass-dominated open vegetation at around 1610–1200 cal BC (Fyfe et al., 2008). Paleoenvironmental research on Bodmin Moor indicates a pre-Neolithic woodland of oak-hazel, with the presence of some alder, elm, lime, and birch. There is evidence for some limited woodland clearance in the early Neolithic, which became more widespread during the Bronze Age (Gearey, Charman, & Kent, 2000a, 2000b).

Pollen analysis of the peat deposits on Exmoor provided pioneering early models of landscape change in the Holocene, with blanket peat initiation on Exmoor dated to before 2908–2515 cal BC (UB821, calibrated OxCal v. 4.3), with human activity visible in the pollen record interpreted from the Neolithic onwards, although increased human activity is noted in the pollen from between 1044 cal BC (UB-819 calibrated OxCal ver. 4.3) and 426 cal AD (UG-816, calibrated OxCal ver. 4.3; Merryfield & Moore, 1974). Straker and Crabtree (1995) also analyzed peat deposits at the Chains and suggested a date of *c.* 3000 BC for peat inception, but attribute this to a climatic driver, interpreting no human impact within the pollen spectra before 1000 BC. On Codsend Moor, Francis and Slater (1992) provide a date for peat inception of no earlier than 470 BC and suggest a model of human-induced forest clearance for livestock grazing during the Mid-Late Bronze Age, with Late Roman pasture and arable seemingly well represented. More recent research on Exmoor has focused on pollen analysis from spring mires that has provided localized sequences next to the monumental complexes of the Seta and Five barrow cemeteries (Fyfe, 2012), demonstrating a Middle Bronze Age date for the major paleoecological transformation of this landscape. Pollen analysis at Molland on the southern edge of Exmoor (Fyfe, Brown, & Rippon, 2003) records a short-lived Early Neolithic woodland disturbance, some woodland clearance from the Early Bronze Age, but intensive woodland clearance from the early Iron Age, creating a cleared pastoral landscape. In the nearby Blackdown Hills, pollen analysis shows some Late Bronze woodland clearance and Iron Age cereal cultivation, with little evidence for Neolithic woodland clearance (Brown et al., 2014).

This removal of woodland in prehistory is intimately linked to the degradation of the original early Holocene brown earth soils within these upland systems. However, in contrast to the paleoenvironmental analysis of pollen data for Exmoor and its surrounding areas, the geoarchaeological study of soils and sediments has been limited. The transition from the original loess derived upland acidic brown earth woodland supporting soils of the early Holocene into podzolic soils is the product of acidification and waterlogging, although as Moore (1993) discusses a variety of factors are likely to contribute to this, including local topography, contemporary land use, geology, and climatic variability. Acidification and waterlogging were exacerbated by tree cover removal, with grasses and herbs like heather reducing the rate of evapotranspiration, and plant litter accumulation at the soil surface increasing localized anaerobism. This facilitated clay breakdown and mobilization of sesquioxides, causing brown earth soils to degrade into stagnogley podzols and peats on the higher moors (Dimbleby, 1962; Duchaufour, 1982, pp. 112–121; Macphail & Goldberg, 2018, pp. 122–134; Maltby, 1995). Across the southwest peninsula, the chronology of brown earth soil deterioration and transition into podzol systems is poorly understood, especially in relation to the dynamics and activities of past human societies. The analysis of sediments beneath Saddlesborough Reave, Dartmoor, demonstrated the soils at this locality had already undergone severe degradation, with a peaty topsoil, Eag horizon, and iron pan over a podzolic B horizon present before reave construction in the Middle Bronze Age (Balaam et al., 1982; Macphail, 1980). At Chysauster, Cornwall, an early Holocene brown earth soil that had developed on late Devensian loess above granite was recognized. This paleosol under a cairn had been affected by some acidification before burial, exacerbated through tilling, demonstrating soil degradation before podzolization was occurring in the Early Bronze Age with significant colluviation during the Bronze Age/Iron Age (Macphail, 1987; Smith, 1996).

Maltby and Caseldine (1982) analyzed paleosols sealed beneath several barrows around the St. Neot Valley, Bodmin Moor, and demonstrated the presence of pre-Bronze Age brown earth soils before podzolization of the surrounding landscape. At Carn Brea the analysis of a paleosol underneath the outer bank of a Neolithic tor enclosure dated to *c.* 3600 BC, demonstrated the development of argillic an acid brown earth derived from loessic and weathered granite parent material. However, preburial this soil had undergone podzolization, with leached iron and clay microfabrics in the upper Ah/Ea horizons, which contained significant amounts of charcoal. The podzolization of this soil was related to early Neolithic woodland clearance, causing soil instability and initiating podzolization, although the process of podzolization was halted due to burial under the bank shortly afterwards (<300 years; Macphail, 1989). Brisbane and Clews (1979) suggested the presence of a poorly preserved brown earth paleosol that had undergone some podzolization before burial, by the construction of a Bronze Age cairn on Bodmin Moor. More recent research has investigated a Middle Bronze Age roundhouse and associated field boundaries on Dartmoor, with a pre-reave/roundhouse brown earth, buried by colluvium demonstrating Middle Bronze Age soil erosion (K. L. Hunnissett et al. [personal communication, August 2019]). Maltby (1995) discussed the development of the extant soils on Exmoor including blanket bogs and stagnogley podzols and their likely transition from an original mineral brown earth soil supporting deciduous woodland. However, the only description of a paleosol (mineral soil) on Exmoor was from Pinkery Canal, whereby a mineral soil that predated the peat formation was found underneath the bank of a C19th canal (Crabtree & Maltby, 1975). The paleosol was not directly analyzed, but pollen analysis was undertaken. Differential pollen preservation is evident in the paleosol, but the presence of *Plantago lanceolate*, Cerelia, Asteraceae (Compositae) and Cruciferae were taken as evidence for pre-peat farming activity, suggested to date to the Bronze Age–Iron Age.

However, given the extent of the southwestern upland areas in the UK, combined with the rich prehistoric archaeological records they preserve, these studies represent a small sample of analyses. The synthesis of these studies also demonstrates a clear potential to directly elucidate the chronology and impacts of human societies on past landscapes within this region. This paper then presents the geoarchaeological identification and analysis of a series of paleosols across Exmoor resulting from site investigations during the Exmoor Mires Project.

1.1 | Background to this study

The Exmoor Mires Project was part of the Upstream Thinking initiative undertaken by Southwest Water from 2011 (South West Water, 2020), which focused on the restoration of the hydrological function of mires as a flood prevention strategy and improving water quality across the catchment (Bray, 2015). This rewetting involved the blocking of historic drainage ditches, requiring heavy plant to traverse the moor along access tracks and necessitating site-specific archaeological mitigation strategies within impacted areas. These interventions used geophysical surveys and targeted excavation to understand the archaeological remains, coupled with geoarchaeological investigations of soils and sediments, to understand the pre-peat deposit sequences. The podzol soils on Exmoor have been shown to contain relatively thin peat deposits (<c. 1 m; see below) away from the spring lines and blanket bogs, and although excavations have revealed archaeology such as Mesolithic flint scatters under the peat (e.g., Hawkcombe Head; Gardiner, 2007), and standing stones now surrounded by peat but cutting an earlier deposit sequence (Gillings et al., 2010), the systematic investigation of the pre-peat podzol landscape of Exmoor has been lacking. This paper details the results from the multiproxy geoarchaeological investigation of three sites across Exmoor, investigating the pre-peat sediment sequences associated with archaeological remains at Wintershead (EWH13; NGR: 276664, 137321), Farley Water (FW16; NGR: 275266, 146168), and Lanacombe (ELN14; NGR: 277319, 142315; Figure 1).

2 | MATERIALS AND METHODS

2.1 | Field sampling

Excavations were undertaken using trenches to investigate archaeological features. The geoarchaeological sampling of sediment sequences collected tins from trench sections for laboratory analysis. Samples were collected using a square plastic drainpipe, with one edge cutoff. The drainpipe was placed over the section and labeled, photographed and recorded on the section drawing, before sample removal. The sample was wrapped in clingfilm and black plastic, before being placed in cold storage.

2.2 | Laboratory subsampling

Samples were cleaned, photographed, and logged. Each sample was continuously subsampled on 1 cm interval removing *c.* 10 g of sediment. The 1 cm subsamples allowed sediment variation both within and between contexts to be analyzed, integrating the analysis with the field excavation data. Spot samples for pollen analysis were collected from each context, with their location recorded. The remaining undisturbed sediment was retained for soil micromorphology. The 1 cm subsamples were oven-dried at 40°C. When dry, each subsample was homogenized in a ceramic pestle and mortar, and fractionated using a 2 mm sieve. The <2 mm fraction was weighed and discarded, with the ≤2 mm fraction retained for analysis.

2.3 | Analysis of fine sediment fraction

The fine sediment fraction was analyzed to determine sediment composition using a Malvern Mastersizer 2000 laser analyzer, using a Mie scattering model (Malvern, 2005). Each subsample was disaggregated through adding 5 ml of sodium hexametaphosphate (Calgon) to a heaped spatula of sediment (*c.* 1 g), which was agitated on a platform rotary shaker at 175 rpm for a minimum of 1 hr. Each subsample was analyzed using Basic Ultrasonic Method, making three measurements, with a mean value calculated. All data were exported from the Malvern Mastersizer using the Wentworth scale, a Phi classification of sediment sizes range (Table 1), and this nomenclature is used throughout.

2.4 | Organic content

Loss on ignition was used to measure the organic content, which is a useful proxy for the identification of paleosols (Canti, 2015). Ceramic crucibles were oven-dried at 100°C for 24 hr before weighing.

TABLE 1 The Wentworth scale used in the analysis of the fine sediment (≤2 mm fraction)

Size (mm)	Wentworth scale
0.0039	Clay
0.0078	Very fine silt
0.0156	Fine silt
0.031	Medium silt
0.063	Coarse silt
0.125	Very fine sand
0.25	Fine sand
0.5	Medium sand
1.0	Coarse sand
2.0	Very coarse sand

A spatula of subsample was added to each crucible before drying for 24 hr at 100°C. The samples were removed from the oven and placed in a desiccator before reweighing, and were then fired at 450°C for 4 hrs, before being placed in a desiccator and reweighed.

2.5 | Magnetic susceptibility

Magnetic susceptibility was used to identify evidence of heating, as well as topsoil inwashing, with both processes enhancing magnetic susceptibility values (Goldberg & Macphail, 2006, pp. 350–352). The magnetic susceptibility of each subsample was measured using a Bartington MS2B magnetic susceptibility meter with the reading calibrated to the mass of the sample, using 10 ml pots. The sample sequence required a blank zero measurement before the sample was added to the meter and the magnetic susceptibility measured for 5 s, before removal and a further blank zero measurement, to calibrate for drift. The sample measurement was mass-specific.

2.6 | Soil micromorphology

Thin sections were taken from within significant contexts, to identify brown earth fabrics, inclusions, and pedogenic features in the sediment sequences underlying the current podzol soil formations (Stoops, Marcelino, & Mees, 2018). Each thin section sample was impregnated with a clear polyester resin–acetone mixture; samples were then topped up with resin, ahead of curing and slabbing for 75 × 50 mm-size thin sections. Thin sections were further polished with 1,000 grit papers and analyzed using a petrological microscope under plane polarized light, crossed polarized light, oblique incident light, and using fluorescent microscopy (blue light), at magnifications ranging from ×1 to ×200/400. Thin sections were described, ascribed soil microfabric types and microfacies types, and counted accordingly (Goldberg & Macphail, 2006). The data provided are semi-quantitative. For inclusions the ranges used are very few 0–5%; few 5–15%; frequent 15–30%; common 30–50%; dominant 50–70%, and very dominant >70%. For burrows and organo-mineral excrements, the ranges used are rare <2%; occasional 2–5%; many 5–10%; abundant 10–20%, and very abundant > 20% (from Bullock, Fedoroff, Jongerius, Stoops, & Tursina, 1985). Key information derived from the soil micromorphology is included in the context descriptions, with a full micromorphological description given in the tabulated data for each context.

2.7 | Pollen

Standard techniques for concentration of the subfossil pollen and spores were used on subsamples of 1.5 ml volume (Moore & Webb, 1978; Moore, Webb, & Collinson, 1991). Minimum pollen counts of 400 grains per level were made at Wintershead and 250 grains per level at Farley Water and Lanacombe. Pollen percentage figures were calculated using the total pollen counted per slide, excluding ferns. Summary figures for trees, shrubs, Ericales, and herbs were calculated using the total pollen counted per slide, excluding ferns. The percentage values for the ferns summary were calculated using the total pollen sum including ferns.

2.8 | Presentation of data

With the analyses completed, the data were entered into an Excel spreadsheet, before exporting to SPSS for the drawing of line graphs. Graphs drawn in SPSS were exported in Adobe Illustrator, and added to the sample logging sheet, with the context boundaries drawn over the graphs. Each context was then described and the data from the soil micromorphology and pollen analyses were integrated.

3 | RESULTS

The results from each site will be presented individually before a wider synthesis. The percentage values in brackets for sediments and organic content are mean percentage values. The values for all pollen, sediment, and organic data have been rounded up in the text, with original values provided in the tables.

3.1 | Wintershead

Five trenches were excavated at Wintershead EWH13 (Figure 2), positioned to investigate anomalies identified by the gradiometer survey. Within Trench 4, three intercutting pits were found cutting context (420), an orange-brown silt clay. Context (420) was cut by pit [421], which in turn was cut by pits [408] and [409]. Cut [408] had been subjected to heating and was filled by (411) containing burnt stones (*c.* 80%) and charcoal. Charcoal analysis identified mature oak trunk wood, with two fragments submitted for radiocarbon dating, returning dates of 7003–6647 cal BC (7896 ± 29 BP; SUERC-52976 [GU33969]) and 7002–6651 cal BC (7902 ± 26 BP; SUERC 52977 [GU33970]) at 95.4% probability. Monolith sample EWH13 <5> sampled the complete deposit sequence revealed by Trench 4, retrieving 26 cm of sediment, with four pollen samples analyzed (Figures 3 and 4; Tables 2–5).

3.1.1 | Context (420)

Context (420) is an orange-brown light gray clay silt. Clay (18%), very fine silt (22%), and fine silt (21%) are all high and increase. Medium silt (15%), coarse silt (12%), and very fine sand (7%) decrease from the base of the unit. Fine sand (3%), medium sand (2%), and coarse sand (1%) are all low, although slightly higher at the base of the unit. Organic content (10%) is relatively high and shows a slight increase upward, while magnetic susceptibility values are generally low. Key soil micromorphology features include (Figure 4c,d) increasing amounts of varyingly ferruginized material, and few humic dark reddish-brown soil particles, associated with

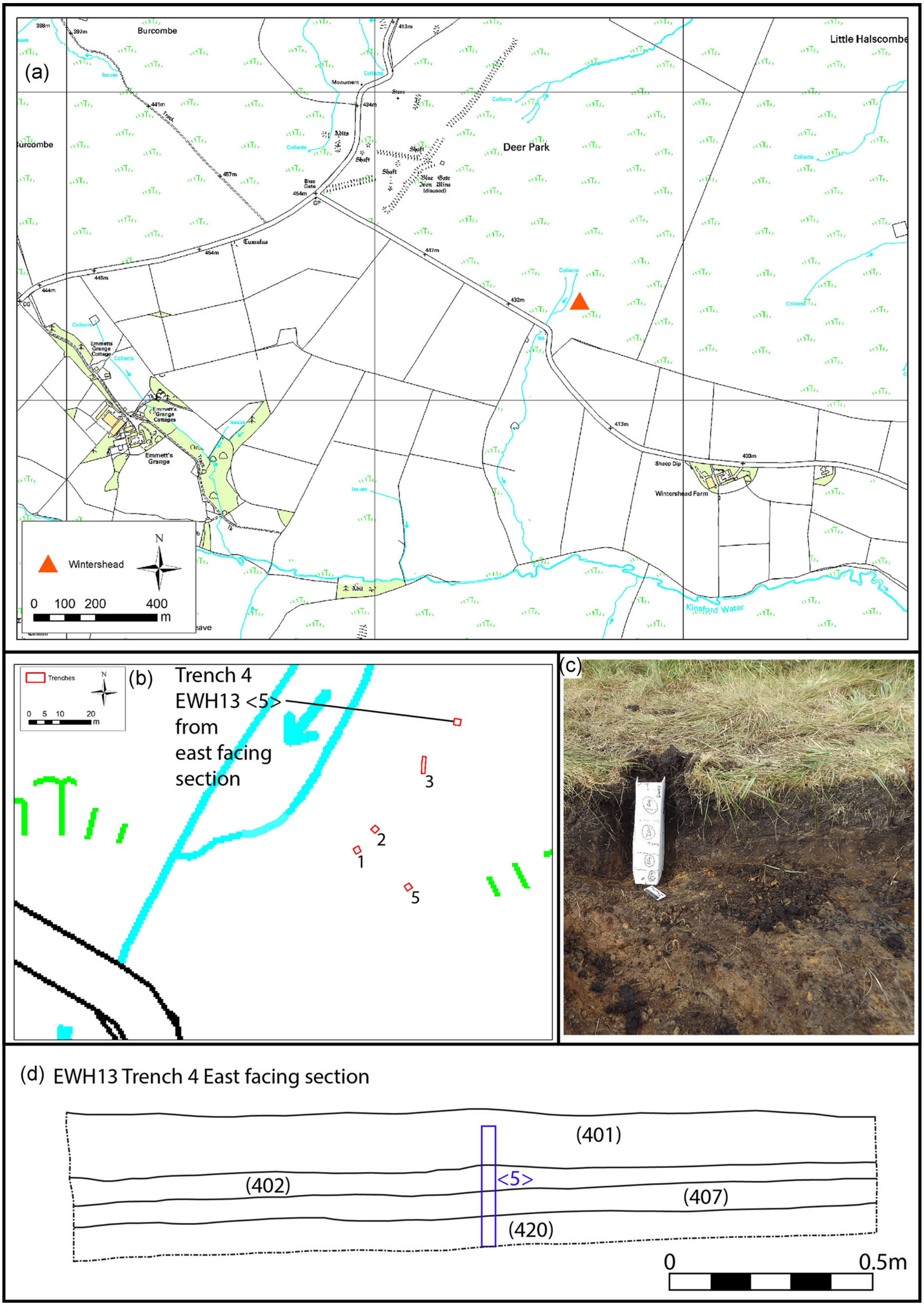
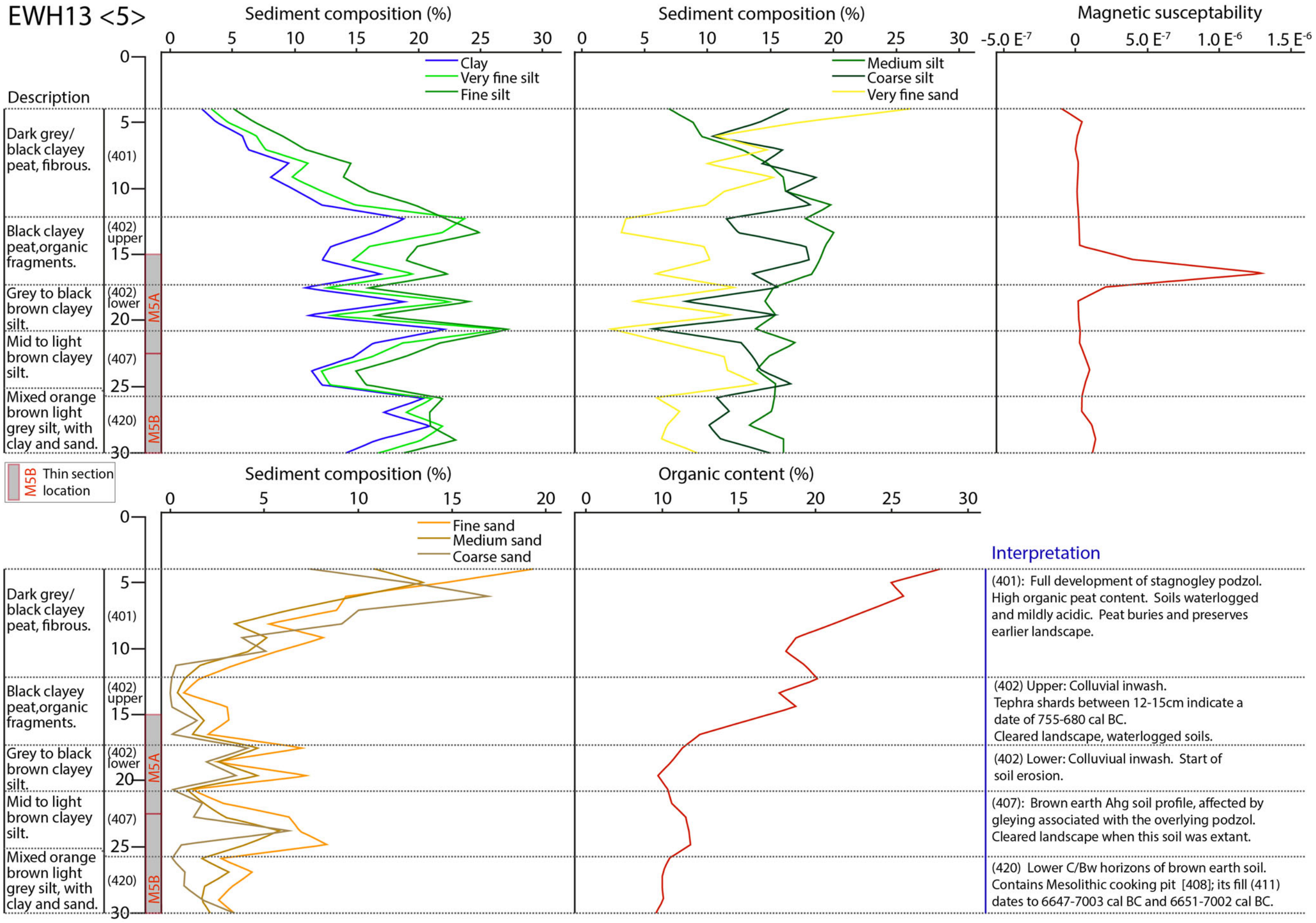


FIGURE 2 Wintershead EWH13 site investigation showing, (a) site location, (b) Trench 4 relative to the other trenches, (c) a working shot of sample EWH13 <5> in the trench section, and (d) the east facing section of Trench 4 [Color figure can be viewed at wileyonlinelibrary.com]



(401): Full development of stagnogley podzol. High organic peat content. Soils waterlogged and mildly acidic. Peat buries and preserves earlier landscape.

(402) Upper: Colluvial inwash. Tephra shards between 12-15cm indicate a date of 755-680 cal BC. Cleared landscape, waterlogged soils.

(402) Lower: Colluviual inwash. Start of soil erosion.

(407): Brown earth Ahg soil profile, affected by gleying associated with the overlying podzol. Cleared landscape when this soil was extant.

(420) Lower C/Bw horizons of brown earth soil. Contains Mesolithic cooking pit [408]; its fill (411) dates to 6647-7003 cal BC and 6651-7002 cal BC.

FIGURE 3 Sediment analysis of sample Wintershead EWH13 <sample 5> [Color figure can be viewed at wileyonlinelibrary.com]

burrows and organic excrements, with the possible relict remains of total excremental microfabric. Pollen (25 cm) included *Quercus* (8%), *Alnus* (4%), and *Corylus* avellena type (22%) indicating some woodland close to the site. However, grassland species are dominant with Poaceae grains (51%) notable as an indicator of open grassland, as well as *Plantago lanceolata* (2%). *Calluna* (10%) signifies some acidified environments close by.

Context (420) interpretation: This is the relict C/Bw horizon of the original "forest" brown earth soil (earthworm-worked), which has been partially converted to a gley podzol. This organic content is consistent with this context being the lower portion (lower B/C horizon) of a thin brown earth paleosol, with high clay and silt fractions. The pollen data records open grassland, with limited woodland and some acidified environments close by. Although originally a forest soil of deciduous woodland, when this soil became buried under the current podzol it is apparent that this landscape had witnessed significant deforestation.

3.1.2 | Context 407

Context (407) is a medium to light brown clayey silt. Clay (13%), very fine silt (14%), and fine silt (17%) are high, showing an initial decrease before increasing. Medium silt (15%) shows an initial decrease before increasing, while coarse silt (15%) and very fine sand (12%) both increase at the base of (407), before decreasing. Fine sand (7%), medium sand (4%), and coarse sand (3%) are again low and increase before decreasing. Organic content is relatively high (13%) and remains relatively constant, although a slight decrease is apparent at the top of the context. Magnetic susceptibility values show a slight increase before decreasing. Key soil micromorphology features include increasing amounts of varyingly ferruginized material and few humic dark reddish-brown soil particles. Pollen (22 cm [407]) contained *Quercus* (9%), *Alnus* (4%), and *C. avellena* type (17%), indicating some woodland close to the site. Again open grassland is dominant with Poaceae (50%) and also small amounts of *P. lanceolata* (1%) and Cyperaceae (1%). *Calluna* (15%) indicates the presence of acidified habitats close by.

Context (407) interpretation: This is a patchy Ahg horizon of the brown earth soil showing an increased organic content that formed after clearance, which became gleyed under increasingly waterlogged conditions. The landscape within the catchment of this sequence continues to represent a mosaic, with some woodland, but grassland dominant.

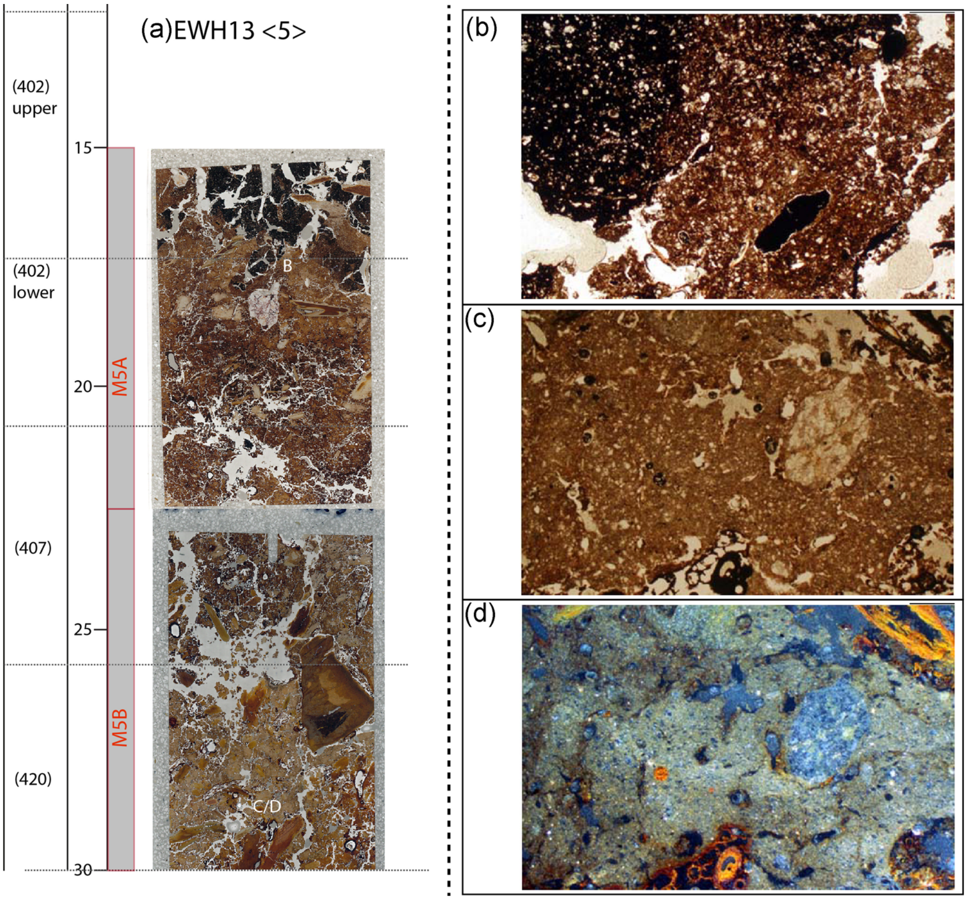


FIGURE 4 Thin section details from Wintershead EWH13 <5> showing: (a) Scan of M5A, contexts (402) upper, (402) lower, and (407). Scan showing mixed boundary between palaeosol (407) and overlying silty peat (402). Note iron-depleted subsoil containing burnt quartzite. And (a) scan of M5B, contexts (407) and (420). Scan showing the palaeosol (420) and (407) containing welded soil microfabric/total excremental microfabric). (b) Photomicrograph of the mixed boundary of (402) lower and silty peat (402) upper. Note, probable charred root (center) probably relates to management by fire (or lightning strike) of the newly developed wet ground soils (humic silt could be colluvial). PPL, frame width is ~4.62 mm. (c) Photomicrograph of (420) with compact soil ("welded" soil microfabric/total excremental microfabric) due to an earlier history of brown earth soil earthworm working. PPL, frame width is ~4.62 mm. (d) As (c) under OIL, showing later Holocene iron depletion (gleying/waterlogging effect), with more recent thin burrowing. PPL, plane polarized light [Color figure can be viewed at wileyonlinelibrary.com]

3.1.3 | Context (402) lower

Context (402) was recorded as one context during excavation, but was split during laboratory processing into a lower and upper portion. Context (402) lower is a gray to black, brown clayey silt. Clay (16%), very fine silt (19%), and fine silt (21%) show an overall decrease compared with context (407), although the data are spikey. Medium silt (15%), coarse silt (12%), and very fine sand (7%) all have a spikey distribution, with an increase compared with the top of (407). Fine sand (4%), medium sand (4%), and coarse sand (3%) show a general increase compared with (407), although the data are again spikey. Organic content remains relatively high (11%) and increases upward. Magnetic susceptibility also rise towards the boundary with (402) upper. The soil micromorphology records the unit to be heterogeneous with dominant humic reddish-brown silt and frequent brown silt soil, containing frequent small stones of bleached shale and (≤12 mm), and occasional burned (rubefied) quartzite (≤7 mm). Pollen (20 cm [402] lower) contained *Quercus* (4%), *Alnus* (4%), and *C. avellena* type (15%) indicating some woodland with the pollen catchment. Again, open grassland is dominant with Poaceae (50%) and also *P. lanceolata* (4%) and Cyperaceae (2%). The presence of *Calluna* (11%) again indicates the presence of acidified habitats.

Context (402) lower interpretation: Given the spikey distribution of the particle size data and the presence of frequent small stones, (402) lower is interpreted as colluvial sediment. The identification of burnt quartzite in the thin section, complements the increase in magnetic susceptibility and indicates burning, correlating with colluvial soil disturbance and deposition. As this subunit is colluvially derived, the pollen data should be treated with caution, but as with the previous contexts indicates a cleared landscape, with some patches of woodland and acidified environments within the pollen catchment.

TABLE 2 Pollen samples analyzed from EWH <5>

EWH13 sample <5>	Count				Percentage			
Depth (cm) and context	15 cm (402 upper)	20 cm (402 lower)	22 cm (407)	25 cm (420)	15 cm (402 upper)	20 cm (402 lower)	22 cm (407)	25 cm (420)
Betula (birch)	7	9	3	1	1.2	1.5	0.5	0.2
Pinus (pine)	0	1	2	0	0.0	0.2	0.3	0.0
Ulmus (elm)	1	1	0	1	0.2	0.2	0.0	0.2
Quercus (oak	23	25	59	48	3.8	4.1	9.3	7.8
Fagus (beech)	0	0	1	0	0.0	0.0	0.2	0.0
Tilia (lime)	0	0	1	0	0.0	0.0	0.2	0.0
Fraxinus excelsior (ash)	0	0	1	0	0.0	0.0	0.2	0.0
Alnus glutinosa (alder)	21	23	23	23	3.5	3.8	3.6	3.7
Rubus type (rose)	0	0	1	0	0.0	0.0	0.2	0.0
Corylus avellena type (hazel)	70	92	105	136	11.5	15.0	16.5	22.0
Erica (heather)	3	2	1	0	0.5	0.3	0.2	0.0
Calluna (ling)	82	88	95	62	13.5	14.4	15.0	10.0
Ranunculus type	0	1	1	0	0.0	0.2	0.2	0.0
Stellaria type	0	1	0	0	0.0	0.2	0.0	0.0
Potentilla (cinquefoils) type	1	7	0	3	0.2	1.1	0.0	0.5
cf Euphorbia (spurges)	0	0	0	1	0.0	0.0	0.0	0.2
Rumex (docks and sorrels)	1	3	0	0	0.2	0.5	0.0	0.0
Scrophulariaceae (undiff)	1	0	0	1	0.2	0.0	0.0	0.2
Plantago lanceolate (ribwort)	0	23	5	11	0.0	3.8	0.8	1.8
Plantago coronopus (plantain) type	0	1	0	1	0.0	0.2	0.0	0.2
Rubiaceae	0	1	1	0	0.0	0.2	0.2	0.0
Knautia	0	1	0	0	0.0	0.2	0.0	0.0
Scabiosa type	1	0	1	0	0.2	0.0	0.2	0.0
Succisa type	2	0	0	1	0.3	0.0	0.0	0.2
Anthemis type	1	0	0	1	0.2	0.0	0.0	0.2
Artemisia	1	0	0	0	0.2	0.0	0.0	0.0
Cirsium type	0	0	1	0	0.0	0.0	0.2	0.0
Centaurea scabiosa type	0	1	0	0	0.0	0.2	0.0	0.0
Lactucoidae (dandelion)	9	13	5	3	1.5	2.1	0.8	0.5

(Continues)

TABLE 2 (Continued)

EWH13 sample <5>	Count				Percentage			
Depth (cm) and context	**15 cm (402 upper)**	**20 cm (402 lower)**	**22 cm (407)**	**25 cm (420)**	**15 cm (402 upper)**	**20 cm (402 lower)**	**22 cm (407)**	**25 cm (420)**
Poaceae (grasses)	381	305	314	314	62.7	49.8	49.4	50.8
Cereal type	1	0	1	2	0.2	0.0	0.2	0.3
Large >45 µ Poaceae	0	3	3	4	0.0	0.5	0.5	0.6
Unidentified/ degraded	0	0	4	4	0.0	0.0	0.6	0.6
Cyperaceae (sedges)	1	11	7	0	0.2	1.8	1.1	0.0
Pteridium aquilinum (bracken)	24	41	53	34	3.8	5.3	8.3	4.8
Dryopteris (wood ferns) type	1	33	80	42	0.2	4.3	12.6	6.0
Polypodium vulgare	3	87	142	11	0.5	11.3	22.4	1.6
Sphagnum (peat moss)	1	0	0	1	0.2	0.0	0.0	0.1
Summary	**15 cm (402 upper)**	**20 cm (402 lower)**	**22 cm (407)**	**25 cm (420)**	**15 cm (402 upper)**	**20 cm (402 lower)**	**22 cm (407)**	**25 cm (420)**
Trees	52	59	90	73	8.6	9.6	14.2	11.8
Shrubs	70	92	106	136	11.5	15.0	16.7	22.0
Ericales	85	90	96	62	14.0	14.7	15.1	10.0
Herbs	400	561	343	346	65.8	60.6	54.0	56.1
Ferns	28	161	275	87	4.4	20.8	30.2	12.3
Misc.	1	0	0	1	0.2	0.0	0.0	0.2
Pollen sum	607	802	635	617				

Note: Percentages rounded to one decimal place.

3.1.4 | Context (402) upper

Context (402) upper is a black clayey peat. Clay (14%), very fine silt (19%), and fine silt (21%) are high and have a less spikey distribution than in (402) lower. Medium silt (19%) and coarse silt (15%) show an overall increase in this context, while very fine sand (2%) has a slight decrease. Fine sand (2%), medium sand (1%), and coarse sand (0.3%) decrease compared with (402) lower. Organic content varies between 15% and 30% (24%) and shows a marked increase upward through the context. Magnetic susceptibility levels increase in this context with a clear spike at 16 cm. Soil micromorphology (Figure 4b) records a strongly heterogeneous soil with a sharply mixed black peaty silt and frequent humic silt and more minerogenic silt loam soil, with few small shale stones, mainly in minerogenic soil. There is rare charcoal (≤1 mm) including likely charred root, with an example of burned quartzite. Pollen (15 cm [402]) shows the same pattern as the previous samples. *Quercus* (4%), *Alnus* (4%), and *C. avellena* type (12%) indicate some woodland, although open grassland is dominant with Poaceae (63%). *Calluna* (14%) indicates the presence of acidified habitats close by. Dating of this context was undertaken using tephrochronology. The subsamples from context (402) contained tephra shards between 12 and 17 cm. These peaked at 12 cm, with shards from 12 to 15 cm selected for analyses. The date of the volcanic eruption evidenced by the tephra shards is interpreted as 755–680 cal BC (Macleaod, 2016), giving a date of disturbance and soil erosion before 755–680 cal BC, pre-podzol formation.

Context (402) upper interpretation: This deposit is somewhat anomalous in terms of stagnogley podzol formation. The sediment is partly derived from a low energy colluvium, containing smaller particle sizes. Evidence of burning was noted, possibly a consequence of the overlying podzol mire management, explaining the magnetic susceptibility spike

TABLE 3 EWH13 <5> summary of mean, maximum, and minimum values for the sediment data

Context		Clay %	Very fine silt %	Fine silt %	Medium silt %	Coarse silt %	Very fine sand %	Fine sand %	Medium sand %	Coarse sand %	Very coarse sand %	Organic matter %	Magnetic susceptibility
(401)	Mean	6.60	7.94	10.88	12.16	15.16	15.05	10.20	7.62	9.30	5.09	35.83	0.0000000002
	Minimum	2.50	3.25	5.00	6.92	10.39	9.88	5.23	3.39	3.81	1.04	26.11	−0.000000103
	Maximum	10.25	12.20	15.97	16.18	18.66	26.26	19.43	13.52	17.00	11.49	46.51	0.00000004450
(402) upper	Mean	14.97	18.50	21.36	19.03	15.26	7.04	2.29	1.14	0.33	0.081	24.64	0.00000030238
	Minimum	12.20	14.69	18.99	17.73	11.48	3.13	0.696	0.37	0	0	14.96	0.00000001480
	Maximum	18.93	23.78	24.97	20.04	18.21	10.20	3.40	1.81	1.45	0.49	30.32	0.00000132000
(402) lower	Mean	15.85	18.71	21.10	15.19	11.54	7.47	4.16	2.92	2.30	0.76	11.03	0.00000006164
	Minimum	10.78	12.57	15.96	13.76	5.62	2.24	1.13	0.88	0.11	0	9.43	0.00000001890
	Maximum	22.18	26.78	27.31	17.01	15.62	12.20	7.37	4.73	4.18	1.62	12.60	0.00000020900
(407)	Mean	12.79	13.75	16.54	14.71	14.84	12.30	7.21	4.27	2.76	0.84	13.41	0.00000007650
	Minimum	11.42	12.18	14.98	13.88	13.58	11.29	6.34	2.92	0.61	0	13.05	0.00000006290
	Maximum	14.74	16.18	18.85	15.41	16.67	14.03	8.38	5.87	6.43	2.50	13.68	0.00000009960
(420)	Mean	17.86	19.81	21.09	15.16	11.70	7.19	3.28	2.09	1.37	0.45	10.03	0.00000009182
	Minimum	14.01	16.62	18.59	13.29	10.09	5.93	2.58	1.65	0.09	0	9.12	0.00000004210
	Maximum	20.99	21.99	23.03	16.04	14.91	9.17	4.39	3.16	3.49	1.59	10.86	0.00000014100

Note: Percentages rounded to two decimal places.

TABLE 4 EWH13 <5> soil micromorphology samples and counts

Thin section	Depth (cm)	Context	Microfacies type	Sediment microfabric type	Voids	Stones	Roots traces	Ferruginized roots	Charcoal	Burned mineral	Fli-nt	Matrix intercalations
M5B	30–26	(420)	A3	1a and 3a	55%	fff	a	aaaa				
M5B	26–21	(407)	A3	1a and 3a	55%	fff	a	aaaa				
M5A	21–17	(402) Lower	A4	3a and 2a	40%	ff	a*	aaa		a-1		
M5A	17–15	(402) Upper	B1	4a,3a, and 2a	45% (10%)	f	aa	aa	a	a-1		

Thin section	Depth (cm)	Context	Secondary Fe	Very thin burrows	Thin burrows	Very thin organic excrements	Very thin excrements	Thin excrements	Broad excrements
M5B	30–26	(420)	aaaaa	aaaa	aa	aaa	aaa	aaa	(tot-Excr?)
M5B	26–21	(407)	aaaaa	aaaa	aa	aaa	aaa	aaa	(tot-Excr?)
M5A	21–17	(402) Lower	aaaa	aaaa	aa	aaaa	aaa	aaa	aa(tot-excr?)
M5A	17–15	(402) Upper	aa		aa	aa	aa	aa	

Note: *, 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%.

and burnt quartzite. The pollen analysis is similar to the preceding contexts, indicating a largely open landscape and limited woodland. Given that this context is interpreted as containing some colluvial inwashing, the tephrochronology date can be interpreted in two ways. First, the date relates to tephra settling in the soil precolluvial erosion and subsequent deposition. Alternatively, it provides a date after which the colluvium formed. The second of these options is considered more likely, given the concentration of the tephra shards at the top of the context, with some limited mixing down the unit. In addition, no tephra shards were visible in contexts (407) and (420), supporting the interpretation of deposition of tephra shards postdeposition of the colluvium.

3.1.5 | Context (401)

Context (401) is described as a dark gray black clayey peat. Clay (7%), very fine silt (8%), and fine silt (11%) show a marked decrease. Medium silt (12%) and coarse silt (15%) both decrease, while very fine sand (15%), fine sand (10%), medium sand (8%), and coarse sand (9%) all increase. Organic matter (36%) is significantly higher than in the underlying contexts. Magnetic susceptibility shows no significant change from context (402) upper and is relatively constant. No soil micromorphology or pollen analysis was undertaken on this context.

Context (401) interpretation: This unit represents the full development of the stagnogley podzol. The development of the podzol and associated peat formation is relatively thin. Increased waterlogging and acidification have caused the fine sediment fractions to decrease with an associated increase in organic matter and limited peat development.

3.1.6 | Wintershead summary

The analysis of the sediment sequence from Wintershead provides a snapshot of the evolution of the landscape at this locale. Contexts (420) and (407) are a preserved paleosol; an earthworm-worked brown earth soil. Context (420) contained evidence of human activity with a Mesolithic heated pit (not shown, cuts [408] and [409]). The landscape was largely open when soil erosion (colluvium) occurred, with the tephrochronology providing a date of soil destabilization at or before 755 and 680 cal BC, preceding the development of a stagnogley podzol. The tephrochronology dates occur at or just after the Sub-Atlantic climatic downturn, and thus the transition at this locale could be driven by climate. However, the burned quartzite in (402) lower, combined with the colluvium beneath the peat, both demonstrate human activity and environmental impacts at this locale before podzolization.

3.2 | Farley Water

The excavation at Farley Water (FW16) investigated a series of Mesolithic flint scatters on Brendan Common (Gardiner, 2019). Sample <FW2> collected 30 cm of sediment and comes from the

TABLE 5 EWH13 <5> soil micromorphology descriptions and interpretations

EWH13 <5>			
Context	**Depth (cm)**	**Soil micromorphology description**	**Soil micromorphology interpretation**
(420)	30–26	Increasing amounts of varyingly ferruginized material and few humic dark reddish-brown soil particles. There are small stone-size fragments (≤15 mm) including finely fissured and fragmenting siltstone. There are abundant bleached rims and rock fragments, abundant iron pseudomorphs of roots, and many void hypocoatings and fabric staining, abundant very thin burrows and occasional thin burrows, and many very thin mainly organic excrements, very thin and thin organomineral excrements, with possible relict remains of total excremental microfabric	This is the relict C/Bw horizon of the original "forest" brown earth soil (earthworm-worked), which has been partially converted to a gley podzol
(407)	26–21	Upwards increasing amounts of varyingly ferruginized material and few humic dark reddish-brown soil particles. There are dominant small stone-size rock fragments (≤15 mm) including finely fissured and fragmenting siltstone, and very abundant fine to coarse mainly ferruginized roots	This is a patchy Ahg horizon of the brown earth soil showing an increased organic content that formed after clearance, which became gleyed under increasingly waterlogged conditions
(402) Lower	21–17	Heterogeneous with dominant humic reddish-brown silt and frequent brown silt soil, containing frequent small stones of bleached shale and (≤12 mm), and occasional burned (rubefied) quartzite (≤7 mm), a trace of fine roots and many ferruginized roots. There are abundant bleached rims and rock fragments, abundant iron pseudomorphs of roots and many void hypocoatings and fabric staining. Also recorded were abundant very thin burrows and occasional thin burrows, and abundant very thin mainly organic excrements, many very thin and thin organomineral excrements, with possible relict remains of total excremental microfabric (relict welded fabric)	The inclusion of relict welded microfabric and the presence of frequent small stones, (402) lower is interpreted as a colluvial sediment
(402) Upper	17–15	Strongly heterogeneous with a sharply mixed black peaty silt and frequent humic silt and more minerogenic silt loam soil, with few small shale stones, mainly in minerogenic soil. Occasional fine roots and ferruginized medium roots, rare charcoal (≤1 mm) including likely charred root, with an example of burned quartzite (4.5 mm), occur. Pedofeatures include abundant bleached rims and rock fragments occasional iron pseudomorphs of roots and rare void hypocoatings and fabric staining, occasional thin burrows, with very coarse mixing/burrowing, occasional very thin mainly organic excrements and very thin and thin organomineral excrements	This deposit is somewhat anomalous in terms of ferric stagnogley podzol formation. The sediment is partly derived from a low energy colluvium, containing smaller particle sizes (clays and silts). Evidence of burning was noted, possibly a consequence of the overlying podzol mire management, explaining the magnetic susceptibility spike and burnt quartzite

southwest facing section of Trench 2 (Figure 5), which investigated one of these flint scatters and yielded 196 pieces of flint, mainly from contexts (2-02) and (2-05). Some of the flints were diagnostically late Mesolithic including a thumbnail scraper, a microcore, a microburin, a denticulate and a narrow retouched blade (Gardiner, 2019). In addition to the sediment analyses, three pollen subsamples were analyzed from <FW2> and these had a low level of pollen diversity and high polypodium numbers, indicating poor preservation and differential survival (Figures 6 and 7; Tables 6–9).

3.2.1 | Context (2-05b)

Context (2-05b) was described as one context during the excavation, but was subdivided within the laboratory into (2-05b) and (2-05a). Context (2-05b) is a light brown-orange silt, with sand and clay. Clay (13%), very fine silt (18%), fine silt (27%), and medium silt (21%) are high and increase slightly. Coarse silt (12%) and very fine sand (5%) show a slight decrease. Fine sand (2%), medium sand (1%), and coarse sand (1%) are all low. Organic content (4%) is moderate and increases

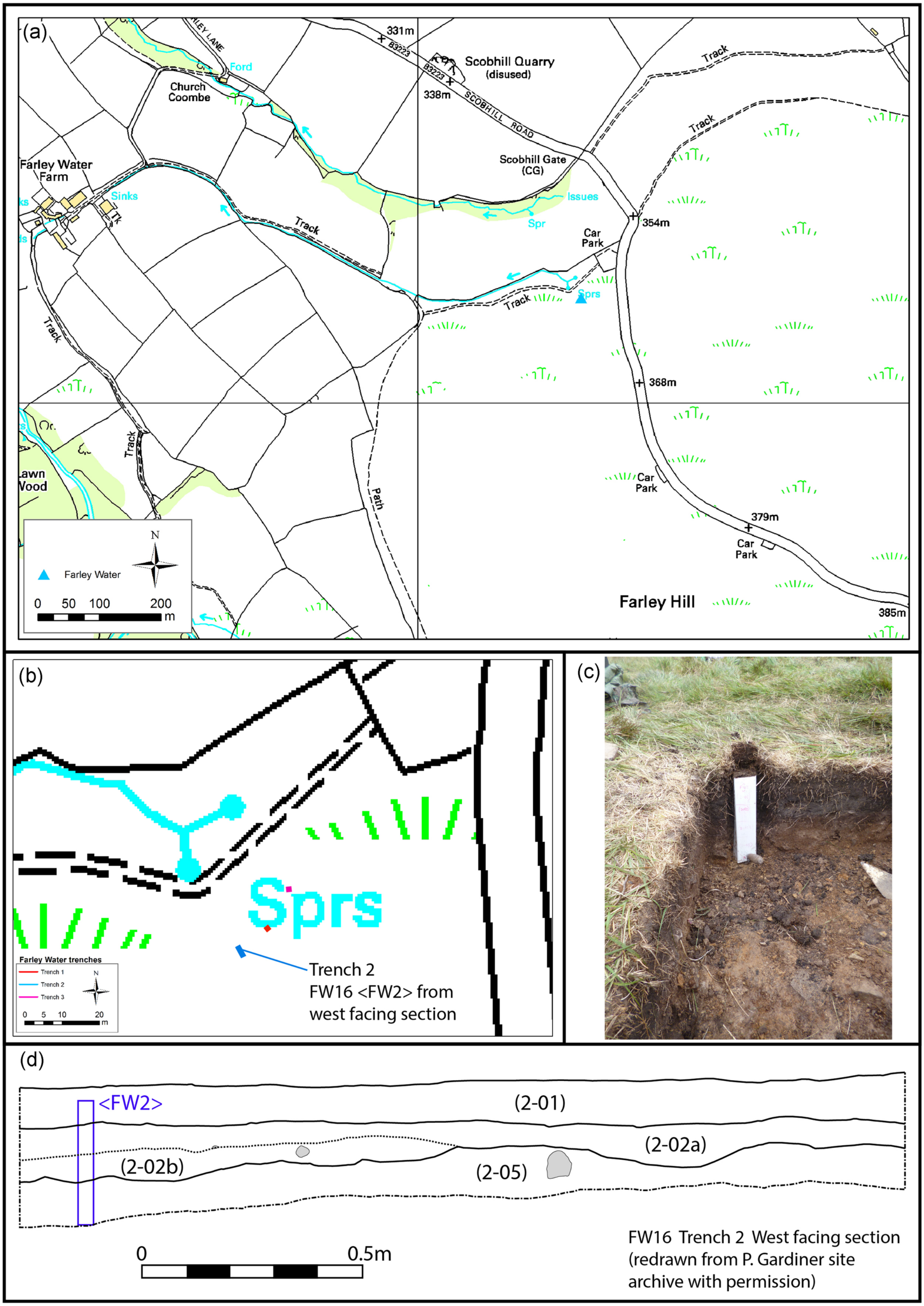


FIGURE 5 Farley Water FW16 site investigation showing (a) the location of Farley Water (FW16), (b) Trench 2 relative to the other trenches, (c) a working shot of sample FW16 <FW2> in the trench section and, (d) the west facing section of Trench 2 [Color figure can be viewed at wileyonlinelibrary.com]

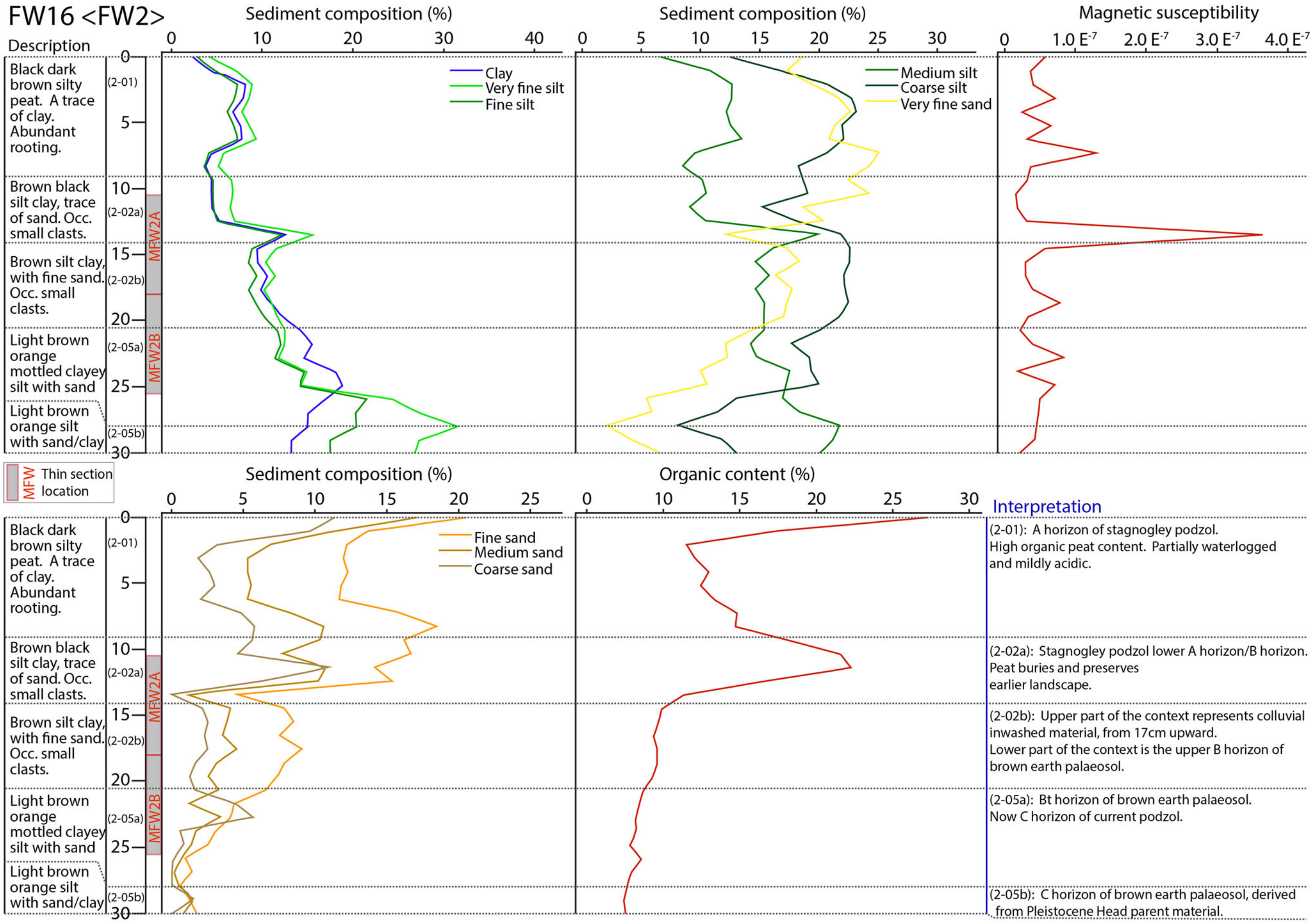


FIGURE 6 Sediment analysis of sample Farley Water FW16 <FW2> [Color figure can be viewed at wileyonlinelibrary.com]

slightly. Magnetic susceptibility values also demonstrate a slight rise. No micromorphology or pollen analysis was undertaken on this context.

Context (2-05b) interpretation: Given the organic content, coupled with the dominance of the fine sediment fractions, this is interpreted as the original C horizon of argillic brown earth soil. The parent material is Pleistocene Undifferentiated Head (visible during excavation), which underwent soil development during the early Holocene.

3.2.2 | Context (2-05a)

Context (2-05a) is a light brown-orange mottled clayey silt with sand. Clay (16%), very fine silt (16%), fine silt (20%), and medium silt (17%) remain high, but decrease upward. Coarse silt (16%) and very fine sand (8%) both increase. Fine sand (3%), medium sand (1%), and coarse sand (2%) are low, but increase. Organic content (5%) shows a slight rise compared with (2-05b). Magnetic susceptibility values show some deviation towards the top of (2-05a). Key soil micromorphological features (Figure 7d) include rare iron-rich fine clay void coatings and infills within relict iron-rich soil, occasional matrix intercalations and associated dusty clay void coatings and infills (argillic fabric). There are very abundant depletion features, gray matrix soil, bleached stone rims, likely occasional organo-sesquioxidic staining along burrows (hypocoatings and polymorphic soil) and rare patches of iron staining of "argillic fabric" soil. Two pollen samples were analyzed from this context at (26 cm) and (21 cm). Both samples demonstrated poor preservation. Sample 26 cm contained *Calluna* (96%), and very low *Quercus* (0.4%), *C. avellena* type (1%), and Poaceae (2%), indicating an acidified heathland habitat around the site. At 21 cm a similar picture emerges, with *Calluna* (74%) and very low *Quercus* (1%), *C. avellena* type (6%), and Poaceae (10%).

Context (2-05a) interpretation: Again there is the dominance of the fine sediment fractions, with moderate organic content. This is a soil palimpsest with stony subsoil formed from Pleistocene Undifferentiated Head and displaying a trace of early-mid Holocene argillic brown earth (Bt horizon) formation. The pollen indicates acid heather dominated environment.

3.2.3 | Context (2-02b)

Context (2-02b) is a brown silt clay with fine sand. Clay (12%), very fine silt (10%), and fine silt (11%) continue to decrease, except at the

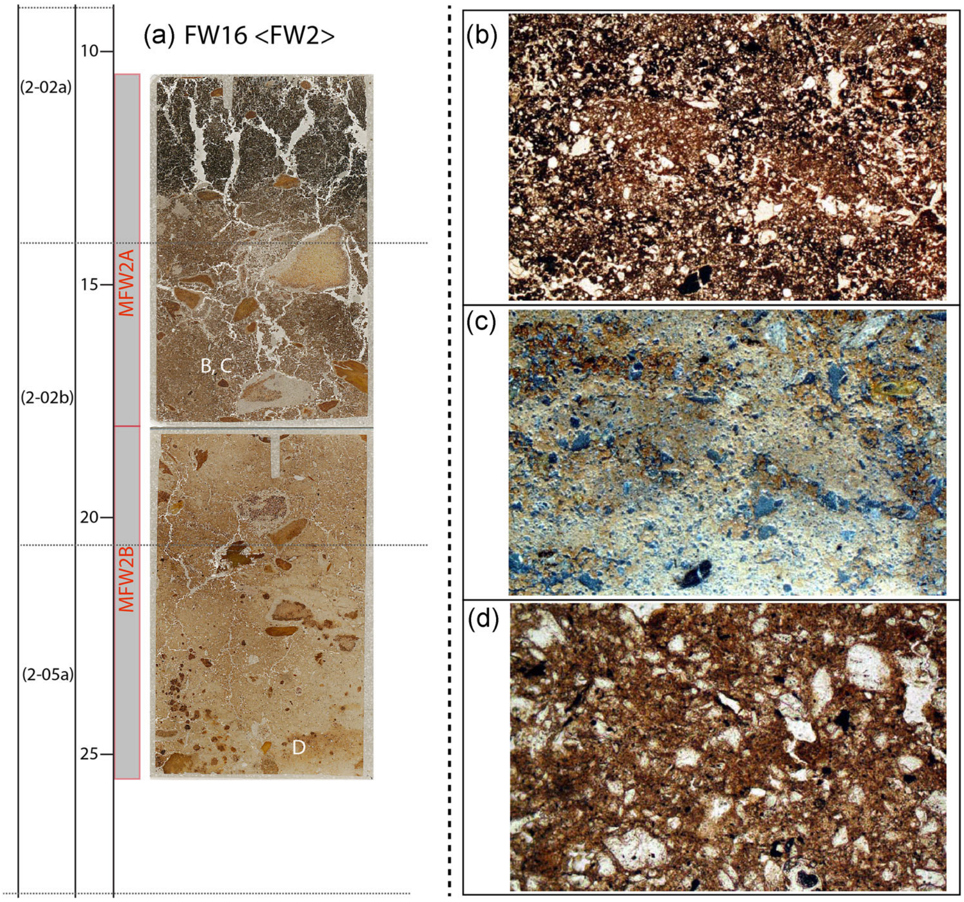


FIGURE 7 Thin section details from Farley Water FW16 <FW2> showing: (a) Scan of MFW2A, with contexts (2-02a) and (2-02b). Stony (2-02b) below organic (2-02a) a minerogenic surface peat. Bleached stone rims, caused by hydromorphic (stagnant water) are visible. And (a) scan of MFW2B, with contexts (2-05a) and (2-02b). A small relict area of iron-stained argillic brown earth soil is visible (bottom left). (b) Photomicrograph of (2-02b) with mixed weakly humic and more pale brown iron-depleted fine sandy silt loam. PPL, frame width is ~4.62 mm. (c) As (b) context (2-02b), under OIL. Relict pale soil is very iron depleted and also contains fine charcoal of possible Mesolithic origin. (d) Photomicrograph of context (2-05a). Detail of soil associated with mesolithic flints, illustrating matrix intercalations, consistent with a muddy trampled(?) origin. PPL, frame width is ~0.90. PPL, plane polarized light; OIL, oblique incident light [Color figure can be viewed at wileyonlinelibrary.com]

junction with (2-02a) where a distinct increase occurs. Medium silt (15%) remains constant, except for the junction with (2-02a) where it increases. Coarse silt (21%) and very fine sand (17%) both remain relatively high. Fine sand (8%) shows a slight increase upward, while medium sand (3%) and coarse sand (2%) are low and relatively constant. Organic content (7%) shows a slight rise compared with (2-05a). Magnetic susceptibility values show some deviation through the unit but no trend is evident. Key soil micromorphology features (Figure 7b,c) include rare to trace becoming occasional fine charcoal (max 0.5 mm) above 20 cm. There are common gravel and small stones (≤18 mm) and abundant thin burrows and burrow-mixing of brown and dark brown loam soil, and many very thin (and sometimes organic pellety) and many thin organomineral excrements. Pollen (16 cm) was again poorly preserved with *Calluna* (82%) present and low levels of *Quercus* (1%), *C. avellena* type (1%), and Poaceae (5%). Again this describes acid heather dominated landscape.

Context (2-02b) interpretation: This unit is a mix of different soil types and sediment material. The lower part of this unit is a Bs horizon of the modern podzol. The top half of the unit (*c.* 17 cm upwards) records an input of colluvium, attested by an increase in the coarse sand fractions, with the micromorphology recording more fine charcoal in this fraction. This colluvium has been subsequently affected by the later podzolization. However, this colluvium effectively seals the remains of the original brown earth (contexts lower [2-02b], [2-05a], and [2-05b]).

3.2.4 | Context (2-02a)

Context (2-02a) is a brown black silt clay, with a trace of sand and occasional small clasts. Clay (7%), very fine silt (7%), and fine silt (9%) all decrease. Medium silt (13%) decreases at the base of the unit and remains low. Coarse silt (20%) and very fine sand (19%) both increase. Fine sand (12%), shows a slight increase, while medium sand (9%) and coarse sand (5%) both increase. Organic content (18%) shows a marked increase in this context, although a slight reduction is evident at the junction with (2-01). Magnetic susceptibility values show a pronounced

TABLE 6 Pollen samples analyzed from FW16 <FW2>

FW16 sample <2>	**Depth**			**Percentage**		
Depth	**16 cm (2-02b)**	**21 cm (2-05a)**	**26 cm (2-05a)**	**16 cm (2-02b)**	**21 cm (2-05a)**	**26 cm (2- 05a)**
Quercus (oak)	6	1	1	1.1	0.8	0.4
Pinus (pine)	2	0	0	0.4	0.0	0.0
Corylus avellena (hazel) type	4	8	2	0.8	6.4	0.9
Calluna (ling)	429	92	216	81.9	73.6	95.6
Cyperaceae (sedges)	5	1	0	1.0	0.8	0.0
Poaceae (grasses)	27	12	4	5.2	9.6	1.8
Succisa	0	1	0	0.0	0.8	0.0
Asteraceae (Lactuceae)	49	10	3	9.4	8.0	1.3
Asteraceae (Asteroideae)	1	0	0	0.2	0.0	0.0
Degraded	1	0	0	0.2	0.0	0.0
Pteropsida	2	1	0	0.1	0.0	0.0
Pteropsida (trilete) indet	13	4	0	0.6	0.1	0.0
Polypodium	1,809	6,287	2,811	77.0	98.0	92.6
Summary	**16 cm (2-02b)**	**21 cm (205a)**	**26 cm (205a)**	**16 cm (2-02b)**	**21 cm (205a)**	**26 cm (205a)**
Trees	8	9	3	1.5	0.8	0.4
Shrubs	4	8	2	0.8	6.4	0.9
Ericales	429	92	216	81.9	73.6	95.6
Herbs	523	125	226	15.6	19.2	3.1
Ferns	1,824	6,292	2,811	63.5	96.2	86.1
Pollen sum	**2,348**	**6,417**	**3,037**			

Note: Percentages rounded to one decimal place.

spike at the junction with (2-02b). Soil micromorphology records this unit to contain very few gravel (≤6 mm). The horizon is composed of very abundant amorphous organic matter and many fine roots, with occasional fine charcoal (≤0.3 mm). No pollen samples were analyzed.

Context (2-02a) interpretation: An almost stone-free minerogenic peaty soil has formed (Oh horizon), a product of podzolization, with organic matter accumulation and contemporary inputs of silt and very fine sand. A moderate amount of bioworking has also taken place.

3.2.5 | Context (2-01)

Context (2-01) is a black dark brown silty peat, with a trace of clay. Clay (6%), very fine silt (6%), and fine silt (7%) remain low. Medium silt (11%), coarse silt (20%), and very fine sand (21%) initially increase before a slight decrease. Fine sand (14%), medium sand (8%), and coarse sand (5%) initially decrease before increasing but remain generally high. Organic content (17%) remains high, although a slight reduction is evident before the A horizon at the top of the context. Magnetic susceptibility values remain low, although spikey, with no discernible trend. No soil micromorphology or pollen analysis was undertaken on this context.

Context (2-01) interpretation: This is the modern lower A horizon of the podzol soil formed post the degradation of the brown earth. The A horizon (minerogenic Oh) is relatively thin and organic rich. While a peat, there is still some clay and silt fractions evident in the soil matrix.

3.2.6 | Farley Water summary

As at Wintershead, <FW2> records a brown earth paleosol ([2-05b] C horizon, [2-05a], and lower part of [2-02b] B horizon), albeit poorly preserved in this sequence. Mesolithic flints were recovered from

TABLE 7 FW16 <FW2> summary of mean, maximum, and minimum values for the sediment data

Context		Clay %	Very fine silt %	Fine silt %	Medium silt %	Coarse silt %	Very fine sand %	Fine sand %	Medium sand %	Coarse sand %	Very coarse sand %	Organic matter %	Magnetic susceptibility
(2-01)	Mean	5.90	5.56	7.27	10.98	19.85	21.23	14.30	8.43	4.94	1.54	16.95	0.0000000548
	Maximum	8.16	7.34	9.37	13.48	23.18	25.05	20.72	17.33	11.39	4.09	37.53	0.0000001305
	Minimum	2.37	2.78	4.12	6.51	12.38	17.24	11.68	5.27	1.84	0.09	10.79	0.0000000242
(2-02a)	Mean	7.18	6.91	9.21	12.99	19.71	19.05	11.90	6.85	4.64	1.55	17.74	0.0000000783
	Maximum	12.47	12.16	15.75	20.09	22.62	24.23	16.70	10.70	11.16	5.37	28.89	0.000000364600
	Minimum	4.53	4.58	6.45	9.05	15.18	12.060	4.55	1.02	0	0	7.72	0.000000015900
(2-02b)	Mean	11.61	9.84	11.41	15.31	21.74	16.55	7.68	3.42	1.87	0.56	7.09	0.000000040660
	Maximum	14.32	11.70	12.56	15.83	22.52	17.74	9.10	4.55	2.53	0.89	7.59	0.000000078800
	Minimum	9.87	8.50	10.24	14.62	20.14	14.38	6.57	2.57	1.28	0.04	6.03	0.000000022100
(2-05a)	Mean	16.32	16.37	19.52	17.23	15.53	8.34	2.46	1.30	1.69	1.23	5.06	0.000000050657
	Maximum	18.89	21.49	31.57	21.74	20.02	12.28	4.42	3.46	5.71	5.81	5.86	0.000000084100
	Minimum	14.60	11.35	11.80	14.21	8.04	2.09	0.62	0.20	0.03	0	4.269	0.000000017200
(2-05b)	Mean	13.22	17.50	27.02	20.68	12.42	5.30	1.49	1.21	0.88	0.30	4.00	0.00000003235
	Maximum	13.23	17.54	27.28	21.22	13.03	6.55	1.72	1.52	1.59	0.60	4.07	0.0000000429
	Minimum	13.20	17.46	26.76	20.13	11.80	4.04	1.30	0.90	0.17	0	3.93	0.000000021800

Note: Percentages rounded to two decimal places.

TABLE 8 FW16 <FW2> soil micromorphology samples and counts

Thin section	Relative depth (cm)	Context	Microfacies type	Sediment microfabric type	Voids	Stones	Roots	Fungal bodies	Charcoal	Amorphous organic matter	Fe-clay coats	Matrix coats	Depletion
M2B	26–21	(2-05a)	B1/A1	1b(2a)/1a(2a)	35%	fff	aa	a	aa/a*		0/a*	aa/0	aaaaa
M2A	21–14	(2-02b)	B3/B2	2a/2a,1b	40%	fff	aaa	a	(aa)			(aa)	aaaaa
M2A	14–10.5	(2-02a)	C1	3a	20% (40%)	*	aaa	(a)	aa	aaaaa			aa

Thin section	Relative depth (cm)	Context	Secondary organo-sesqui-oxide	Secondary Fe	Thin burrows	Very thin organo excrements	Thin organo excrements	Very thin organomineral excrements	Thin organomineral excrements
M2B	26–21	(2-05a)	aa	a*	aaa/aa			aaa/a	
M2A	21–14	(2-02b)	aaa	a*	aaa	a		aaa	aaa
M2A	14–10.5	(2-02a)		a*	aaaa	aaaa	aaaa		

Note: *, 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%.

these lower contexts, attesting to an Early to Mid Holocene land surface/soil at this locale. Above this, a colluvium indicates the effects of human impact on unstable soils (2-02b upper), before the onset of podzolization ([2-02a] and [2-01]). The pollen in this sample was poorly preserved with *Calluna* present throughout; this potentially indicates some downward mixing in the profile, with *Calluna* being incongruous with the brown earth paleosol. The date of the colluvium and the brown earth soil degradation at this location is unknown. However, the Mesolithic material excavated from the brown earth paleosol must predate the podzolization, giving a Later Mesolithic or later date for this transition.

3.3 | Lanacombe

At Lanacombe (ELN14) two trenches investigated a series of pits forming an ovoid enclosure (c. 80 m diameter long axis) and linear features, identified by the gradiometer survey (Figure 8; gradiometer data not shown). Trench 4 excavated one of these pit features, with <LC05> sampling the sediment sequence, collecting 40 cm of sediment. Contexts (453) and (452) were cut by pit [458], with its fill sequence producing no datable finds or charcoal. Four pollen samples were taken from sample <LC05> but all were sterile (Figures 9 and 10; Tables 10–12).

3.3.1 | Context (453)

Context (453) is a mid to light brown clayey silt. Clay (12%), very fine silt (17%), and fine silt (31%) are all relatively high. Fine silt (31%) initially increases and then remains high, as does medium silt (25%). Both coarse silt (8%) and very fine sand (3%) decrease, indicating some sorting of these fractions. Fine sand (2%), medium sand (2%), and coarse sand (1%) all show a decrease through the unit, also indicating sorting, with a spike visible at 25 cm. Organic content (4%) is moderate, while magnetic susceptibility shows a slight increase. Key soil micromorphological features (Figure 10d) include weakly humic brown silt and sand over very dominant, very weakly humic pale brown silt and sands. There is occasional weak organo-sesquioxidic staining becoming abundant, many thin burrows, becoming abundant upwards, and very abundant very thin organomineral excrements.

Context (453) interpretation: Context (453) lower is the lower subsoil B(s)/C(s) horizon material of a podzol, where possibly relict imbricated shale fragments occur, and where an acid brown earth subsoil fine fabric has been affected by podzolization. The parent material is probably the remains of a Pleistocene stony Head deposit.

3.3.2 | Context (452)

Context (452) is an orange-brown clayey silt. Clay (11%) and very fine silt (15%) remain high, albeit with some fluctuation. Fine silt

TABLE 9 FW16 <FW2> Soil micromorphology descriptions and interpretations

FW16 <FW2>			
Context	**Depth on sample (cm)**	**Soil micromorphology description**	**Soil micromorphology interpretation**
(2-05a)	26–21	Heterogeneous and broadly horizoned with very dominant pale brown and dusty fine sandy silt loam, becoming dominant upwards, brown to dark dusty brown fine sandy silt loam, with few fine burrow fills with dark reddish-brown humic soil. It is poorly sorted with a silt, coarse silt, very fine sand matrix containing sand to coarse sand-size ferruginous soil clasts and common small stone-size (<12 mm) siltstone and quartzite fragments with 0.5–1 mm thick bleached rims. Rare birefringent arbuscular mycorrhizae fungal bodies, occasional fine roots (<0.75 mm) and rare trace fine charcoal. There are rare iron-rich fine clay void coatings and infills within relict iron-rich soil, occasional matrix intercalations and associated dusty clay void coatings and infills (argillic fabric), very abundant depletion features, gray matrix soil, bleached stone rims, likely occasional organo-sesquioxidic staining along burrows (hypocoatings and polymorphic soil), and rare patches of iron staining of “argillic fabric” soil, occasional becoming many (upwards) thin burrows, and rare becoming many, upwards, and very thin organomineral excrements	Soil palimpsest with stony subsoil formed at the top of the Pleistocene Head, and displaying a trace of early Holocene argillic brown earth (Bt horizon) formation
(2-02b)	21–14	Rare to trace becoming occasional fine charcoal (max 0.5 mm) above 20 cm. The profile continues to be heterogeneous upwards, with strongly mixed fine patches of brown to dark dusty brown fine sandy silt loam and dark reddish-brown humic soil, which becomes more dominant upwards. Common gravel and small stones (<18 mm), often with bleached rims and/or near totally bleached character are present, alongside many fine roots remains, rare birefringent arbuscular mycorrhizae fungal bodies, occasional fine charcoal mainly in brown fine sandy silt loam soil patches/clasts. There are occasional matrix intercalations in brown fine sandy silt loam, very abundant relict bleached stones and brown silt loam that is iron-depleted, a rare trace of iron root staining, many weak organo-sesquioxidic/organic staining of darker brown fine sandy silt loam, abundant thin burrows and burrow-mixing of brown and dark brown loam soil, and many very thin (and sometimes organic pellety) and many thin organomineral excrements	A moderately iron-depleted colluvium formed of presumed Eb (A2) horizon soil, containing a small concentration of fine and very fine charcoal, and matrix textural pedofeatures suggesting muddy colluvial (possibly trampled?) formation. Later leaching, iron, and organo-sesquioxidic soil formation (weak Bs horizon) occurred, the last being introduced by burrowing from above. Upwards, the more humic but still stony fine sandy silt loam (Bs horizon) becomes dominant, although many small relict patches of fragmented fine sandy silt loam colluvium are present. The latter include fine charcoal
(2-02a)	14–10.5	Very few gravel (<6 mm). The horizon is composed of very abundant amorphous organic matter and many fine roots, with occasional fine charcoal (<0.3 mm) and rare fungal materials are also present. A rare trace of iron-stained root residues, occasional bleached rims gravel, abundant thin burrows, and abundant very thin and thin organic excrements (containing fine mineral material)	An almost stone-free minerogenic peaty topsoil has formed (Oh horizon), through organic matter accumulation and contemporary inputs of silt and very fine sand. A moderate amount of bioworking has also taken place

(27%) and medium silt (24%) are relatively high, however, at the junction with (451) both significantly reduce. Coarse silt (11%) and very fine sand (5%) are relatively constant, although a slight rise is visible at the junction with (451). Fine sand (4%), medium sand (2%), and coarse sand (1%) all show a spike at 19 cm, before another significant rise at the junction with (451). Organic content (7%) is higher than in (453) and increases, with a spike at the junction with (451). Magnetic susceptibility fluctuates but a clear spike is visible at the junction with (451), indicating an iron pan. Key soil micromorphology features (Figure 10b,c) include between 19 and 20 cm

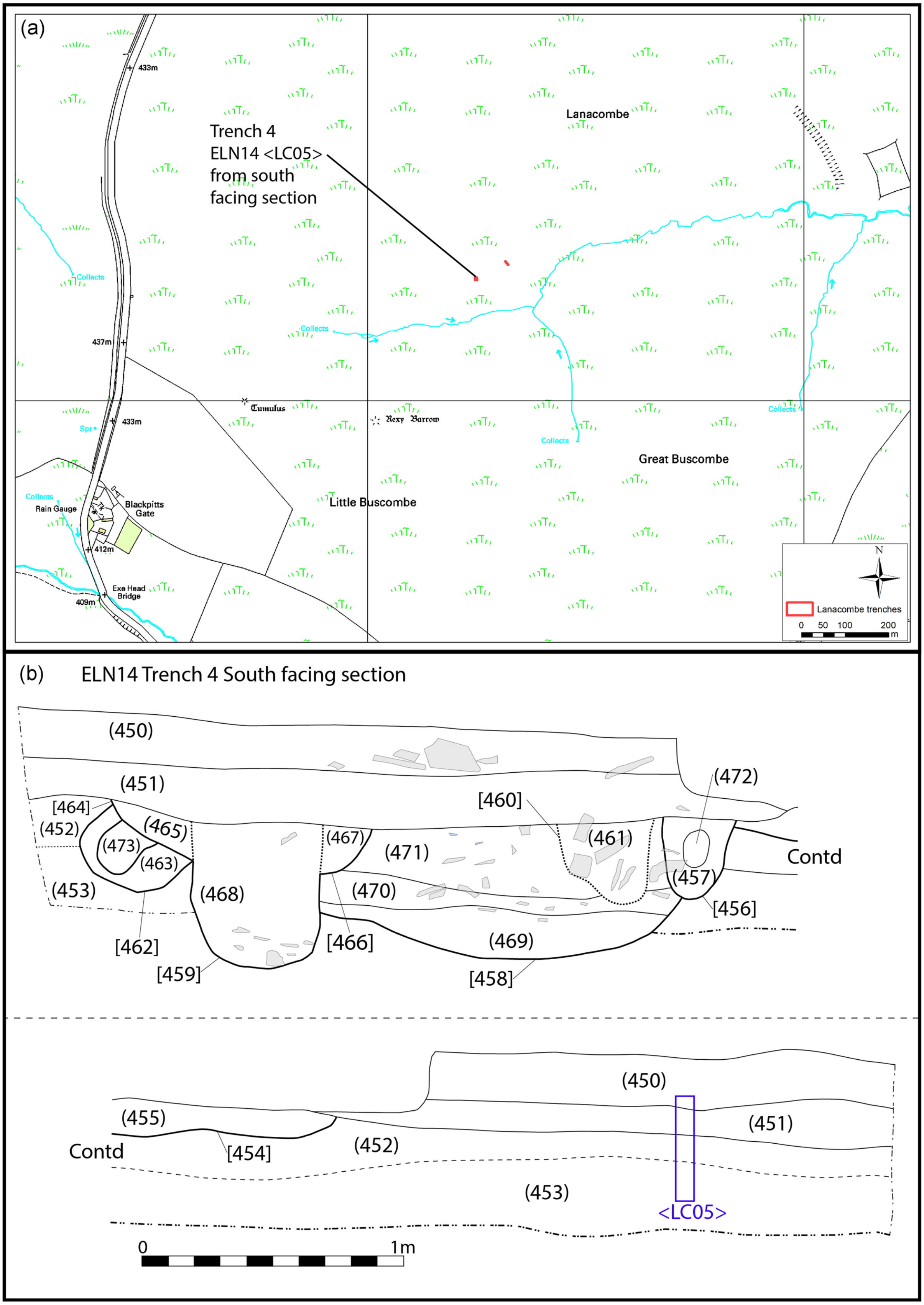


FIGURE 8 Lanacombe ELN14 site investigation showing, (a) site location and Trench 4 location and (b) the east section of Trench 4 [Color figure can be viewed at wileyonlinelibrary.com]

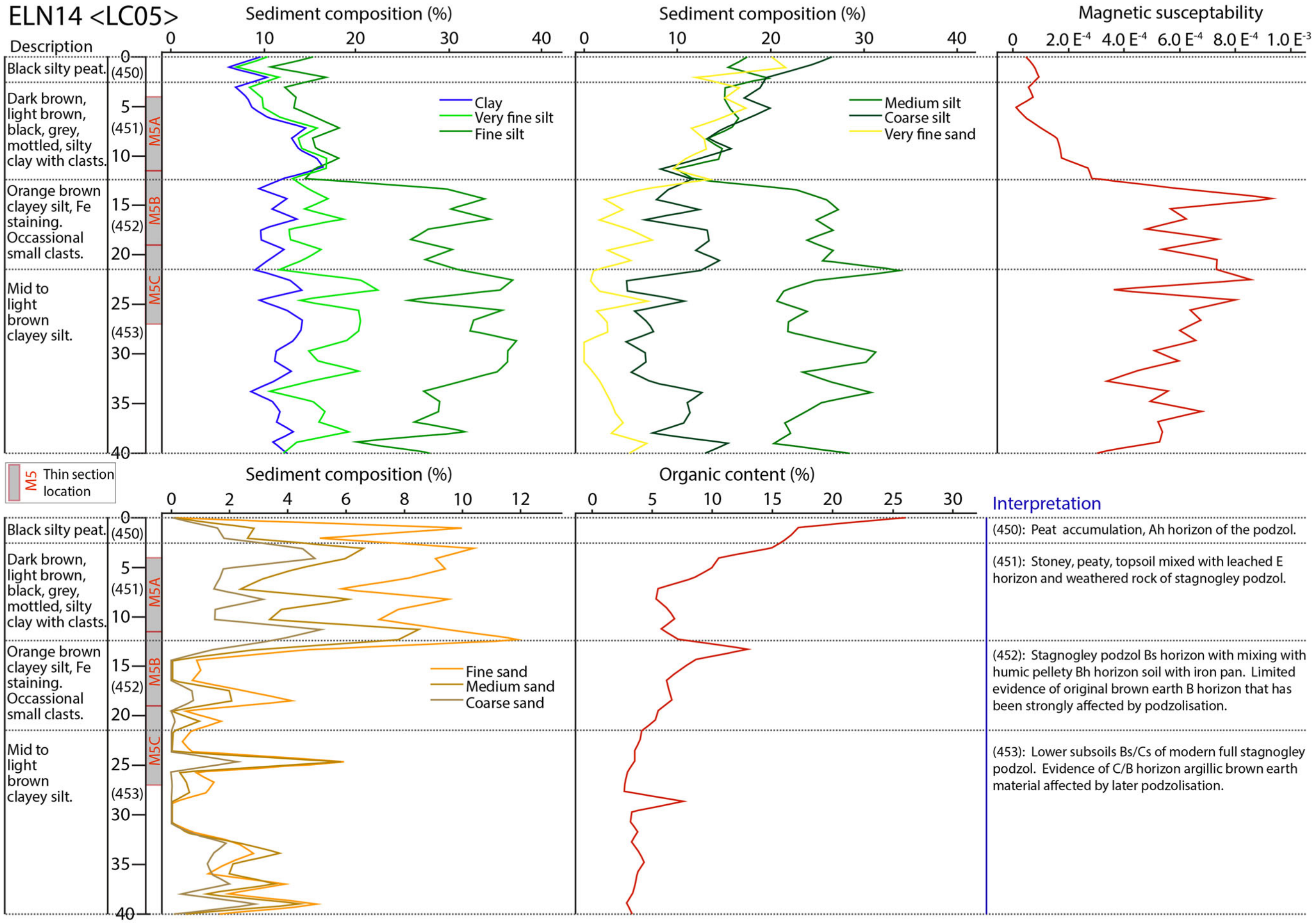


FIGURE 9 Sediment analysis of sample Lanacombe ELN14 <LC05> [Color figure can be viewed at wileyonlinelibrary.com]

dominant dark reddish-brown humic and brown silt and sands, making up a band of sesquioxidic pellety humus (Bhs horizon) within the podzol. Between 11 and 19 cm the unit is heterogeneous with dominant weakly humic brown silt and sands and frequent broad chamber and channel fills with dark reddish-brown humic silt and sands. At 11.5 cm, there is a 2–4 mm thick amorphous iron pan, possibly cementing and replacing peat in the peaty sands. The pollen sample at 16 cm was sterile.

Context (452) interpretation: This is mainly Bs podzol horizon with mixing with humic pellety Bh horizon soil which becomes more dominant upwards, before being cemented into the iron pan. There is limited evidence of original brown earth soil profile, presumably A/upper B horizons that have been affected by podzolization.

3.3.3 | Context (451)

This is a dark brown with light brown, black, and gray mottled silty clay. Clay (11%), very fine silt (13%), and fine silt (15%) show a gradual reduction. Medium silt (15%), coarse silt (16%), and very fine sand (14%) increase. Fine sand (8%), medium sand (5%), and coarse sand (3%) initially decrease from the spike at the junction with (452), but remain higher compared with (452) and (453). Organic content (9%) shows a sharp increase, while magnetic susceptibility decreases in this unit. Soil micromorphology records a heterogeneous sample with dark reddish-brown organic silt and sands and pale greyish-brown minerogenic fine sandy silt loam, and frequent gray minerogenic silts and very fine sand. Rare fine charcoal (≤0.5 mm) is present.

Context (451) interpretation: This is a stony, peaty, topsoil mixed with leached E horizon, and weathered rock. The presence of podzolic B horizon soil was not noted. The mixed topsoil material contains only a small trace of charcoal.

3.3.4 | Context (450)

Context (450) is a black silty peat. Clay (9%), very fine silt (10%) and fine silt (14%) remain at similar values to unit (451). Medium silt (18%), coarse silt (23%), and very fine sand (18%) remain high and show a slight increase. Fine sand (5%), medium sand (2%), and coarse sand (1%) show a spikey distribution with a significant reduction at the top. Organic content (20%) is high and increases. Magnetic susceptibility values remain low. No soil micromorphology or pollen analysis was undertaken in this context.

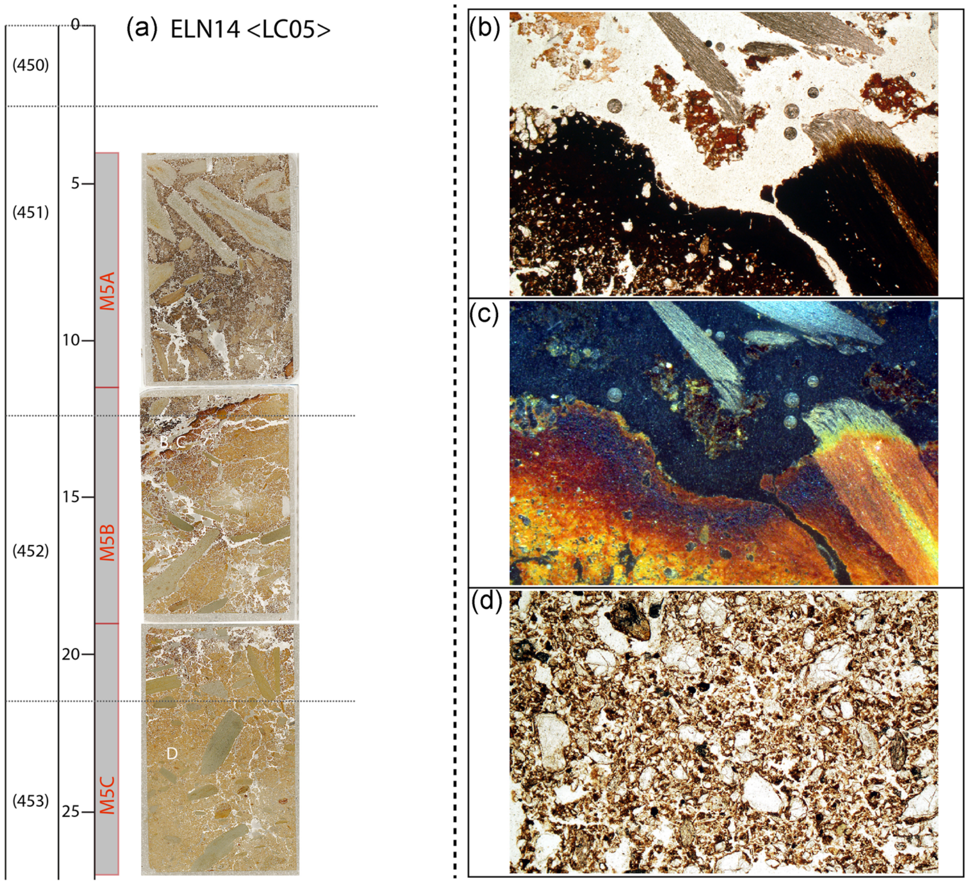


FIGURE 10 Thin section details from Lanacombe ELN14 <LC05> showing: (a) Scan of M6A, context (451). A stony dump of mainly humic Ah and leached E horizon soil, with minerogenic weathered rocks and C horizon material. Stones show bleached rims because of the wet leaching soil environment. And (a) scan of M6B, with contexts (451) and (452). Sealed below a thin iron pan (Fe-pan placic horizon; top left to top right), above which mainly leached waterlogged soil occurred with some peat and root concentrations forming a root mat. And (a) scan of M6C, contexts (452) and (453). Profile development of the podzolic weathered acid brown earth subsoil (453) lower slide. With an overlying more strongly developed Bs horizon (453) upper slide, and a band of mixed Bs and humic Bh soil (452). (b) Photomicrograph showing contexts (452)/(451), with iron pan cementing Bh horizon soil, with often iron-depleted leached stones above, due to surface waterlogging. PPL, frame width is ~4.62 mm. (c) Contexts (452)/(451), as in (b) above, under OIL, showing red iron pan colors and leached stones. (d) Photomicrograph of (453). The fine pellety and minerogenic Bs horizon (453), which is slightly more humic and includes illuvial sesquioxides. PPL, frame width is ~2.38 mm. PPL, plane polarized light; OIL, oblique incident light [Color figure can be viewed at wileyonlinelibrary.com]

Context (450) interpretation: This sample represents the accumulation of peat in the Ah horizon of the podzol. Although there is the formation of peat the fine sediment fractions (clays and silts) are still present, albeit at much reduced values compared with the lower contexts.

3.3.5 | Lanacombe summary

This sample records a poorly preserved brown earth paleosol in context (453) and (452). In context (453), in particular, relicts of brown earth fabric are still visible. However, this paleosol has been subsequently affected by podzolization. It is noteworthy that pits [458] and [459] only cut units (453) and (452), demonstrating these features were present before podzolization.

4 | DISCUSSION

The analysis of these samples demonstrates the residual presence of brown earth paleosols under the current peat deposits of Exmoor. The identification of paleosols with relict argillic brown earth fabric is consistent with previous pollen data that demonstrates a widespread temperate deciduous tree cover in the early Holocene that was subsequently cleared (e.g., Maltby, 1995; Merryfield & Moore, 1974). The identified brown earth paleosols are clay to fine silt dominated, with the particle size data demonstrating a reduction in the fine sediment fractions in the upper parts of the sediment sequences, as clay and very fine silt become depleted due to a combination of clay translocation, acidification, and waterlogging, producing stagnogley podzols; a pattern found across western and upland UK, and western mainland Europe (Dimbleby, 1962; Duchaufour, 1982, pp. 112–121; Findlay et al., 1984; Gebhardt, 1993; Macphail, 1989).

TABLE 10 ELN14 sample <LC05> summary of mean, maximum, and minimum values for the sediment data (percentages rounded to two decimal places)

Context		Clay %	Very fine silt %	Fine silt %	Medium silt %	Coarse silt %	Very fine sand %	Fine sand %	Medium sand %	Coarse sand %	Very coarse sand %	Organic matter %	Magnetic susceptibility
(450)	Mean	8.87	9.68	14.24	17.53	23.24	17.90	5.04	1.81	1.13	0.56	19.88	0.0000730
	Minimum	6.37	6.97	10.56	15.38	19.49	12.06	.032	0	0	0	16.31	0.0000490
	Maximum	10.47	11.55	16.70	19.70	26.67	21.60	9.97	2.83	1.79	1.16	26.21	0.0000930000
(451)	Mean	11.33	12.46	15.13	15.03	16.20	13.99	8.39	4.47	2.56	0.43	8.47	0.0000986250
	Minimum	6.85	8.36	12.11	12.93	12.31	10.81	5.69	2.38	1.45	0.06	5.30	0.0000110000
	Maximum	15.63	16.70	18.05	16.57	19.91	17.32	10.37	6.59	4.95	1.50	14.95	0.0001750000
(452)	Mean	11.41	14.65	27.23	23.55	10.98	5.274	3.474	2.20	1.07	0.17	6.90	0.0005917272
	Minimum	8.99	11.55	14.34	9.73	6.45	0.98	0.47	0	0	0	4.15	0.0002710000
	Maximum	16.47	18.43	34.35	34.31	14.52	13.36	12.09	8.49	4	0.84	13.01	0.0009510000
(453)	Mean	11.92	16.90	31.33	24.69	8.39	2.52	1.78	1.53	0.79	0.16	3.65	0.0005607778
	Minimum	8.51	10.57	19.42	20.37	4.47	0	0	0	0	0	2.64	0.0003120000
	Maximum	14.11	22.27	37.22	31.23	15.441	6.77	5.92	5.83	3.03	0.91	7.62	0.0008560000

The spatial distribution of the samples analyzed indicates that these paleosols are potentially widespread across Exmoor. The paleosols analyzed were not preserved by burial under archaeological monuments, but were instead preserved by the formation of the overlying podzol, although in the case of Lanacombe especially, the podzolization had severely affected the paleosol at the base of the sediment stack. Other examples of a pre-podzol paleosols have recently been analyzed at Spooners Burnt Mound and Farley Water Burnt Mound on Exmoor (Carey et al. in review) that have been fossilized by the construction of archaeological features above them. The identification of these paleosols demonstrates a considerable potential for the archaeological remains from the Early, Mid (and possibly later) Holocene to be contained, preserved and buried under the more recent peat accumulation (Gearey & Fyfe, 2016).

These analyses contextualize the presence of recent archaeological discoveries on Exmoor. At Hawkcombe Head, where Mesolithic pits and flints were preserved within and around a spring line (Gardiner, 2007), a brown earth paleosol can now be identified around the site. A Mesolithic heated pit (Sample 6) was recently excavated at Wintershead (Bray, 2017; Carey, 2017), which had been backfilled with brown earth soil. While the pit enclosure at Lanacombe is currently undated, based on morphology it is likely to be prehistoric; its pits [458] and [450] cut the brown earth and are buried by the podzolic peat, and defines the potential for the premire landscape of Exmoor to contain significant archaeological features. Likewise, the stone holes excavated by Gillings et al. (2010) had fill sequences containing fine brown silt, which can now be interpreted to have been derived from the brown earth paleosol that these stones were cut into, before the accumulation of peat.

The presence of these paleosols in various states of preservation is significant, given the relatively thin peat sequences of Exmoor. The dating of the onset of podzolization during these analyses was limited, primarily due to these samples not being fossilized under archaeological monuments. However, there is considerable potential to selectively excavate monuments built onto the land-surface, for example, field banks enclosure banks, and barrows, to investigate the premonument environments within a more secure chronological framework, with the construction of such dumped deposits preserving the soil system beneath them. Such a program of research would allow the investigation of the Exmoor landscape in different time periods and locations, looking at the transition from a brown earth soil to podzolic soil in both chronological and spatial dimensions, permitting comparison with other upland areas of the UK, specifically Dartmoor and Bodmin Moor, which contain a more visible prehistoric archaeological record, notably the extensive Middle Bronze Age land divisions.

The identification of colluvium overlying the paleosols, but under the formation of peats at both Farley Water and Wintershead is significant. The colluvium at Wintershead is interpreted as dating at or before 755–680 cal BC and this would be consistent with a Bronze Age transformation of the locale. It is notable that nearby at Brightworthy on the river Barle floodplain, Fyfe, Brown, and Coles (2003) recorded increased alluviation between 2270 and 1940 cal

TABLE 11 ELN14 <LC05> soil micromorphology samples and counts

Thin section	Conte-xt	Relative depth (cm)	Microfacies type	Sediment microfabric type	Voids	Stones	Roots	Plant tissues	Charco-al	Iron depletion	Secondary Fe	Thin burrows
M6C	(453)	27–21	A2/A1	1b/1a	30%	fff						
M6B	(452)	21–11.5	B2–B1	1b,2a	40%	fff	a				(iron pan)	aaaaa
M6A	(451)	11.5–2	C1–D1	3a, 4a, and 1c	35–55%	F to fffff	aaa to a	Aaa to a*	a*	aaaaa/0	0/aaaa	aaaa

Thin section	Context	Relative depth	Very thin organomineral excrements	Thin organomineral excrements	Very thin organo excrements	Thin organo excrements	Organo- sesqui-oxide
M6C	(453)	27–21	aaaaa				
M6B	(452)	21–11.5	aaaaa	aaa			aaaa
M6A	(451)	11.5–2			aaaaa	aaaaa	

Note: *, 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%.

BC, potentially caused by woodland clearance, leading to soil instability. The alluvium at Brightworthy could be a correlative unit associated with soil erosion and colluvium, a process which is also visible at Wintershead. At Farley Water the paleosol was associated with Mesolithic material, but the colluvium could date to any time after this, although a Bronze date (2000-700 BC) is suggested, this is untested. Recent excavations on Dartmoor have also identified substantive deposits of colluvium above a paleosol before reave construction (K. L. Hunnissett et al. [personal communication, August 2019]) dating to pre-Middle Bronze Age.

This colluvium indicates land disturbance at these locales and is strongly suggestive of a significant human influence through activities such as deforestation and potentially tilling, during the mid-later Holocene, but before podzolization. It is likely the colluvium contributed directly to loss of soil fertility through a loss of finer fractions and contributed to podzolization. The recently excavated Bronze Age hillslope enclosure at Holworthy, Exmoor, contained quern stones and carbonized cereal grain (Green, 2009) highlighting the possibility of some cultivation in the uplands during later prehistory. While the human impact is clearly definable at both Wintershead and Farley Water, human agency in driving widespread landscape change from a brown earth soil system to podzols and peats is an ongoing debate (Amesbury, Charman, Fyfe, Landon, & West, 2008; Maltby, 1995; Merryfield & Moore, 1974).

It is, therefore, important to reconcile past environmental change, not only with human activity but with wider models of palaeoclimatic change. In particular, is the Sub-Atlantic climatic downturn at *c.* 800 BC the driver of soil degradation, with increasing precipitation loads? Or is the combination of the human landscape impacts associated with a changing climate the driver of these changes? There is a general lack of Holocene paleoclimatic data from southwest England. Significantly, Amesbury et al. (2008) identify a climatic downturn of cooler and wetter conditions at 1395–1155 cal BC from Tor bog, Dartmoor using testate ameba and peat humification, which correlated with data from northern Britain. This climatic downturn was interpreted as coincidental with reave abandonment, indicating a potential climatic causality for the abandonment of upland areas in the Middle Bronze Age. Contrastingly, Dark (2006) synthesized paleoenvironmental data from 75 pollen diagrams across southern England, looking at land-use change and investigated upland abandonment around the time of the Sub-Atlantic downturn at *c.* 800 BC. The data showed no evidence for significant change in the pollen diagrams in the southern uplands through this critical time period.

There is a need to integrate site-specific geoarchaeological analysis of paleosols and sediments, coupled with wider paleoenvironmental (pollen) and paleoclimatic data, for understanding the human impacts on the landscapes of the southwest uplands and beyond. In particular, does a deterministic climatic model of a climatic downturn correlate with podzolization of the previous brown earth soil systems? And does podzolization correlate with abandonment? Merryfield and Moore (1974) in their pioneering work suggested that the human contribution to the initiation of peat deposits on Exmoor was critical. If human activity within these landscapes can be demonstrably linked to the degradation of brown earth soils and the onset of podzolization with

TABLE 12 ELN14 <LC05> soil micromorphology descriptions and interpretations

ELN14 <LC05>			
Context	**Depth (cm)**	**Soil micromorphology description**	**Soil micromorphology interpretation**
(453)	27–21	Very dominant, weakly humic brown silt and sand over very dominant, very weakly humic pale brown silt, and sands. Both horizons contain very poorly sorted silts and fine sands (quartz, quartzite, feldspars, and micas), with medium and coarse sands and common gravel and small stones (≤22 mm), siltstones, fine sandstones, and shale, some of which are possibly subvertically imbricated. There are occasional weak organo-sesquioxidic staining becoming abundant, many thin burrows, becoming abundant upwards, and very abundant very thin organomineral excrements, with also many thin organomineral excrements are also present	Context (453) lower is composed of lower subsoil B(s)/C(s) horizon material, where possibly relict imbricated shale rocks occur, and where an acid brown earth subsoil fine fabric is becoming very weakly affected by podzolization. Upwards (453) upper, remains of the likely relict Pleistocene stony head is present, alongside a more strongly podzolic and sesquioxidic pellety fine fabric (Bs horizon)
(452)	21–11.5	Between 19 and 20 cm dominant dark reddish-brown humic and brown silt and sands, make up a band of sesquioxidic pellety humus (Bhs horizon) within the podzol. Between 11 and 19 cm the unit is heterogeneous with dominant weakly humic brown silt and sands and frequent broad chamber and channel fills with dark reddish-brown humic silt and sands. Gravel and small stones (>35 mm) occur. Rare root remains associated with ferruginization are present just below iron pan. There are many pellety organo-sesquioxidic polymorphic features. At 11.5 cm, there is a 2–4 mm thick amorphous iron pan, possibly cementing and replacing peaty sands, patches of very abundant thin burrows and chambers, and very abundant very thin organomineral excrements, with occasional thin organomineral excrements	Mainly subsoil Bs horizon soil with mixing with humic pellety Bh horizon soil which becomes more dominant upwards, before being cemented into the iron pan
(451)	11.5–2	A heterogeneous sample with dark reddish-brown organic silt and sands and pale greyish-brown minerogenic fine sandy silt loam, and frequent gray minerogenic silts and very fine sand. It is stony with very dominant gravel to small stone-size fragments (max 35 mm), with bleached rims. Rare thin in situ roots, showing weak iron staining, a rare trace of plant remains and fine charcoal (≤0.5 mm) also occur. The main depletion features are the bleached rims of rock fragments. There are abundant thin burrows, and very abundant thin and very thin organic excrements (which contain silt and fine sand)	This is a stony dump of peaty topsoil mixed with leached E horizon and weathered sock and C horizon material. The presence of podzolic B horizon soil was not noted. The mixed topsoil material contains only a small trace of charcoal

greater chronological precision, then human society and their activities hold the balance for the ecological transformations of such landscapes. This, then, would be significant in understanding the definition of the Anthropocene (Brown et al., 2017) and assessing when human activities become the primary driver of ecosystem change, especially if such correlations can be shown to exist over time and across wider areas. Relationships have been demonstrated between human activities destabilizing landscapes within fluvial catchments and the onset of alluviation. This has been used to define the Anthropocene through geomorphological change within alluvial systems, caused by anthropogenic disturbance of wider landscapes (Brown, Toms, Carey, & Rhodes, 2013). Likewise, the analysis of pollen data demonstrates increasing human interference and impact upon the environment from the Neolithic onwards, again demonstrating human drivers of ecosystem change in prehistory (Stephens et al., 2019). Data from the study of soils and paleosols during the Holocene can also play a key role in the definition of the Anthropocene, through consideration of the human contribution to evolution and transition of soils over time. Human impacts on past environments and an assessment of the role of past human societies in terms of landscape evolution and soil degradation has significant potential to inform the definition and discussion of the Anthropocene.

5 | CONCLUSION

This study represents the first geoarchaeological analysis of a prepodzol brown earth soil on Exmoor, which in two locations was associated with colluvium before podzolization, suggesting clear human impacts within this landscape. It is noteworthy that while there was some research into paleosols on the upland landscapes of the southwest in the late 1970s and 1980s (principally Dartmoor), there has been a hiatus since. The analysis of these paleosols has significant potential to contribute to our understanding of human lifeways and economy in these remarkably rich upland archaeological landscapes. The extensive preservation of prehistoric hut circles and field divisions across the uplands provides the possibility of combining the study of paleosols beneath these monuments with past environments and soil erosion, integrated with the analysis of paleoecological data, to understand past agricultural and site-specific environments. The identification of paleosols helps contextualize prehistoric finds and provide a linkage between localized pollen sequences and archaeological site-specific environments within these landscapes. With more work and critically more dating, it should prove possible to construct wider chronological models across regions that can help elucidate the significance of the human impacts and the role human society played in the development of podzol soils within these upland environments. Increased chronological resolution of the transition of brown earth soils into podzolic peats has importance in understanding past human impacts on the environment, the fragility of such ecosystems in the face of changing climates and could help define when human beings became the primary drivers of ecosystem transition and change. In such upland landscapes, where the balance between sustainable habitats and the environmental transition is delicately poised, it is pivotal to understand the contribution of past human societies in changing these prehistoric worlds.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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