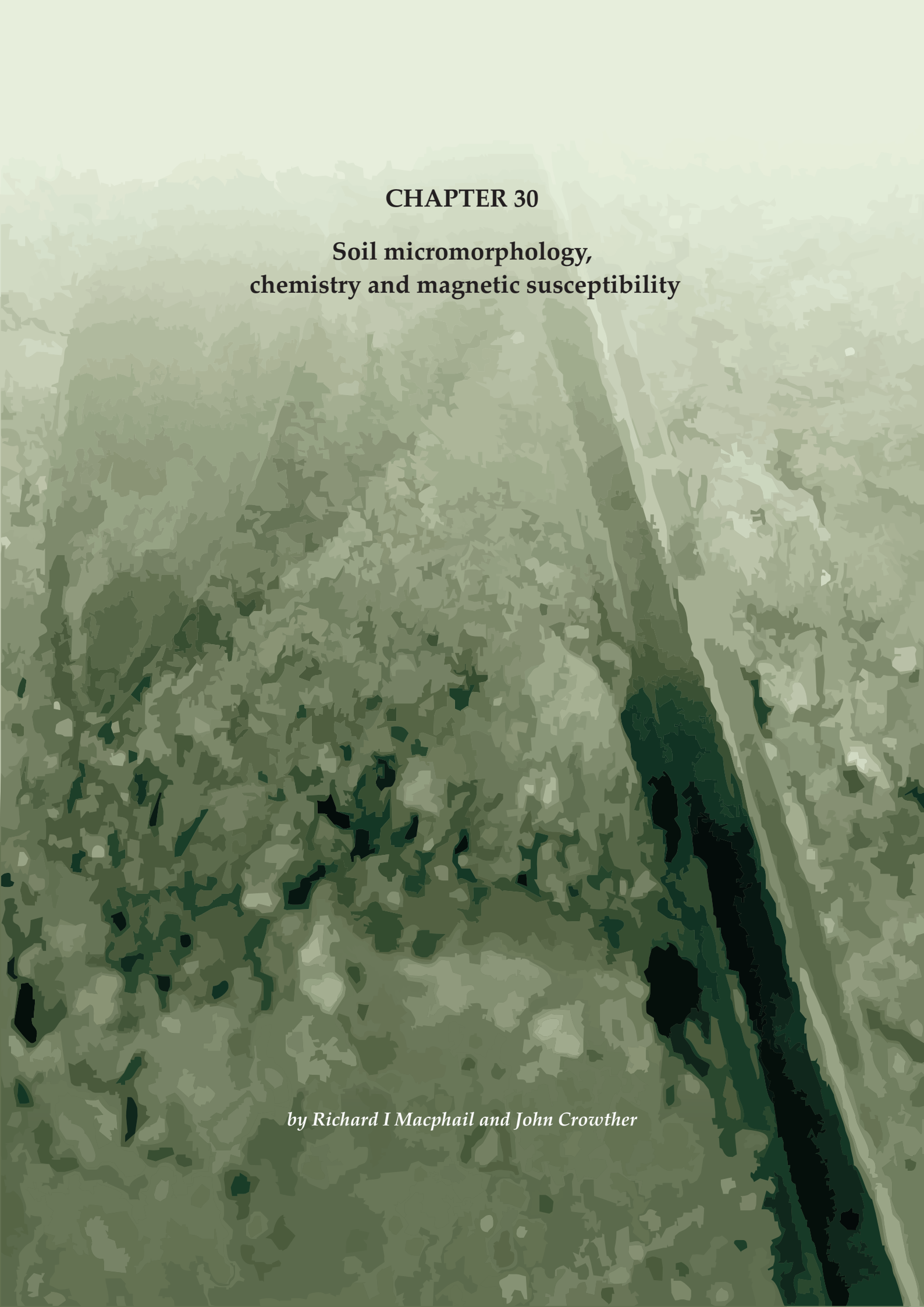


CHAPTER 30

Soil micromorphology, chemistry and magnetic susceptibility

by Richard I Macphail and John Crowther

30 Soil micromorphology, chemistry and magnetic susceptibility

Richard I. Macphail and John Crowther

Excavation of the LTCP and MTCP sites at Stansted Airport found multi-period occupation that included Middle Bronze Age to post-medieval archaeology. After two visits to the Stansted sites in 2000, 20 monoliths were assessed at Oxford Archaeology. No buried soils as such were found and soil studies focused upon Middle Bronze Age barrow ditch fills, Late Iron Age gully fills and droveway deposits, Romano-British ditch and trackway sediments and Medieval ditch and pit fills. Soil studies – soil micromorphology, chemistry and magnetic susceptibility – were employed to investigate 16 monoliths selected after the assessment process. These were processed and studied during Autumn 2004 and New Year 2005.

Samples and sub-sampling

The 16 long monoliths that had been selected were first sub-sampled for bulk analyses (by Drs Jill Cruise and Richard I Macphail), for each context under study – producing 33 bulk samples in all (see below; Tables 30.1 and 30.4). Parts of the monoliths were then cut up to produce 25 thin section block samples, according to the assessment (see below and Table 30.4).

Methods

Chemistry and Magnetic Susceptibility

Thirty-three bulk samples were analysed for phosphate (see reviews by Bethel and Máté 1989; Crowther 1997; Heron 2001) and magnetic susceptibility (Clark 1996; Scollar *et al.* 1990), both of which are widely used in the investigation of archaeological contexts; and for loss-on-ignition (LOI), which provides an estimate of the organic matter concentration. Analysis was undertaken on the fine earth fraction (ie <2 mm) of the samples. Phosphate-P_i (inorganic phosphate) and phosphate-P_o (organic phosphate) were determined using a two-stage adaptation of the procedure developed by Dick and Tabatabai (1977) in which the phosphate concentration of a sample is measured first without oxidation of organic matter, using H_2SO_4 as the extractant (P_i); and then on the residue following alkaline oxidation with NaOBr (P_o). These were summed to give total phosphate (phosphate-P), and the ratios phosphate-P_i:P and phosphate-P_o:P (expressed as percentages) were calculated. For eight of the samples (detailed in footnote of Table 30.1) it was not possible to determine the phosphate-P_i concentration because of chemical interference in the colorimetry, which is presumed to be attributable to the organic matter present. In five of these cases, it was possible to determine phosphate-P following alkaline oxidation, but for the remaining three samples, which had the highest organic matter concentration, analysis was undertaken on residual soil from the LOI analysis (see below).

In addition to χ (low frequency mass-specific magnetic susceptibility), determinations were made of χ_{max} (maximum potential magnetic susceptibility) by subjecting a sample to optimum conditions for susceptibility enhancement in the laboratory. χ_{conv} (fractional conversion), which is expressed as a percentage, is a measure of the extent to which the potential susceptibility has been achieved in the original sample, viz: (χ/ χ_{max}) x 100.0 (Tite 1972; Scollar *et al.* 1990)(Tite 1972). In many respects this is a better indicator of magnetic susceptibility enhancement than raw χ data, particularly in cases where soils have widely differing χ_{max} values (Crowther and Barker 1995; Crowther 2003). A Bartington MS1 meter

was used for magnetic susceptibility measurements. χ_{max} was achieved by heating samples at 650°C in reducing, followed by oxidising conditions. The method used broadly follows that of Tite and Mullins (1971), except that household flour was mixed with the soils and lids placed on the crucibles to create the reducing environment (after Graham and Scollar 1976; Crowther and Barker, 1995). LOI (loss-on-ignition) was determined by ignition at 375^{o}C for 16 hours (Ball 1964).

Pearson product moment correlation coefficients have been used to examine the relationships between the various properties analysed. In cases where the data for individual properties had a skewness value of ≥1.0, a $\log_{10}$ transformation has been applied in order to increase the parametricity. Statistical significance was assessed at $p = 0.05$ (ie 95% confidence level).

Soil micromorphology

Monolith samples were impregnated with a crystic resin mixture, cured and cut up into 75 x 50 mm size blocks, which were then sent to Quality Thin Sections, Tucson, Arizona for thin section manufacture (Murphy 1986). 25 thin sections were analysed both as scanned images and under the petrological microscope: under plane polarised light (PPL), crossed polarised light (XPL), oblique incident light (OIL) and using fluorescent microscopy (blue light – BL), at magnifications ranging from x1 to x200/400. Thin sections were described (and counted) according to standard authorities and reference studies on soil micromorphology applied to archaeology (see Tables 30.4 and 30.6)(Bullock *et al*. 1985; Courty *et al*. 1989; Macphail and Cruise 2001; Stoops 2003). Soil micromorphological interpretations were based upon the identification of soil microfabric types (SMTs), included natural and anthropogenic materials, along with bulk and microprobe data, all of which were combined with the archaeological context information to produce microfacies types (MFTs)(Courty 2001; Macphail and Cruise 2001). Literature sources and reference materials utilised in these identifications are listed throughout the text. Microprobe analysis (M415 and M2252C) was carried out at the Institute of Archaeology, UCL, by Kevin Reeves and comprised the selective mapping of Al, Ca, Fe, Mg, P, Mn, Pb, K, Cu, Si, Zn, S and Na, with quantitative grid and line analyses (*c* 86-93 points; Table 30.5).

Results

Chemistry and magnetic susceptibility

The analytical data for individual samples, summary statistics and results of the correlation analysis are presented in Tables 30.1-3, respectively. The majority of the samples are largely minerogenic, with LOI values of <5.00%. Three of the samples (2608, 2719B and 2719C1 – highlighted in Table 30.1), all from the Middle Bronze Age barrow, have notably higher organic matter concentrations (range, 11.3-13.8%), which may be significant in the interpretation of these contexts – eg they may represent organic-rich infill material.

The phosphate data display considerable variability (0.186-3.77 mg g^{-1}). In view the range of values observed, it is reasonable to assume that samples with concentrations of ≥1.50 mg g^{-1} indicate likely enrichment, and that values ≥3.00 mg g^{-1} are strongly enriched (highlighted in Table 30.1). The two samples in the latter category are from Late Iron Age enclosure ditch 109166 (context 140028, intervention 140027 - sample 415A: 3.44 mg g^{-1}) and from Middle Bronze Age waterhole 309075 (context 309076 - sample 2268C: 3.77 mg g^{-1}). The phosphate-P present is predominantly in an inorganic form – the phosphate-P_i:P ratio averaging 73.0% (range, 48.6-90.1%). Whilst these figures are quite high, they are on the whole lower than is often encountered in archaeological contexts, and this may reflect inhibited organic

decomposition as a result of the poorly-drained character of the site. There is a strong correlation ($r = 0.812$, $p<0.001$) between LOI and phosphate-P_o.

Magnetic susceptibility analysis is problematic in gleyed soils such as these because of the instability and mobility of Fe minerals under anaerobic conditions. This probably accounts for the very wide variability of χ_{max} (range, 313-5080 x 10^{-8} SI), and consequently for the rather weak, though statistically significant, relationship between χ and χ_{conv} (Table 30.3 and Fig. 30.1). In these circumstances, as noted above, χ_{conv} undoubtedly provides a much more reliable measure of susceptibility enhancement than the 'raw' χ data. As is commonly the case in gleyed soils (Crowther 2003), there is a significant inverse relationship between χ_{conv} and χ_{max}. Unfortunately, the results for all of the samples are disappointing, with none showing clear signs of enhancement either in terms of the χ values (range 3.5-26.0 x 10^{-8} SI) or, more importantly, the χ_{conv} values (range, 0.140-3.10%). Two samples have χ_{conv} values of ≥2.00% (2268C: 2.30% and 2668B: 3.10%; highlighted in Table 30.1), but even these must be regarded as only representing possible low levels of enhancement.

Soil micromorphology

25 thin sections were analysed. 36 microstratigraphic units (mainly corresponding to contexts) were identified, and counted and described separately. These were characterised according to their descriptions, including soil microfabric type (SMT), void space, structure and counts of inclusions (eg, gravel, soil fragments, charcoal, burned flint, roots, organic fragments, bone and dung residues), and pedofeatures (intercalations, excrements of mesofauna, secondary $CaCO_3$ and pyrite – depletion features and iron and manganese mottling were described but not counted because of its ubiquitous presence). These data were combined with other findings (bulk and microprobe analyses, archaeological information) to produce microfacies types (MFTs), which with variants numbered 16. There is clear consistency between the soil micromorphology, microprobe and bulk data. Counts, the results of the microprobe study and the descriptions and preliminary interpretations of MFTs, are given in Tables 30.4-6, respectively. Selected thin section scans, photomicrographs and microprobe images are presented in archive.

Local soils and modern land use

The sites are located on Chalky Till (Chalky Boulder Clay), an area of typical calcareous pelosols (Hanslope soil association; Jarvis *et al*. 1983). This soil association is commonly clayey, calcareous to non-calcareous and with flint gravel in places. It is only moderately permeable and liable to seasonal waterlogging, and after periods of heavy rainfall "disposal of excess water is by lateral flow" (Jarvis *et al*. 1984, 191). The authors also note that opportunities for spring cultivation are limited and autumn cultivation and winter crops are preferred, and that grassland is a significant landuse. These background soil conditions are reflected at the site, with both areas of non-calcareous and calcareous soils, extensive waterlogging (gleyic) features, and the deposition of calcareous deposits in some upper feature fills; the last a result of erosion.

Discussion

Unphased

Palaeochannel 327003

This palaeochannel lay on the eastern edge of the plateau, on the slopes of the MTCP site, and runs roughly parallel to the Pincey Brook (Nick Cooke and Fraser Brown, pers. comm.). Although not phased directly, it certainly predates the Late Iron Age, Romano-British and medieval features excavated on the site, and may be considerably earlier. It was examined at a section in its southern part, and sampled by monoliths 2537/2539 and above, 2537/2538, with 2535 as a lateral and lower sample (5 thin sections and 2 bulk analyses). The lowest lateral samples (2535A and 2535B) are very poorly sorted, compact calcareous deposits that show horizontal fissuring/layering (and evidence of structural collapse – intercalations and closed vughs)(context 327004). They also contain fragments of possible stabling refuse (and fungal material) and are heavily yellowish brown stained (Fe and P?). They appear to be likely stock trampled deposits (watering site?), possibly near a stabling area? – or where there has been spillage of manure.

Upwards (context 327006) the deposit becomes a well-sorted calcareous silt inwash deposit with likely rooting between a succeeding inwash phase. Here a focus of animal activity (droveway/waterhole?) became inundated with fine alluvium. This alluviation is also recorded in 2537/2539 as mainly fine silty clay sedimentation, intercalated with sandy deposits (context 327006). Sediments have been weakly burrowed and rooted between alluvial events. The palaeochannel fill continues upwards (context 327008) as a now mainly massive, but once poorly layered calcareous sediment of poorly sorted chalk gravel and coarse silt through to coarse sand. Overall, the sediment shows a broad (till-derived) mineralogy. The sediment was rooted and partially burrow-mixed and has a history of dusty to impure clay inwash (from alluviation?), and minor secondary calcium carbonate formation. This was succeeded by major hydromorphic iron impregnation, and probably associated calcium carbonate and iron depletion (mottling). The deposit continues upwards (contexts 327009 and 327010) as fine clayey to fine sandy and generally calcareous sediments, with included fine charcoal, and textural pedofeatures indicating 'muddy' and finely laminated deposition at times. Later inwash of chalky alluvium (above) and moderate iron mottling are also recorded. The alluvial deposits show small amounts of phosphate are present (0.351-0.562 mg g^{-1} phosphate-P).

This location clearly shows a probable early history of animal trampling (unfortunately there is no chemistry for this sample) – perhaps associated with drinking, and upwards the palaeochannel appears to have been episodically (seasonally?) active, with biological working of the sediment between alluvial events. It is possible that animals continued to occasional trample the site, as indicated by 'muddy' textural pedofeatures.

Trackway 324058

Sample 2668 found a generally homogeneous, moderately well-sorted coarse silt and sand infilling, induced by silting, with towards the base, gravels and a totally iron-depleted sediment indicative of a waterlogged (gleyed) conditions (context 324021). Whilst this appears inconsistent with the relatively high magnetic susceptibility signal (3.10% χ_{conv}), it should be noted that at most this represents only possible weak enhancement. Upwards the deposits are affected by fine rooting, weak iron staining, and later phases of silting produced some thin dusty clay coatings, which together with low levels of phosphate (0.186-0.224 mg g^{-1} phosphate-P), appear to be poor evidence of a trackway compared to other examples studied at Stansted.

In terms of the fills and droveway sediments examined for the Late Iron Age at Stansted, the samples analysed are clearly indicative of a stock (cattle dominated?) landuse. It is probably an accident of sampling that very little evidence of domestic activity (eg phytolith cereal processing waste, burned soil from hearths etc.) was found, in comparison to some other Iron Age sites (eg, Maiden Castle, Wiltshire and White Horse Stone, Kent; Macphail 1991; Macphail and Crowther, 2004). The soils and sediments at White Horse Stone produced good evidence of mixed farming, and Balksbury Camp, Hampshire also showed how important stock management was in the Iron Age (Macphail *et al*. 2001).

Middle Bronze Age (c 1500-1100 BC)

The Middle Bronze Age was investigated through thin sections and bulk samples of the barrow ditch (324078) fills (4 thin sections and 5 bulk samples), waterhole 302043 (1 thin section and 4 bulk samples) and waterhole 309075 (1 thin section and 3 bulk samples) sediments. The waterholes lay within the Middle Bronze Age settlement on the MTCP site.

Middle Bronze Age barrow 324078

This barrow (324078) lay on the north-east extremity of the MTCP site, on low ground within 50 m of the Pincey Brook. The ditch fill sequence (sample 2719) commences with a non-calcareous mineralogenic (0.921% LOI) primary gravel-rich fill that contains two bone fragments that are possibly relict of Pleistocene animal activity (scat). There is an upward fining sequence above that develops into a finely laminated silty mineralogenic peat rich in detrital monocotyledonous plant fragments (context 320139, intervention 320131). This highly organic (11.3-13.8% LOI) but mineral intercalated peat, shows increasing influence of fluctuating water tables (burrowing and burrowed-in silty soil/sediment) and episodes of moderately low impact anthropogenic activity; much coarse charcoal in places, with possible charring of peat surfaces, and the presence of flint concentrations and burned flint (contexts 320140 and 320142, interventions 320140). At the top of the sampled sequence context 320144 (intervention 320143, barrow recut 324080) is mineralogenic but contains a likely burned flint. Another sample of the barrow ditch fill (2608) found a similarly peaty (11.6% LOI) deposit (context 320115, intervention 320111), with evidence of occasional faunal working and possible woody plant rooting. There may also be a trace amount of dung here but as there is no phosphate evidence of a major dung input, such a suggestion needs confirmation from another data source.

Overall it seems that the Middle Bronze Age barrow was constructed in an area of high water tables that was little disturbed allowing mineralogenic peaty deposits to form. Small amounts of anthropogenic activity are recorded by the inclusion at times of charcoal, flint and burned, and probable local burning. Disturbance and more rapid inputs of mineral material are found at the top of the sequence. The barrow is located in non-calcareous sediments, presumably exposed through fluvial erosion of the till cover. The lack of calcareous sediments implies little disturbance and erosion of the chalky till plateau to the west at this time.

Middle Bronze waterhole 302043

At waterhole 302043, the base of sample 2012 is a homogeneous, compact calcareous and chalky sediment containing fine charcoal, some mainly fine pot fragments, rare examples of bone and burned flint, and numerous inclusions of organic fragments – possibly some of which are dung/stabling refuse (context 311002 and 302008). The sediment is iron mottled but some staining may come from animal slurries – trampling producing many textural

features and a compact (but once-muddy) deposit; concentrations of phosphate, however, are low (0.459-0.470 mg g^{-1} phosphate-P). Upwards, the compact calcareous deposit with its included anthropogenic materials content (context 302006) has been affected by later earthworm burrowing and mixing with non-calcareous silty soil, and lastly by iron panning and mottling because the trampled deposit formed a hydraulic barrier (context 311002). Despite the presence of small amounts of trampled-in material/slurries, amounts of organic matter and phosphate remain low (1.58% LOI, 0.615 mg g^{-1} phosphate-P).

Middle Bronze waterhole 309075

In contrast the sediments at waterhole 309075 (sample 2268) are both more humic (3.16-3.47% LOI) and phosphate enriched (1.10-3.77 mg g^{-1} phosphate-P) especially at the base of the sampled sequence (context 309080). The thin section showed heterogeneous and mottled fine loamy fills, composed of fine charcoal-rich soil with many small soil inclusions of coprolitic material, including bone, and compact slaked soil and burned very humic soil. It is characterised by very abundant textural pedofeatures indicative of mixing and slaking, and contains examples of fine bone, burned flint and a fungal body. The soil micromorphology indicates occupation deposits that have been likely trampled under wet conditions – presumably by stock in the waterhole. The inclusion of burned material is reflected in an enhanced magnetic susceptibility here (2.30% χ_{conv}).

The waterhole deposits are clearly indicative of animal management (trampled slurries), with at Waterhole 3 the obvious inputs of anthropogenic materials clearly reflecting juxtaposition to the settlement (tracked-in materials/discard). It is also clear that occupation land use at the waterholes seems to have greatly differed from the low impact activities recorded at the barrow. The fills at the waterholes indicate a mosaic of (mainly) calcareous and non-calcareous soils, while towards the northwest, by the Pincey Brook, soils were non-calcareous and often wet. There is strong environmental evidence of a grassland dominated landscape around the barrow, logically grazing land use, as argued for the River Nene environs during the Early Neolithic and Early Bronze Ages at Raunds, Northamptonshire that was maintained after clearance (burned tree-throws)(Healy and Harding forthcoming).

Late Iron Age (c100 BC-AD 43) and Romano-British (c AD 43-410)

The Late Iron Age landscape was studied from a series of samples of droveway deposits (1 thin section and 1 bulk samples), enclosure ditchfills (4 thin sections and 5 bulk samples), and a ring ditch fill (1 thin section and 2 bulk samples).

Late Iron Age enclosure ditch 113048

The lower and middle fill was analysed from sample 121, with sample 120 examining the middle and upper fill junction. The lower fill is a heterogeneous and mainly calcareous, chalk-rich and land snail-rich deposit (context 107008). It is much burrowed and contains evidence of occasional slaking and mixing, but only contains small amounts of anthropogenic indicators, eg, of bone and mixed-in once-humic soil. This has resulted in a low phosphate (0.760 mg g^{-1} phosphate-P) and organic matter (2.47% LOI) contents. Upwards, both contexts 107007 and 107006 are massive, heterogeneous, and probable part-earthworm burrowed non-calcareous fills that have been slaked and likely trampled. These contain small amounts of fine charcoal with inclusions of once-humic soil clasts and clayey material that have probably been ultimately brought in by local stock. These activities have led to increased amounts of organic matter (3.46-4.11% LOI) and phosphate (1.42-1.56 mg g^{-1} phosphate-P) being present.

Late Iron Age enclosure ditch 109166

The lowest part of the enclosure ditch fill was sampled by 415. Towards the base of the fill pans and inwash features of moderately calcareous and charcoal-rich (and phytoliths) deposits – some phosphate-rich – occur, probably as ditch fill slurries. Upwards there is also the probability of *in situ* animal trampling producing moderately poorly sorted fine soil containing soil clasts and very abundant slaking features (pans and intercalations), with evidence of co-eval earthworm and other burrowing, and possible inwash of phosphate-rich fine soil that sometimes contain phytoliths. Anthropogenic inclusions occur as charcoal, but organic matter is not high (1.97-3.18% LOI). On the other hand, the sediment is phosphate enriched (2.09-3.44 mg g^{-1} phosphate-P). There are no obvious ash, bone or coprolitic inclusions to account for this, and microprobe analysis has shown that phosphate (mean 0.35% P, *n*=93; closely matching the bulk data) is in fact associated with iron staining and textural pedofeatures (clay inwash). Examples of the latter show combinations of Al, Si, Ca, Fe and P (maxima of 2.99-3.40% P). These chalky and iron-stained clay slurries that are phosphate-rich are likely the result of animal concentrations – possibly within this wide feature itself at times. Analyses included testing for the possibility that heavy metals (Cu, Pb and Zn) could be concentrated in these Late Iron Age animal slurries (as found in dung-rich organic deposits at early medieval Guildhall, London; (Macphail *et al*. forthcoming), but only very low trace amounts were found, the highest being lead (mean 0.035% Pb), and no concentrations were identified by elemental mapping.

Early Romano-British droveway ditch 109089

This has a fill (sample 479) composed of moderately heterogeneous non-calcareous fine loam with very abundant inclusions of slaked subsoil and probable humic/humic stained (now iron and manganese replaced) soil clasts. There are fragments of textural pedofeatures, set in a matrix dominated by textural pedofeatures of different phases/episodes – some possibly humic stained. Only rare obvious anthropogenic inclusions are present, however.

It seems probable that trampling by stock has produced a droveway soil with multiple phases of slaked mixing, and likely inputs of humic waste and humic soils and (traces of dung), even whilst the organic (3.14% LOI) and phosphate (0.803 mg g^{-1} phosphate-P) content is only moderate. Other indications of this are that mesofauna such as earthworms and/or dung beetles were present and their burrows have been partially infilled with slaked soil. Detailed analysis of an Iron Age droveway at Malmö, Sweden found the same moderately low amounts of organic matter (3.9-4.1% LOI), similarly numerous textural pedofeatures and burrows of mesofauna; dung traces were more concentrated, however, and this droveway contained 0.2% P compared to a background of 0.01% P (Johan Linderholm, pers. comm.)(Macphail 2003; Macphail in press).

Early Romano-British ring gully 129162

Sample (443) showed the presence of a heterogeneous and mottled fine loamy fill, with textural pedofeatures of mixing and structural collapse evidence of inputs of slurry and probable occasional *in situ* trampling. Upwards, the wet and occasionally trampled ditch fill that contains inclusions of charcoal and fine organic matter, was characterised by slaked burrow-mixed moderately calcareous soil. The deposit also showed an increase in organic matter (2.20-3.54% LOI) and phosphate (0.516-1.51 mg g^{-1} phosphate-P) upwards, possibly reflecting the use of the enclosure for stock.

Late Romano-British (c AD 270-410)

Late Romano-British Enclosure Ditch 143007

This feature comprises a large late Romano-British enclosure ditch. The fills examined in thin sections 360A and 360B (intervention 152001), are, from the lower levels (context 152007), moderately well sorted fine soil with much slaking and infilling, probable due to trampling of the muddy basal fill of this wide (*c* 10 m) feature. This lower part is also influenced by gleying and natural shrink and swell features. Upwards the deposit becomes moderately heterogeneous and moderately poorly sorted and contains soil clasts and very abundant slaking features, with evidence of shrink and swell features and gley mottling. There are, however, only trace amounts of anthropogenic inclusions such as once-humic, clay soil and burned humic topsoil clasts, the last possibly coming from occupation activities (context 152003). Also present (context 152006) are clay inwash pans containing 'chalky clay' clasts are further indications of animal trampling, which are also probably indicated by concentrations of organic matter (3.34-3.48% LOI) and phosphate (1.44-2.44 mg g^{-1} phosphate-P)(context 152007).

The samples studied, as for the Late Iron Age, again seem to reflect animal management activities, rather than the mixed farming that involved crop processing (corn dryers and grain processing; see Carruthers CD Chapter 34). Although some burned soil was found, burned daub and vitrified corn drier debris and associated enhanced magnetic susceptibility (as in other Romano-British rural sites; cf. Haynes Park, Bedfordshire; Cruise and Macphail 2000) were not present in the samples examined.

Late Saxon and Medieval (c AD 850 – 1066 and AD 1066-1499)

Samples were studied from a drainage ditch (3 thin sections and 3 bulk samples) and a pit fill (2 thin sections and 3 bulk samples).

Late Saxon pit 305011

This feature lay close to a burned beamslot of a late Saxon long house, where the remains of wattle panels and cob daub were identified. The lowermost deposits examined (305015 and 305021) are an iron stained calcareous fill containing gravel and occasional to many charcoal, and evidence of burrowed-in more humic and fine charcoal-rich soil. They contain generally small amounts of phosphate (up to 1.25 mg g^{-1} phosphate-P) and cob fragments. Upwards (context 305019) there is an increase in organic matter and slightly higher concentrations of phosphate and a possible rise in magnetic susceptibility (5.06% LOI, 1.57 mg g^{-1} phosphate-P, 1.89% χconv). Earthworm-mixed anthropogenic deposits are composed of fine charcoal-rich anthropogenic soil with likely included ash (burned debris), and very abundant daub materials including charcoal rich poorly burned calcareous material, alongside strongly burned clay loam and examples of chalky cob-like material. Burned chalk is also present.

These findings can be compared to other examples of the use of chalky till-based cob, such as at the 12th Century Templar Cressing Temple, Essex, where it was used for ground raising and constructing floors and lime mortar floors (Macphail 1995). It was also found employed at Medieval structures in Norwich (Macphail 2001; Shelley 2005), again possibly from an East Anglian till source. Chalky cob has also been used at the experimental site of middle Saxon West Stow, Suffolk and middle Saxon West Heslerton, North Yorkshire (Macphail *et al*. forthcoming; West 1985).

Early medieval ditch 336090

An early medieval field system comprising a parallel series of ditches was excavated on the MTCP site. Samples 2252A-C examined the fill. The lowermost sample is a poorly sorted gravel-rich fill, containing coarse mineral material, and shows an initial phase of probable earthworm working of the fine fill, that was succeeded by major clay inwash (ditch drainage episodes and fine settling). Slaking features may indicate trampling, possibly associated with cleaning activities. As the ditch sediments accrued post-depositional processes involved major iron impregnation and iron-depletion (ie, strong mottling). Microprobe measurements and elemental mapping confirmed that mottling involved iron, and gleyed (pale) zones were also strongly depleted of cations (Na, Ca, and Mg).

Similar fills were found upwards and these showed a slight increase in amounts of phosphate (0.194-0.475 mg g^{-1} phosphate-P), but this may reflect less strong leaching as well as a higher input of phosphate. The chief finding here is corroboration of the land drainage model for poorly drained soils on slopes where soils are only moderately permeable and liable to seasonal waterlogging and after periods of heavy rainfall "disposal of excess water is by lateral flow" (Jarvis *et al*. 1984, 191). The ditch must also have experienced periods of standing water/slow drainage – hence the need for cleaning – which led to *in situ* gleying and leaching.

Summary and conclusions

The site was studied employing 25 thin sections and 33 bulk analyses chosen after the assessment process. The geological substrate is generally dominated by the presence of chalky till (although a mosaic of both calcareous and non-calcareous soils is recorded across the site), which often produces waterlogged soils. The palaeochannel, which remains undated, shows evidence of both alluviation and animal use, possibly by stock. The Middle Bronze Age barrow, which is located some 450 m from the settlement, is situated in low ground by the Pincey Brook. Ditch fills are highly humic and show only low levels of human activity, and the fills remain non-calcareous indicating that little or no erosion of the chalky till plateau upslope was taking place at this time. In contrast, near the settlement's entrance, Waterhole 309075 has a marked soil micromorphological and phosphate signature that records animal trampling and inputs of anthropic materials, which with the other waterholes investigated, also signals the importance of stock management. There is also a rare record of a relatively enhanced magnetic susceptibility at waterhole 309075, which is significant given the overall deleterious waterlogging effects on magnetic susceptibility at this site. There is generally good evidence from both trackways and wide ditch fills during the Late Iron Age and Romano-British periods that stock were being managed. High phosphate concentrations in some of these features are not related to anthropic inclusions (bone, etc.). Micromorphology and microprobe studies have shown that this chemical enhancement is due to the deposition of slurries contaminated by animal waste. The character of the late Romano-British samples also reflects animal management. The burned and ash-rich debris from the razed Saxo-Norman long house was dumped in Pit 305011, and clearly show the use of a chalky till-based cob, as a building material. The poorly drained nature of the soils at Stansted is well documented in an early medieval ditch, the fills of which show that they sometimes held standing water and probably needed and underwent cleaning.

Table 30.1: Chemical and magnetic susceptibility data for the individual samples (n = 33)

Sample[a]	LOI[b] (%)	Phosphate-P_i (mg g^{-1})	Phosphate-P_o (mg g^{-1})	Phosphate-P[c] (mg g^{-1})	Phosphate-P_i:P (%)	Phosphate-P_o:P (%)	χ (10^{-8} SI)	χ_{max} (10^{-8} SI)	χ_{conv}[d] (%)
Late Iron Age enclosure ditch 113048									
120A	4.11	1.048	0.516	**1.56***	67.0	33.0	11.6	1860	0.624
120B	3.46	1.088	0.327	1.42	76.9	23.1	9.1	1270	0.717
121	2.47	0.381	0.379	0.760	50.1	49.9	6.1	1820	0.335
Late Iron Age enclosure ditch 109166									
415A	3.18	3.083	0.355	**3.44****	89.7	10.3	7.7	733	1.05
415B	1.97	1.739	0.354	**2.09***	83.1	16.9	6.8	1580	0.430
Early Romano-British droveway ditch 109089									
479	3.14	0.399	0.404	0.803	49.7	50.3	10.9	1990	0.548
Early Romano-British ring gully 129162									
443A1	3.54	1.048	0.464	**1.51***	69.3	30.7	13.8	1980	0.697
443A2	2.20	0.334	0.182	0.516	64.7	35.3	12.2	1950	0.626
Late Romano-British enclosure ditch 143007									
360A1	3.40	1.170	0.272	1.44	81.1	18.9	6.2	397	1.56
360A2	3.48	2.076	0.362	**2.44***	85.2	14.9	12.8	1890	0.677
360B	3.34	1.854	0.277	**2.13***	87.0	13.0	8.6	1440	0.597
Middle Bronze Age waterhole 302043									
2012A1	1.58	0.420	0.195	0.615	68.3	31.7	4.0	1390	0.288
2012A2	1.39	0.351	0.110	0.461	76.1	23.9	5.6	1440	0.389
2012B1	1.57	0.379	0.091	0.470	80.6	19.4	6.9	1460	0.473
2012B2	1.65	0.365	0.094	0.459	79.5	20.5	7.0	1560	0.449
Middle Bronze Age waterhole 309075									
2268A	3.16	0.573	0.526	1.10	52.1	47.9	13.8	1800	0.767
2268B	3.47	1.370	0.386	1.76	78.0	22.0	22.9	1390	1.65
2268C	3.35	3.395	0.375	**3.77****	90.1	9.9	26.0	1130	**2.30***
Middle Bronze Age barrow 324078									
2608	**11.6****	n.d.[e]	n.d.[e]	0.325[f]	n.d.[e]	n.d.[e]	4.2	568	0.739
2719A	1.62	n.d.	n.d.	0.281	n.d.	n.d.	5.7	2970	0.192
2719B	**11.3****	n.d.	n.d.	0.401[f]	n.d.	n.d.	3.5	416	0.841
2719C1	**13.8****	n.d.	n.d.	0.410[f]	n.d.	n.d.	3.8	736	0.516
2719C2	0.921	0.477	0.154	0.631	75.6	24.4	5.2	1640	0.317
Unphased trackway 324058									
2668A	1.96	n.d.	n.d.	0.224	n.d.	n.d.	6.9	2260	0.305
2668B	2.10	n.d.	n.d.	0.186	n.d.	n.d.	9.7	313	**3.10***
Late Saxon pit 305011									

2106A	**5.06***	n.d.	n.d.	**1.57***	n.d.	n.d.	17.8	943	1.89
2106B1	2.59	n.d.	n.d.	1.25	n.d.	n.d.	8.3	1450	0.572
2106B2	1.33	n.d.	n.d.	0.420	n.d.	n.d.	5.4	1590	0.340
Unphased palaeochannel 327003									
2538A	1.32	0.450	0.112	0.562	80.1	19.9	6.9	2010	0.343
2538B	1.68	n.d.	n.d.	0.351	n.d.	n.d.	6.7	4900	0.137
Early Medieval ditch 336090									
2252A	2.01	n.d.	n.d.	0.475	n.d.	n.d.	6.6	1570	0.420
2252B	1.93	0.156	0.165	0.321	48.6	51.4	7.7	2170	0.355
2252C	2.06	n.d.	n.d.	0.194	n.d.	n.d.	9.2	5080	0.181

Notes:

[a] Samples highlighted in bold show signs of phosphate enrichment and/or magnetic susceptibility enhancement

[b] LOI: figures highlighted in bold have higher concentrations of organic matter:
* LOI = 5.00-9.99%, ** LOI = 10.0-14.9%

[c] Phosphate-P: figures highlighted in bold show likely signs of phosphate-P enrichment:
* = enriched, ** = strongly enriched

[d] Magnetic susceptibility: figures highlighted in bold show possible signs of magnetic susceptibility enhancement, as reflected in χ_{conv} values:
* = possible weak enhancement (none of the samples show clear signs of enhancement)

[e] Phosphate fractionation: n.d. = not determined (see text)

[f] Phosphate-P determination: analysis undertaken on ignited samples from the LOI determination (see text).

Table 30.2: Summary of analytical data for the 33 bulk samples

	n	Mean	Minimum	Maximum	Standard deviation
LOI (%)	33	3.39	0.921	13.8	3.01
Phosphate-P_i (mg g^{-1})	21	1.06	0.156	3.40	0.917
Phosphate-P_o (mg g^{-1})	21	0.290	0.091	0.526	0.139
Phosphate-P (mg g^{-1})	33	1.04	0.186	3.77	0.915
Phosphate-P_i:P (%)	21	73.0	48.6	90.1	13.3
Phosphate-P_o:P (%)	21	27.0	9.9	51.4	13.3
χ (10^{-8} SI)	33	9.08	3.5	26.0	5.15
χ_{max} (10^{-8} SI)	33	1690	313	5080	1034
χ_{conv} (%)	33	0.740	0.140	3.10	0.656

Table 30.3: Pearson product-moment correlation coefficients (r) for relationships between the various soil properties for all samples† (n = 33)

	P_i§	P_o	P§	P_i:P	χ§¶	χ_{max}§¶	χ_{conv}§¶
LOI§	0.609	0.812*	n.s.	n.s.	n.s.	-0.524	0.459
P_i§		0.531	0.979*	0.690	0.463	-0.459	0.697*
P_o			0.678*	n.s.	0.590	n.s.	0.476
P§				0.528	0.545	n.s.	0.486
P_i:P					n.s.	-0.499	n.s.
χ§						n.s.	0.526
χ_{max}§							-0.747*

† Statistical significance: n.s. = not significant (ie $p \geq 0.05$), * = significant at $p<0.001$.

§ Indicates $\log_{10}$ transformation applied to the data set.

¶ For the untransformed data (which are conventionally used in assessing the relative strength of the relationship between χ and χ_{max} and χ_{conv}) the *r* values are: χ and χ_{max} = n.s.; χ and χ_{conv} = 0.585 ($p<0.001$).

Table 30.4: Soil Micromorphology and bulk sub-samples

Sample Number	SG Number	Contexts	Thin Section	Relative Depth cm (from top of monolith)	Bulk analyses	Microfacies type	Voids	Gravel	Structure	Rooting/root traces	Intercalations	Intercalations	Broad textural infills	Microlaminated textural features	Soil inclusions	Secondary CaCO3	Charcoal	Burned flint	Pottery	Coprolite?	Dung/stabling refuse	Phytoliths	Plant fragments	Org. Matter	Bone	Pyrite'	Burrowing	Org-min excrements
120	113048	107006	**M120**	60-95 mm	x120A	8b	25%	*	Massive		aaaaa	aaaaa			aaaaa		aa					a	a*	a			aaaa	
120	113048	107007		95-145 mm	x120B	8b	40%	*	Massive/chambered		aaaaa	aaaaa			aaaaa		aa					a	a*	a			aaaaa	
121	113048	107008	**M121**	230-310 mm	x121	8a	25%	ff	Massive/burrowed		aaaa	aaaa			aaa		a*	a*?			a*?	a	a*	a			aaaa	
415	109166	140028	**M415**	10-40(60) mm	x415A	7c	25%		massive/burrowed		aaaaa	aaaaa		aaaaa	aaaaa		aaa					aa		aa			aaaaa	aa
415	109166	140029		40-45(70) mm	x415B	7b	30%		Massive/lamina		aaaaa	aaaaa		aaaaa	aaa		aaa					aa		aa				
479	109089	134078	**M479**	40-120 mm	x479	7a	30%	f	massive/prismatic		aaaaa	aaaaa		aa	aaaaa		a			a-1	a*	a*	a*	a	a-1		aaa	
443	129162	114053	**M443A**	40-110 mm	x443A1	5b	35%		Prismatic		aaaaa	aaaaa			aaa		aa				a?	a*	a*	a	a-1		aaa	
443	129162	114052	**M443A**	40-110 mm	x443A2	5b	35%		Prismatic		aaaaa	aaaaa			aaa		aa				a?	a*	a*	a	a-1		aaa	
360	143007	152003	**M360A**	160-240 mm	x360A1	7c	35%		Prismatic		aaaaa	aaaaa			aaa		a				a*	a*	a*	a			a	
360	143007	152006	**M360A**	160-240 mm	x360A2	7b	35%		Prismatic		aaaaa	aaaaa			aaa		a				a*	a*	a*	a			a	
360	143007	152007	**M360B**	360-440 mm	x360B	8b and 7c	40%		Prismatic		aaaaa	aaaaa			aa		a				a*	a*	a*	a			aaa	
2012	302043	302006	**M2012A**	110-145 mm	x2012A1	6b	25%	fff	Massive		aaa	aaa					aa	a*			a*?	a*	a*	a*			aaaa	aaaa
2012	302043	311002	**M2012A**	145-190 mm	x2012A2	6a	20%	fff	Massive		aaa	aaa			a		aa	a*	a*		a?	a*	a	a				
2012	302043	311002	**M2012B**	220-300 mm		6a	20%	ff	Massive		aaa	aaa					aa	a*	a	a-1	a?	a*	aa	aa	a-1			
2012	302043	302008	**M2012B**	220-300 mm	x2012B1	6a	20%	ff	Massive		aaa	aaa					aa	a*	a	a-1	a?	a*	aa	aa	a-1			
2012	302043	3002003	**M2012B**	220-300 mm	x2012B2																							
2268	309075	309078	**M2268**	240-320 mm	x2268A	5a	35%	*	Prismatic		aaaaa	aaaaa			aaa		aa	a				a		aa	a-2			
2268	309075	309079	**M2268**	240-320 mm	x2268B																							

Sample Number	SG Number	Contexts	Thin Section		Relative Depth cm	Bulk analyses	Microfacies type	Voids	Gravel		Structure	Rooting/root traces	Intercalations	Intercalations	Broad textural infills	Microlaminated textural features	Soil inclusions	Secondary CaCO3	Charcoal	Burned flint	Pottery	Coprolite?	Dung/stabling refuse	Phytoliths	Plant fragments	Org. Matter	Bone	Pyrite'	Burrowing		Org-min excrements	
2268	309075		309080				x2268C																									
2608	324078		320115?	**M2608**	0-80 mm		x2608	4b	30%	*	Massive/lamina		aa						a		aa	a*				a	aaaa	aaaaa		a*	aaa	aaa
2719	324078		320144	**M2719A**	30-110 mm		x2719A	3b	25%	ff	Massive		a						a		a	a-1				a*	a*	a*			aaaaa	
2719	324078		320142	**M2719B**	180-250 mm		x2719B	4c	30-40%	ff	Lamina		a						a		aa	a-1					aaaaa	aaaaa			aaaa	
2719	324078		320140	**M2719C**	370-400 mm		x2719C1	4b	30%		Massive/blocky		aaa			a*					aaa					a*	aaaaa	aaaaa		a*	aaaa	
2719	324078		320139		400-420 mm		x2719C2	4a	15-20%	*	Lamina		aa								a						aaaa	aaaa		a*	a	
2719	324078		320139		420-440 mm		x2719C2	3a	25-30%	ffff	Massive		a*							a*	a*						a*	a*	a-2	a*		
2668	324058		324021	**M2668**	170-200 mm		x2668A	9	25%	*	Planar/prismatic										a					a*		a*			aa	
2668	324058		324022	**M2668**	200-240 mm		x2668B	9	25%	ff	Planar/prismatic		a*								a					a*		a*			aa	
2106	305011		305019	**M2106A**	30-110 mm		x2106A	12	30%	f	Massive/burrowed		a*						aaaaa		aaaa					a		a			aaaaa	aaa
2106	305011		305015	**M2106B**	240-320 mm		x2106B1	11	45%	f	Prismatic		a*	aa	aa				a		aa				?	a*		a			aaaaa	
2106	305011		305021	**M2106B**	240-320 mm		x2106B2																									
2538	327003			**M2538A**	120-140 mm		x2538A	2	10-15%		Massive/Lamina		a							a*	aa											
2538	327003			**M2538A**	140-190 mm		x2538A	1	25%	ff	Massive/channel		aaa			a	aaaa			a*											aa	
2538	327003			**M2538B**	310-390 mm		x2538B	1	20%	fff	Massive		aa			aa	a			a*												
2252	336090		327002	**M2252A**	0-80 mm		x2252A	10	20-30%	ff	Massive/channel			aaa	aaa				aaa		a*					a*		a			aaaa	
2252	336090		327002	**M2252B**	150-225 mm		x2252B	10	25%	fff	Massive/prismatic			aaaa	aaaa		aa		a		a							a*			aa	
2252	336090		327002	**M2252C**	225-300 mm		x2252C	10	15-25%	ffff	Massive/prismatic			aaaa	aaaa		aaa		a									a*			aaa	aa

Sample Number	SG Number	Contexts	Thin Section	Relative Depth cm	Bulk analyses	Microfacies type	Voids	Gravel	Structure	Rooting/root traces	Intercalations	Intercalations	Broad textural infills	Microlaminated textural features	Soil inclusions	Secondary CaCO3	Charcoal	Burned flint	Pottery	Coprolite?	Dung/stabling refuse	Phytoliths	Plant fragments	Org. Matter	Bone	Pyrite'	Burrowing	Org-min excrements
2537/ 2539	327003	327006-327004	**M2537/ 2539**	120-200 mm		4a	15-29%	*	Massive/bedded		aaa	aaa		a											a*			aa
2535	327003	327006	**M2535A**	190-205 mm		13	10%		Massive/bedded		aa	aa			a*										a*			
2535	327003	327004	**M2535A**	205-280 mm		6c	15%		Massive/cracked		aaaaa	aaaaa			aa		a*	a*			a*	a	a		(a)			a
2535	327003	327004	**M2535B**	380-460 mm		6c	20%	fff	Massive/cracked	a*	aaaaa	aaaaa			aa		a	a*			aa	a	aa		(aaa)			
			25 TS		33 bulk																							

* - 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%

Table 30.5: Microprobe analysis (%) of samples M415 (line analysis) and M2252C (grid analysis)

M415

	Al	Ca	Fe	Mg	P	Mn	Pb	K	Cu	Si	Zn	S	Na
Mean	4.413	3.149	3.076	0.300	0.352	0.016	0.035	1.578	0.006	19.966	0.010	0.017	0.105
Standard Deviation	3.367	5.946	3.474	0.243	0.665	0.026	0.039	2.073	0.007	10.048	0.012	0.015	0.297
Range	12.143	45.028	17.259	0.929	3.410	0.174	0.171	12.530	0.024	40.600	0.076	0.069	2.065
Minimum	0.000	0.022	0.021	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000
Maximum	12.143	45.050	17.280	0.929	3.410	0.174	0.171	12.533	0.024	40.600	0.076	0.069	2.065
Sum	410.423	292.830	286.092	27.912	32.690	1.463	3.276	146.742	0.571	1856.833	0.961	1.610	9.789
Count	93	93	93	93	93	93	93	93	93	93	93	93	93

M2252C

Mean	4.752	0.474	4.193	0.303	0.029	0.038	0.039	1.437	0.006	20.141	0.009	0.014	0.133
Standard Deviation	3.713	0.375	4.229	0.296	0.030	0.212	0.041	2.333	0.007	10.363	0.010	0.013	0.518
Range	11.628	1.199	23.275	1.531	0.125	1.969	0.150	11.759	0.032	37.721	0.042	0.057	3.732
Minimum	0.000	0.004	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Maximum	11.628	1.203	23.288	1.531	0.125	1.969	0.150	11.759	0.032	37.721	0.042	0.057	3.732
Sum	408.692	40.779	360.570	26.060	2.472	3.293	3.364	123.583	0.501	1732.144	0.774	1.184	11.402
Count	86	86	86	86	86	86	86	86	86	86	86	86	86

(Raw data supplied by Kevin Reeves, Institute of Archaeology, UCL)

Table 30.6: Soil Micromorphology and bulk sub-samples: Soil Micromorphology (Microfacies Types -soil microfabric types and associated micromorphological data)

Material	Sample Number	Sampling depth, soil micromorphology (SM), bulk data (BD) and microprobe (probe)	Phase, Interpretation and Comments
Microfacies type 2 (SMT 2a)	**M2538A**	120-190 mm SM: layered with finer bedded sediments between 120-140 mm. 120-140 mm: homogeneous; *Structure*: massive/lamina microstructure; 10-15% voids, fine channels and vughs; *Coarse Mineral*: C:F 25:75, moderately well sorted with coarse silt and fine sand-size quartz, chalk, and shell, with very few mica and rock fragments; very few medium to very coarse sand; 2 examples of horizontal oriented 3 mm long shell; *Organic/Anthropogenic*: rare to occasional fine charcoal (max. 2.5 mm); *Fine fabric*: SMT 2a – mainly finely speckled, cloudy greyish brown (PPL), moderate interference colours (close porphyric, speckled, unistrial and crystallitic b-fabric, XPL), mainly grey (OIL); thin humic staining, rare amorphous fine organic matter and fine charred OM; traces of phytoliths; *Pedofeatures*: *Textural*: many intercalations developing into thin (50-100 μm) dusty clay void coatings; rare chalky very fine void infills; *Crystallitic*: rare traces of micritic void infills; *Amorphous*: occasional ferruginous impregnations, often picking out 250 μm thick laminae; *Fabric*: occasional burrow mixing. BD (2538A): 1.32% LOI, 0.562 mg g^{-1} phosphate-P, 6.9 x 10^{-8} SI χ, 0.343% χ_{conv}	**327003** 327010 Palaeochannel fill Fine clayey to fine sandy generally calcareous sediment, with included fine charcoal, and textural pedofeatures indicating 'muddy' and finely laminated deposition at times; later inwash of chalky alluvium (above) and moderate iron mottling.
Microfacies type 1 (SMT 1)		140-190 mm: very similar to M2538B (SMT 1), but fewer chalk gravel, and co-eval many fine (0.5 mm) to very fine (200 μm) rooting (channel formation) and burrowing (vughs); 25% voids; *Pedofeatures*: as below; *Textural*: abundant broad infills, intercalations and microlaminated dusty to impure void coatings.	327009 As below, but with marked co-eval biological activity and inwash.
Microfacies type 1 (SMT 1)	**M2538B**	310-390 mm SM: homogeneous; *Structure*: massive with traces of broad layering; 20% voids, very fine (<1 mm) channels and planar voids, with fine (<2 mm) chambers, very fine (200 μm) vughs; *Coarse Mineral*: Coarse:Fine (C:F limit at 10 μm) 60:40, very poorly sorted; dominant medium and coarse silt-size, fine to very coarse sand-size quartz (common chalk, very few shell, fossil, mica, and rock fragments – greensand, metamorphic, sedimentary and igneous material), with frequent gravel-size chalk (subangular to subrounded; max. 8 mm); *Organic/Anthropogenic*: occasional traces of rooting/root traces (now Fe replaced etc), some 250 μm and coarse; *Fine fabric*: SMT 1 - cloudy greyish, brownish and dark reddish (PPL), isotic to moderately high interference colours (close porphyric, undifferentiated to crystallitic b-fabric, XPL), pale yellow to dark orange (OIL); trace amounts of humic staining and amorphous fine organic material; *Pedofeatures*: *Textural*: abundant broad (500 μm) impure clay infills and associated intercalations and 150 μm thick microlaminated finely dusty void coatings; *Depletion*: probable rare depletion of calcium carbonate and iron; *Crystalline*: trace amounts of micritic and microsparitic void infills; *Amorphous*: very abundant ferruginous nodular impregnations and poorly pseudomorphic organic matter (eg, roots) replacement. BD (2538B): 1.68% LOI, 0.351 mg g^{-1} phosphate-P, 6.7 x 10^{-8} SI χ, 0.137% χ_{conv}	**327003** 327008 Palaeochannel fill A now massive, once poorly layered calcareous sediment of poorly sorted chalk gravel and coarse silt through to coarse sand, showing a broad mineralogy (till-derived); sediment was rooted and partially burrow-mixed and history of dusty to impure clay inwash (alluviation?) and minor secondary calcium carbonate formation, which was succeeded by major hydromorphic iron impregnation, and probably associated calcium carbonate and iron depletion (mottling).
Microfacies type 4a (SMT 3)	**M2537/ 2539**	120-200 mm SM: Homogeneous beds; *Structure*: massive with fine (2 mm), medium (5 mm) and coarse massive bedding; 15-20%, mainly fine closed vughs and partially collapsed chambers and channels; *Coarse Mineral*: well sorted very dominant beds of silt, silt with intercalated fine and medium sand, and fine sand beds; *Fine Fabric*: as SMT 3; *Pedofeatures*: *Textural*: very abundant dusty clay void infills and intercalations; *Depletion*: likely patchy iron depletion in lower half of the thin section; *Amorphous*: very abundant impregnative iron staining of upper thin section; many nodular iron and manganese impregnations in lower half; *Fabric*: occasional moderately thin (0.5 mm) to broad (2 mm) burrows – some associated with sand accumulations (earthworm aestivating burrows).	**327003** 327006 Palaeochannel? Mainly fine silty clay sedimentation, intercalated with sandy deposits. Deposits weakly burrowed and rooted between alluvial events.
Microfacies type 13 (SMT 12)	**M2535A**	190-205 mm SM: Homogeneous; *Structure*: massive with faint very fine bedding; 10% voids, fine channels; *Coarse Mineral*: well sorted very dominant silt-size quartz with 2 gravel size chalk; increase in very fine sand content upwards; *Fine Fabric*: SMT 12: cloudy grey (PPL), moderately high interference colours (close porphyric, crystallitic b-fabric, XPL), grey (OIL); rare traces of humic staining; *Pedofeatures*: rare dusty clay void coatings (80 μm); very abundant thin horizontal bedding/micropanning features.	**327003** 327006 Well sorted calcareous silt inwash with likely rooting between a succeeding inwash phase.

Microfacies type 6c (SMT 6)		205-280 mm SM: Similar to MFT 6c – below; with a poorly sorted flint and chalk gravel rich (frequent gravel) and Fe/P?-stained deposit (abundant intercalations and micropanning), which upwards contains very few gravel and has been affected by *Depletion* (Fe leaching); only very weak *Amorphous* Fe staining; examples of burned flint	327004 As below – animal trampling and deposition of animal slurry; burned flint present.
Microfacies type 6c (SMT 6)	**M2535B**	380-460 mm SM: Moderately heterogeneous; *Structure*: massive/cracked/layered; 20% voids, sloping medium (0.5 mm) planar voids (marking out approximately 20 mm thick 'layers') with fine closed vughs and vesicles; *Coarse Mineral*: as MFT 6a, very poorly sorted with frequent to common chalk gravel (in the 'layers') up to 18 mm in size (some heavily iron stained and rounded, with flint, chalk fossils and shell; ironstone; *Organic/Anthropogenic*: rare charcoal (max. 2 mm); rare to occasional sand size fragments of layered plant fragments (stabling crust waste?; fragments of finely layered organic material up to 0.5 mm); examples of burned mineral; trace of roots; many patches of iron replaced fine organic matter including pollen (eg, alder) and possible very high amounts of fungal material; *Fine Fabric*: As SMT 6; *Pedofeatures*: *Textural*: very abundant intercalations forming closed vughs and vesicles and 500 µm fills (collapsed burrows?) and 150 µm thick void coatings; major infilling along sloping fissures; *Amorphous*: very abundant iron staining in large areas and concentrated down vertical and along sloping fissures where it produces hypocoatings; colour: yellowish brown (PPL), yellowish orange (Fe/P?); iron replacement of fine organic matter – fungal material?; *Fabric*: occasional relict broad burrows.	**327003** 327004 Very poorly sorted, compact calcareous deposits that show horizontal fissuring/layering (and evidence of structural collapse – intercalations and closed vughs), and which contain fragments of possible stabling refuse (and fungal material) and are heavily stained yellowish brown (Fe and P?). Likely stock trampled deposit – near stabling area?.
Microfacies type 12 (SMT 11 and various daub inclusions)	**M2106A**	30-110 mm SM: Heterogeneous (SMT 11 and burned daub(s)); *Structure*: massive/burrowed; 30% voids; chambers and planar voids; *Coarse Mineral*: as MFT 8a, with a patch of few rounded chalk gravel (12 mm); rare traces of shell; *Organic/Anthropogenic*: common ash and charcoal-rich SMT 11; many coarse charcoal (8 mm); Daub 1: very abundant poorly burned/unburned poorly calcareous clay daub (dotted, slightly reddish yellowish brown [PPL], moderate interference colours [close porphyric, speckled and crystallitic b-fabric, XPL], yellowish brown with rare red specks [OIL]; occasional fine charred organic matter; slightly rubefied clay fragments and relict clay coatings; rare traces of burned chalk; example of root trace with examples of calcium oxalates; Daub 2: rare examples (4 mm size reddish iron stained chalky/calcareous matrix with quartz sand, chalk sand and chalk gravel temper – cob?); Daub 3: 2 examples 2 mm size dark reddish brown [isotic, dark reddish brown – OIL) clay with silt size quartz and included charcoal]; rare traces of biogenic calcite; *Fine Fabric*: SMT 11: dotted grey to pale yellowish brown (PPL), moderately high interference colours (close porphyric, crystallitic b-fabric, XPL), pale yellow to grey with black specks (OIL); very abundant fine charred organic matter/charcoal, abundant probable ash and rare phytoliths; *Pedofeatures*: *Fabric*: very abundant broad (3- 4 mm) burrows; *Excrements*: many broad mammilated organo-mineral excrements. BD (2106A): 5.06% LOI, 1.57 mg g^{-1} phosphate-P, 17.8 x 10^{-8} SI χ, 1.89 % χ_{conv}	**Late Saxon pit 305011** 305019 Earthworm mixed anthropogenic deposit composed of fine charcoal rich anthropogenic soil (SMT 11) with likely included ash, and very abundant daub materials including charcoal rich poorly burned calcareous material alongside, strongly burned clay loam and examples of chalky cob-like material; burned chalk also present. Anthropogenic character is partially paralleled by the bulk chemistry, compared to lower deposits (see below)
Microfacies type 11 (SMT 6 and 7)	**M2106B**	240-320 mm SM: Moderately heterogeneous (SMT 6 with burrowed-in SMT 7); *Structure*: prismatic; 45% voids, dominant coarse planar voids and chambers (7 mm), with fine and medium vughs and channels; *Coarse Mineral*: as MFT 8a, with few chalk gravel (13 mm); *Organic/Anthropogenic*: trace amounts of root fragments; occasional to many 2 mm size charcoal; rare occurrences of 3-4 mm size heavily iron stained chalky fine material (SMT 6-like) of possible but unknown anthropogenic origin (cob? – see above); occasional fine soil fragments and traces of organic inclusions; rare to occasional biogenic calcite – including earthworm; *Fine Fabric*: dominant SMT 6 with frequent SMT 7; *Pedofeatures*: *Textural*: occasional intercalations and associated closed vughs 120 µm thick impure chalky void coatings; *Amorphous*: very abundant iron and occasional iron and manganese staining/impregnations; *Fabric*: very abundant broad burrows; BD (2106B1): 2.59% LOI, 1.25 mg g^{-1} phosphate-P, 8.3 x 10^{-8} SI χ, 0.572 % χ_{conv} As above, but rather less included charcoal, more extant textural pedofeatures and fewer burrows (abundant). BD (2106B2): 1.33% LOI, 0.420 mg g^{-1} phosphate-P, 5.4 x 10^{-8} SI χ, 0.340 % χ_{conv}	**Late Saxon pit 305011** 305015 Iron stained calcareous fill containing gravel and occasional to many charcoal, and evidence of burrowed-in more humic and fine charcoal-rich soil. 305021 As above, but with less inclusion of anthropogenic materials and soil.

Microfacies type 10 (SMT 2b and 7)	**M2252A**	0-80 mm SM: Heterogeneous (SMT 2b with burrowed-in SMT 7); *Structure*: massive/channel/burrowed, 20-30% voids; as below but with dominant fine to medium channels; *Coarse Mineral*: as below; *Organic/Anthropogenic*: rare traces of charcoal; *Fine Fabric*: with dominant SMT 2b and frequent to common SMT 7; *Pedofeatures*: *Textural*: abundant intercalations and associated dusty void coatings on closed vughs/collapsed channels, especially associated with SMT 7; rare thin dusty void coatings; *Depletion*: probable very abundant depletion (iron depleted); *Amorphous*: occasional strong iron staining of fabric; *Fabric:* abundant broad burrows. BD (2252A): 2.01% LOI, 0.475 mg g^{-1} phosphate-P, 6.6 x 10^{-8} SI χ, 0.420% χ_{conv}	**Early Medieval ditch 336090** Moderately poorly sorted ditch fill, showing phases of iron staining followed by iron depletion (gleying) all predating burrow mixing-in of finer, possibly once more humic soil – later use of ditch?.
Microfacies type 10 (SMT 2b)	**M2252B**	150-225 mm SM: Homogeneous; *Structure*: massive/prismatic, with burrowing; 25% voids, coarse (3-8 mm) planar voids and fine closed vughs; *Coarse Mineral*: as MFT 3a, poorly sorted with dominant coarse gravel-size flint; *Organic/Anthropogenic*: rare charcoal (1-2 mm) – iron stained; traces of very fine rooting; *Fine Fabric*: as SMT 2b; *Pedofeatures*: *Textural*: abundant intercalations and associated dusty void coatings on closed vughs/collapsed channels; many microlaminated clay pans (in very broad burrow) – 50 µm size laminae forming 500 µm complex fills (now heavily iron impregnated); *Depletion*: probable many patchy depletion (iron depleted) with iron-stained flints showing 500 µm thick leached margins; *Amorphous*: very abundant moderate to strong iron staining of fabric and some textural pedofeatures; *Fabric:* occasional broad burrows. BD (2252B): 1.93% LOI, 0.321 mg g^{-1} phosphate-P, 7.7 x 10^{-8} SI χ, 0.355% χ_{conv}	**Early Medieval ditch 336090** Poorly sorted gravel-rich ditch fill, containing coarse mineral of substrate, and showing examples of probable earthworm burrowing and continuing fine filling (alluviation?, fine settling) and slaked mixed fill (trampling/cleaning?); all followed by iron impregnation/depletion.
Microfacies type 10 (SMT 2b)	**M2252C**	225-300 mm SM: Heterogeneous; *Structure*: massive/prismatic, 15-25% voids, medium (2-3 mm) planar voids and closed vughs; *Coarse Mineral*: as MFT 3a, poorly sorted with dominant coarse gravel-size flint (25 mm); *Fine Fabric*: as SMT 2b; *Pedofeatures*: *Textural*: very abundant intercalations and associated dusty void coatings on closed vughs/collapsed channels; many microlaminated clay pans (in very broad burrow) – 50 µm size laminae forming 500 µm complex fills (now heavily iron impregnated); *Depletion*: probable many patchy depletion (iron and other cation-depleted – see microprobe); *Amorphous*: very abundant moderate to strong iron staining of fabric and some textural pedofeatures; *Fabric and Excrements*: many broad burrows and occasional broad mammilated organo-mineral excrements. BD (2252C): 2.06% LOI, 0.194 mg g^{-1} phosphate-P, 9.2 x 10^{-8} SI χ, 0.181% χ_{conv} Probe: 4.75% Al, 0.47% Ca, 4.19% Fe, 0.30% Mg, 0.03% P, 0.04% Mn, 0.04% Pb, 1.44% K, 0.01% Cu, 20.14% Si, 0.01% Zn, 0.01% S, 0.13% Na. Elemental map: Flint (Si), and clay (Al-Si) dominated soil; iron (Fe)-stained clayey areas (Al), with around major void - depleted (leached) of cation and P, and Fe.	**Early Medieval ditch 336090** Poorly sorted gravel-rich lower ditch fill, containing coarse mineral of substrate, and showing initial probable earthworm working of the fine fill, major clay inwash (alluviation?, fine settling) and slaked mixed fill (trampling/cleaning?); all followed by iron impregnation and iron-depletion/cation-depletion.
Microfacies type 7c (SMT 7 and Soil Inclusion Type 1) Microfacies type 7b (SMT 7 and pans)	**M360A**	160-200 mm SM: Moderately heterogeneous; *Structure*: prismatic; fragmented sample – 35% voids; as MFT 7c, with SMT 7; less co-eval burrowing, but very abundant intercalations and uni-strial b-fabric formation; occasional soil inclusions of Types 1, 2 and 3). BD (360A1): 3.40% LOI, 1.44 mg g^{-1} phosphate-P, 6.2 x 10^{-8} SI χ, 1.56 % χ_{conv} 200-240 mm SM: As above, with very few ironstone and iron stained flint (max. 9 mm); as MFT 7b, with mainly non-calcareous SMT 7, but abundant pans of clay containing fine to coarse sand size 'chalky clay'. BD (360A2): 3.48% LOI, 2.44 mg g^{-1} phosphate-P, 12.8 x 10^{-8} SI χ, 0.677% χ_{conv} BD (360B): 3.34% LOI, 2.13 mg g^{-1} phosphate-P, 8.6 x 10^{-8} SI χ, 0.597% χ_{conv}	**Late Romano-British Enclosure Ditch 143007** 152003 Moderately heterogeneous moderately poorly sorted fine soil containing soil clasts and very abundant slaking features, with evidence of shrink and swell features and gley mottling; only trace amounts of anthropogenic inclusions – once-humic, clay soil and burned humic topsoil clasts. 152006 As above, with clay inwash pans containing 'chalky clay' clasts; trampling. 152007 Phosphate enhancement.
7c (SMT 7 and Soil Inclusions Type 1 and 2)	**M360B**	360-380 mm SM: As MFT 7c – very abundant intercalations and pans; coarse burned topsoil fragment. 380-440 mm SM: As MFT 8b; 40% voids (planar voids and closed vughs); burrowing,	**Late Romano-British Enclosure Ditch 143007** 152007 Moderately well sorted fine soil with much slaking and infilling, probable due to

Microfacies type 8b (SMT 5a)		iron depletion and iron impregnation.	trampling of mud. Massive, heterogeneous, probable part earthworm burrowed non-calcareous fill, that has been slaked and trampled?, with inclusions of once-humic soil clasts and clayey material (from local stock activity); small amounts of included fine charcoal.
Microfacies type 9 (SMT 10)	**M2668**	170-200 mm SM: Homogeneous; *Structure*: massive/channel; 25% voids, fine to medium channels; *Coarse Mineral*: moderately well-sorted dominant coarse silt and fine sand with frequent medium sand, and very few flint gravel; *Organic/Anthropogenic*: rare charcoal; rare root traces; *Fine Fabric*: SMT 10 – dusty and speckled brown to dark brown (PPL), very low interference colours (close porphyric, speckled b-fabric, XPL), generally very pale yellow (OIL); rare amorphous and charred fine organic matter and traces of phytoliths; *Pedofeatures*: *Textural*: rare very thin (50 µm) dusty clay void coatings; *Depletion*: probable occasional iron depletion; *Amorphous*: abundant weak iron impregnation of matrix; *Fabric*: occasional thin burrowing. BD (2668A): 1.96% LOI, 0.224 mg g^{-1} phosphate-P, 6.9 x 10^{-8} SI χ, 0.305% χ_{conv} 200-240 mm SM: Homogeneous: *Structure*: massive/channel; 25% voids, fine to medium channels; *Coarse Mineral*: moderately poorly-sorted dominant coarse silt and fine sand with frequent medium sand, and frequent flint gravel (15 mm) and an example of ironstone; *Organic/Anthropogenic*: rare charcoal; rare root traces; *Fine Fabric*: SMT 9 – dusty and speckled brown to dark brown (PPL), very low interference colours (close porphyric, speckled b-fabric, XPL), generally very pale yellow (OIL); rare amorphous and charred fine organic matter and traces of phytoliths; *Pedofeatures*: *Textural*: rare very thin (50 µm) dusty clay void coatings; *Depletion*: probable very abundant iron depletion; *Fabric*: occasional thin burrowing. BD (2668B): 2.10% LOI, 0.186 mg g^{-1} phosphate-P, 9.7 x 10^{-8} SI χ, 3.10% χ_{conv}	**Unphased Trackway ditch 324058** 324021 Homogeneous, moderately well sorted coarse silt and sand infilling – silting; affected by fine rooting, weak iron staining, and later phases of silting produced some thin dusty clay coatings. 324022 As above, but with some gravel fill, and total iron depletion – gleyed zone.
Microfacies type 8b (SMT 5a)	**M120**	60-95 mm SM: Moderately heterogeneous; *Structure*: massive; 25% voids, mainly fine to medium closed vughs; *Coarse Mineral*: as MFT 5a, with very few chalk gravel (3 mm), but frequent fragments of Soil inclusion Types 1 and occasional Soil Type 3; *Organic/Anthropogenic*: example of biogenic calcite granule (Arionid?); occasional charcoal; occasional Fe and Mn replaced humic soil fragments/amorphous organic matter: *Fine Fabric*: as MFT 7a; *Pedofeatures*: *Textural*: very abundant intercalations forming dusty void coatings to closed vughs (50-150 µm); *Depletion*: many probable depletion of iron from matrix areas; *Amorphous*: abundant iron staining and matrix impregnation and occasional to many iron and manganese staining of probably once-humic soil/organic inclusions *Fabric*: very abundant burrowing – mixing in different soil clasts – broad (2-4 mm). BD (120A): 4.11% LOI, 1.56 mg g^{-1} phosphate-P, 11.6 x 10^{-8} SI χ, 0.624% χ_{conv} 95-145 mm SM: Moderately heterogeneous; *Structure*: massive and chambered; 40% voids, dominant coarse (5 mm) chambers, with fine to medium closed vughs; *Coarse Mineral*: as MFT 5a, with very few chalk gravel (3 mm), but frequent fragments of Soil inclusion Types 1 and occasional Soil Type 3; *Organic/Anthropogenic*: occasional charcoal; example of burned shell; occasional Fe and Mn replaced humic soil fragments/amorphous organic matter; *Pedofeatures*: *Textural*: very abundant intercalations forming dusty void coatings to closed vughs (50-150 µm); *Depletion*: many probable depletion of iron from matrix areas; *Amorphous*: abundant iron staining and matrix impregnation and occasional to many iron and manganese staining of probably once-humic soil/organic inclusions *Fabric*: very abundant burrowing – mixing in different soil clasts – broad (2-4 mm) BD (120B): 3.46% LOI, 1.42 mg g^{-1} phosphate-P, 9.1 x 10^{-8} SI χ, 0.717% χ_{conv}	**Late Iron Age enclosure ditch 113048** 107006 Massive, heterogeneous, probable part earthworm burrowed non-calcareous fill, that has been slaked and trampled?, with inclusions of once-humic soil clasts and clayey material (from local stock activity); small amounts of included fine charcoal. 107007 As above, but presently more open structured.
Microfacies type 8a (SMT 8 and Soil Type 3)	**M121**	230-310 mm SM: Heterogeneous: *Structure*: massive and burrowed; 25% voids, fine channels and vughs and very fine vughs; *Coarse Mineral*: very poorly sorted with MFT 1 and 2 components (clay to coarse silt-fine sand), with few fragments of soil Type 3 (Fe-Mn stained once-humic soil clasts); frequent chalk gravel (up to 7 mm, with one example of a 1 mm iron-depleted edge)	**Late Iron Age enclosure ditch 113048** 107008 Heterogeneous, mainly calcareous, chalk-rich and land snail-rich much burrowed deposits, containing evidence of occasional slaking and mixing; only small amounts of

		and very few flint; *Organic/Anthropogenic*: example of 7 mm long bone; rare traces of fungal bodies, charcoal and flint flakes/burned flint?; many land snails (max. 5 mm); possible examples of rare amorphous organic matter/dung residues? – Fe-Mn replaced; *Fine Fabric*: mainly SMT 6 (but heterogeneous with SMT 8 and soil inclusions); *Pedofeatures*: *Textural*: many intercalations and rare dusty clay void coatings; *Depletion*: many probable depletion of iron from matrix areas and from once-iron stained chalk; *Amorphous*: abundant iron staining and matrix impregnation and occasional to many iron and manganese staining of probably once-humic soil/organic inclusions; *Fabric*: very abundant burrows – broad to very broad (2-7 mm). BD (121): 2.47% LOI, 0.760 mg g^{-1} phosphate-P, 6.1 x 10^{-8} SI χ, 0.335% χ_{conv}	anthropogenic indicators, eg, of bone and mixed-in once-humic soil.
Microfacies type 7c (SMT 8 with soil inclusions Types 1 and 3))	**M415**	10-40(60) mm SM: heterogeneous (including burrowed-in dark humic/phosphate-stained moderately charcoal rich soil); *Structure*: massive/burrowed; 25% voids, fine and medium (200-400 µm) vughs and closed vughs formed in previous chambers (burrows); *Coarse Mineral*: as MFT 5a, moderately poorly sorted with silt to coarse sand (no gravel); *Organic/Anthropogenic*: rare traces of coarse charcoal, but occasional to abundant very fine charcoal; examples of earthworm granules – possibly leached; very abundant soil inclusions – as MFT 7a; Fine Fabric: as SMT 8; *Pedofeatures*: *Textural*: as MFT 7a, but with 2 mm thick laminated very dusty clay/impure soil pans; rare thin (100 µm) dark – humic-phosphate-rich dusty clay void coatings; *Amorphous*: as MFT 7a; *Fabric*: very abundant broad (2-4 mm) relict burrows; *Excrements*: occasional preserved broad (1-2 mm) mammilated organo-mineral excrements. BD (415A): 3.18% LOI, 3.44 mg g^{-1} phosphate-P, 7.7 x 10^{-8} SI χ, 1.05% χ_{conv}	**Late Iron Age enclosure ditch 109166** 140028 Heterogeneous moderately poorly sorted fine soil containing soil clasts and very abundant slaking features (pans and intercalations), with evidence of co-eval earthworm and other burrowing, and possible inwash of phosphate-rich fine soil – sometimes with phytoliths (ditch slurry), over:
Microfacies type 7b (SMT 9)		40-45(70) mm SM: heterogeneous with many soil inclusions (eg, soil Type 1); as MFT 6a – moderately calcitic with rare fragments of biogenic calcite – some examples of likely fragmented earthworm granules?; totally dominated by textural pedofeatures – pans (see below); *Organic/Anthropogenic*: very abundant very fine charcoal; examples of coarse charcoal; *Fine Fabric*: SMT 9 (similar to SMT 6): finely speckled and dotted very dark cloudy grey (PPL), generally low birefringence (open porphyric, crystallitic b-fabric, XPL), pale grey with very many fine black and rare red dots (OIL); very abundant dark staining (??phosphate), many to abundant fine charred and amorphous organic matter; rare to occasional phytoliths; *Pedofeatures*: *Textural*: very abundant (dominated by) 2 mm thick and horizontally extensive pans/sedimentary laminae (full extent of deposit lost through previous sampling for pollen). BD (415B): 1.97% LOI, 2.09 mg g^{-1} phosphate-P, 6.8 x 10^{-8} SI χ, 0.430% χ_{conv} Probe (Line analysis down length of thin section): 4.41% Al, 3.15% Ca, 3.08% Fe, 0.30% Mg, 0.35% P, 0.02% Mn, 0.03% Pb, 1.58% K, 0.01% Cu, 20.0% Si, 0.01% Zn, 0.02% S, 0.10% Na. Elemental map: areas of 0.35% P, and 16.0% of P associated with Al and Si – textural pedofeatures mainly; or with Fe.	Pans and inwash features of moderately calcareous and charcoal-rich (and phytoliths) deposits – some possibly phosphate-rich enclosure sediments; probability of *in situ* animal trampling.
Microfacies type 7a (SMT 8 with soil inclusions Types 1 and 3)	**M479**	40-120 mm SM: moderately heterogeneous; *Structure*: massive with medium prisms; 30% voids, dominant poorly accommodated planar voids (max. 6 mm), with partially collapsed channels and chambers forming fine (0.5 mm) closed and partially closed vughs; *Coarse Mineral*: as MFT 5a, with few flint gravel (max. 15 mm); *Organic/Anthropogenic*: two flint gravel horizontally aligned – also associated with horizontal fissure across the thin section; very abundant soil inclusions (eg, Type 1 [SMT 5a], and Type 3 – similar to Type 1, with very abundant iron and manganese staining – some possibly relict of organic matter/biological fabric) 2-4 mm in size; also occasional 'papules' – fine to medium sand-size fragments of textural pedofeatures clay; rare fine charcoal; example of fine sand-size burned bone and coprolite; possible fine sand size iron replaced dung fragment; *Fine Fabric*: SMT 8 - speckled yellowish brown to darkish reddish brown (PPL), low interference colours (close porphyric, speckled b-fabric, XPL), yellow to pale and dark orange (OIL); thin relict humic staining, rare to occasional amorphous and charred fine organic matter; rare traces of phytoliths; *Pedofeatures*: *Textural*: very abundant intercalations and associated dusty clay/impure clay coatings and infills; several phases – early phase infilling collapsed burrows/channels, with dark dusty clay eg, 400 µm thick, with planar voids exhibiting later	**Early Romano-British droveway ditch 109189** 134078 Moderately heterogeneous non-calcareous fine loam with very abundant inclusions of slaked subsoil and probable humic/humic stained (now iron and manganese replaced) soil clasts, and fragments of textural pedofeatures, set in a matrix dominated by textural pedofeatures of different phases – some possibly humic stained; only rare obvious anthropogenic inclusions present; all affected by mottling. Trampling by stock have produced a soil with multiple phases of slaked mixing, and likely inputs of humic waste and humic soils and (traces of dung); mesofauna such as earthworms and/or dung beetles were present and their burrows have been partially infilled with slaked soil.

		phases of laminated silty clay 300 µm thick; *Depletion*: probable many areas of moderate iron depletion; *Amorphous*: very abundant iron, and iron and manganese moderately strongly formed impregnative nodules – some concentric; *Fabric*: many broad (4 mm) burrows often associated with textural pedofeatures. BD (479): 3.14% LOI, 0.803 mg g^{-1} phosphate-P, 10.9 x 10^{-8} SI χ, 0.548% χ_{conv}	
Microfacies type 5a and 6b (SMT 5 mainly)	**M443A**	40-110 mm SM: Very similar to MFT 5a (SMT 5), with very abundant inclusions of soil Type 1 (slaked loamy clay), rare Type 2 (burned humic soil, including strongly rubefied variants – as 3-4 mm rounded clasts; prismatic structure, 35% voids (planar voids); stone-free; occasional charcoal (max 1-2 mm); example of very fine sand-size bone in soil inclusion Type 1; *Pedofeatures*: *Textural*: very abundant intercalations and dusty clay void (closed vugh) coatings; upwards, very abundant partially calcitic (chalky – chalk clasts present) intercalations, and infills associated with '*Fabric'* burrowing/collapsed burrows; *Amorphous*: very abundant iron (and manganese) impregnative mottling – often associated with soil inclusions (Type 1). BD (443A1): 3.54% LOI, 1.51 mg g^{-1} phosphate-P, 13.8 x 10^{-8} SI χ, 0.697% χ_{conv} BD (443A2): 2.20% LOI, 0.516 mg g^{-1} phosphate-P, 12.2 x 10^{-8} SI χ, 0.626% χ_{conv}	**Early Romano-British ring gully 129162** Ring gully 114053 A heterogeneous and mottled fine loamy fill, with textural pedofeatures of mixing and structural collapse – trampling, with – upwards- slaked burrow-mixed moderately calcareous soil; inclusions of charcoal and fine organic matter; wet and occasionally trampled ditchfill?
Microfacies type 6b (SMT 6 and 7) Microfacies type 6a (SMT 6)	**M2012A**	110-190 mm 110-145 mm SM: Similar to MFT 6a, but with very coarse chalk stones (25 mm) and very strongly impregnative discontinuous 1-2 mm thick ironpan at the base; heterogeneous with SMT 6 very abundant burrow-mixed SMT 7 (fine dusty darkish yellow brown [PPL], moderately low interference colours [close porphyric, speckled b-fabric/unistrial b-fabric, XPL], pale yellowish brown [OIL]; occasional fine charcoal; abundant intercalations and closed vughs with impure dusty clay coatings); anthropogenic inclusions and pedofeatures as below, with abundant broad (2 mm) burrowing and mammilated organo-mineral excrements. BD (2012A1): 1.58% LOI, 0.615 mg g^{-1} phosphate-P, 4.0 x 10^{-8} SI χ, 0.288% χ_{conv} 145-190 mm SM: As M2012B, but with fewer anthropogenic inclusions (charcoal, pottery and plant fragments/stabling residues), and more coarse flint (25 mm) and chalk (>15 mm). BD (2012A2): 1.39% LOI, 0.461 mg g^{-1} phosphate-P, 5.6 x 10^{-8} SI χ, 0.389% χ_{conv}	**Middle Bronze Age Waterhole 302043** 302006 Once compact, calcareous trampled waterhole deposit, affected by later earthworm burrowing and mixing with non-calcareous silty soil (and ironpanning – hydraulic barrier/ and mottling) 311002 As below, compact calcareous deposit with included anthropogenic materials – likely trampled and 'stained' through animal trampling.
Microfacies type 6a (SMT 6)	**M2012B**	220-300 mm SM: Homogeneous; *Structure*: massive; 20% voids, fine (0.5 mm) poorly accommodated planar voids; *Coarse Mineral*: C:F 30:70, moderately poorly sorted with dominant fine silt to sand-size quartz, shell, calcite, mica, examples of glauconite and rock fragments, with frequent gravel size (max 15 mm) rounded chalk and shell fragment (7 mm); *Organic/Anthropogenic*: rare fine sand-size rounded pottery fragments – up to 4 mm; occasional fine charcoal (<0.5 mm), possible example of rounded sand-size coprolite??; examples of bone, burned shell and flint; occasional sand-size fragments of layered plant tissues and amorphous organic matter (stabling refuse?); relict 0.5 mm size fungal? body; *Fine Fabric*: SMT 6 (similar to SMT 1): speckled and cloudy and brownish cloudy grey (PPL), moderately high to moderately low interference colours (close porphyric, crystallitic b-fabric, XPL), greyish yellow to yellowish orange (OIL); very low to moderate humic (?) staining with occasional charred and amorphous organic matter; *Pedofeatures*: *Textural*: many intercalations with associated impure clay and calcitic void coatings (100-150 µm); *Amorphous*: very abundant weak to moderate impregnative mottling and staining. BD (2012B1): 1.57% LOI, 0.470 mg g^{-1} phosphate-P, 6.9 x 10^{-8} SI χ, 0.473% χ_{conv} BD (2012B2): 1.65% LOI, 0.459 mg g^{-1} phosphate-P, 7.0 x 10^{-8} SI χ, 0.449% χ_{conv}	**Middle Bronze Age Waterhole 302043** 311002 and 302008 Homogeneous, compact calcareous and chalky sediment containing fine charcoal, some mainly fine pot fragments, examples of bone and burned flint, and numerous inclusions of organic fragments – possibly some of which is dung/stabling refuse; sediment is iron mottled but some staining may come from animal slurries – trampling producing many textural features and a compact (once-muddy) deposit.
Microfacies type 5a (SMT 5)	**M2268**	240-320 mm SM: Heterogeneous (different soil materials); *Structure*: planar void/prismatic microstructure; 35% voids, dominant inter aggregate medium (2-4 mm) moderately well accommodated planar voids (cracks), and fine intra-aggregate planar voids, channels and vughs/closed vughs; *Coarse Mineral*: C:F 40:60, moderately well sorted dominant silt and fine sand-size	**Middle Bronze Age Waterhole 309075** 309078 A heterogeneous and mottled fine loamy fill, composed of fine charcoal-rich soil with many small soil inclusions of compact slaked soil (Type 1) and burned very

		quart (and mica), with few medium, coarse and gravel size (max. 6 mm) quartz, flint, ironstone and pisolite (and soil inclusions – see below); *Organic/Anthropogenic*: examples of stained/coprolitic bone (2 mm) and leached bone, occasional fine charcoal (0.5 mm) and rare burned flint; example of 200 µm wide fungal body; many soil inclusions – commonly 2-5 mm in size – C:F as main fabric, Type 1: dark reddish brown (PPL), low interference colours (close porphyric, speckled and grano-striate b-fabric, XPL), orange to reddish (OIL); many fine charcoal and amorphous organic matter traces; very abundant intercalations and dusty void/vughs coatings and infills; Type 2: black (PPL), isotic (XPL), black (OIL); very abundant blackened organic matter and fine fungal material; *Fine Fabric*: SMT 5: speckled and dotted dark yellowish brown (PPL), moderate interference colours (close porphyric, speckled b-fabric, XPL), pale yellowish brown (OIL); abundant fine charred and amorphous organic matter; rare phytoliths; *Pedofeatures*: *Textural*: very abundant intercalations and very dusty void coatings and infills (eg, 50-150 µm); *Depletion*: probable very abundant patchy weak iron depletion; *Amorphous*: very abundant fine to medium (1-4 mm) iron (and manganese) impregnative mottling. BD (2268A): 3.16% LOI, 1.10 mg g^{-1} phosphate-P, 13.8 x 10^{-8} SI χ, 0.288% χ_{conv} BD (2268B): 3.47% LOI, 1.76 mg g^{-1} phosphate-P, 22.9 x 10^{-8} SI χ, 1.65% χ_{conv} BD (2268C): 3.35% LOI, 3.77 mg g^{-1} phosphate-P, 26.0 x 10^{-8} SI χ, 2.30% χ_{conv}	humic soil (Type 2) etc.; with very abundant textural pedofeatures indicative of mixing and slaking; examples of fine bone, burned flint and a fungal body – along with general character – indicate occupation deposits that have been likely trampled under wet conditions – presumably by stock in the waterhole. 309079 309080
Microfacies type 4b (SMT 3 and 4)	**M2608**	0-80 mm SM: Generally homogeneous; *Structure*: massive with traces of fine laminae (interdigitating plant fragments and silt for example); 30% voids, fine to medium (1-4 mm) root channels; *Coarse Mineral*: as MFT 4b, but only very few gravel-size flint, and medium sand-size soil/sediment clasts (SMT 2a); *Organic/Anthropogenic*: example of 4 mm size woody root, rare to occasional fine 'fleshy' roots (250-500 µm); very abundant plant fragments (monocotyledonous eg, 3 mm long), often horizontally oriented, some showing humification and some associated with iron staining; occasional charred and charcoal fragments throughout – possible rare charred layers?; *Fine fabric*: as SMT 3 and 4; *Pedofeatures*: *Amorphous*: many generally weak patches of iron impregnation of organic matter; examples of ferruginised pyrite framboids; *Fabric*: moderate biological mixing, abundant broad (3-4 mm) burrowing in lower half of thin section; *Excrements*: many broad (3-4 mm) organo-mineral excrements in lower half. BD (2608): 11.6% LOI, 0.325 mg g^{-1} phosphate-P, 4.2 x 10^{-8} SI χ, 0.739% χ_{conv}	**Middle Bronze Age barrow 324078** 320115? Peaty and mineralogenic peaty deposit(s) with high amounts of monocotyledonous material – likely some growing *in situ* (fleshy roots), with occasional 'drying out' allowing faunal mixing, eg, by earthworms, and later woody? rooting and weak secondary iron mottling; fine charcoal inputs. (Presence of humified organic materials also possibly implies inputs of humified organics – dung?? – needs some independent evidence)
Microfacies type 3b (SMT 2b and 3)	**M2719A**	30-110 mm SM: Homogeneous; *Structure*: massive; 25% voids, very fine channels; *Coarse Mineral*: as MFT 3b with few flint gravel; *Organic/Anthropogenic*: example of burned flint and very few angular flints; occasional fine charcoal (max. 1.5 mm); *Fine fabric*: as SMT 2b and 3; with patches of humic or very poorly humic staining; rare fine charcoal and rare traces of phytoliths; *Pedofeatures*: *Amorphous*: very abundant mainly weak iron impregnation; *Fabric*: total homogenisation by biological mixing. BD (2719A): 1.62% LOI, 0.281 mg g^{-1} phosphate-P, 5.7 x 10^{-8} SI χ, 0.192% χ_{conv}	**Middle Bronze Age barrow recut 324080** 320144 mainly coarse silty mineralogenic sediment, with flint gravel – including a burned example; fine scatter of charcoal.
Microfacies type 4b (SMT 3 and 4)	**M2719B**	180-250 mm SM: moderately heterogeneous; *Structure*: relict broad laminated, 30-40%; medium channels (1-2 mm) and broad (3-4 mm) chambers; *Coarse Mineral*: as MFT 4b, with frequent coarse (max. 18 mm) and angular flint; *Organic/Anthropogenic*: occasional fine charcoal and possible charred very thin (200 µm) amorphous peat layers; example of burned flint and possible angular flint lithics; abundant plant fragments including possible wood and bark fragments; *Fine fabric*: as SMT 3 (lower slide) and 4 (upper slide); *Pedofeatures*: as below. BD (2719B): 11.3% LOI, 0.401 mg g^{-1} phosphate-P, 3.5 x 10^{-8} SI χ, 0.841% χ_{conv}	**Middle Bronze Age barrow 324078** 320142 Once well laminated peat and mineralogenic peats, showing minor mixing by burrowing fauna and rooting (local wood peat?); anomalous inclusion of coarse flint and angular flint and burned flint.
Microfacies type 4b (SMT 4 [SMT 2a, 2b and 3])	**M2719C**	370-400 mm SM: moderately homogeneous; *Structure*: massive with poorly developed fine subangular blocky; 30% voids, fine (<1mm) root channels, chambers and planar (1-3 mm) voids; *Coarse Mineral*: C:F, 30:70, very dominant well sorted coarse silt, with very few coarse (humic and silty) soil/sediment inclusions up to 5 mm in size; *Organic/Anthropogenic*: occasional coarse charcoal (2-3 mm), occasional to many in places, fine (500-1,000 µm) fleshy and woody roots; abundant plant organs and tissues; *Fine fabric*: very	**Middle Bronze Age barrow 324078** 320140 Highly organic but mineral intercalated peat, containing burrowed-in silty soil/sediment; contains much coarse charcoal; only a small amount of iron staining.

Microfacies type 4a (SMT 3) Microfacies type 3a (SMT 2b)		dominant SMT 4 with thin laminae and burrow fills of SMT 2b and 2b; SMT 4 – dark reddish brown (PPL), mainly isotic with some very low interference colours (close to open porphyric, mainly undifferentiated b-fabric, XPL), mainly dark reddish brown (OIL); very abundant amorphous and tissue fragments of organic matter; rare traces of phytoliths, probable diatoms and pollen; *Pedofeatures*: *Textural*: occasional humic clay inwash/pans/intercalations; *Amorphous*: rare patches of iron impregnation around partially ferruginised roots; *Fabric*: abundant very broad (4-10 mm) burrowing; *Excrements*: occasional very fine (c. 50 µm) mite? Excrements, especially in root traces. BD (2719C1): 13.8% LOI, 0.410 mg g^{-1} phosphate-P, 3.8 x 10^{-8} SI χ, 0.516% χ_{conv} 400-420 mm SM: As below, but C:F, 80:20, moderately well sorted dominant silt-size quartz; very few gravel; *Organic/Anthropogenic*: many to abundant – upwards – fine detrital thin plant fragments; rare charcoal; (monocotyledonous); occasional roots and root traces (200-1,000 µm); *Fine fabric*: SMT 3 – dusty, dotted brown to reddish brown (PPL), low to moderate interference colours (close porphyric, speckled and granostriate b-fabric, XPL), pale brown to brown (OIL); very abundant amorphous organic matter with many plant tissues and organs; *Pedofeatures*: *Fabric*: fabric mixing by roots? 420-400 mm SM: Generally homogeneous; *Structure*: massive; 25-30% voids; complex packing voids, channels, vughs, and chambers; *Coarse Mineral*: at base of thin section - C:F 85:15, very poorly sorted dominant gravel-size (max. 8 mm) flint, siltstone, chalk and ironstone, etc., with frequent coarse silt to coarse sand-size quartz mainly; *Organic/Anthropogenic*: rare browned plant remains and fragments of amorphous organic matter ('peat'); two 800 µm size bone (pale and leached); *Fine fabric*: SMT 2b – as SMT 2a, with very thin humic traces and trace amounts of charcoal; and with patches of crystallitic b-fabric; *Pedofeatures*: *Crystalline*: rare traces of micritic void coatings and infills; *Depletion*: probable iron and calcium carbonate depletion affecting bone and matrix and gravel; *Amorphous*: trace amounts of pyrite framboids now iron replaced. BD (2719C2): 0.921% LOI, 0.631 mg g^{-1} phosphate-P, 5.2 x 10^{-8} SI χ, 0.317% χ_{conv}	320139 Upward fining sequence from iron depleted poorly sorted gravel that contains two fine bone fragments, becoming a finely laminated silty mineralogenic peat rich in detrital monocotyledonous plant fragments.
Microfacies type 2 (SMT 2a) Microfacies type 1 (SMT 1)	**M2538A**	120-190 mm SM: layered with finer bedded sediments between 120-140 mm. 120-140 mm: homogeneous; *Structure*: massive/lamina microstructure; 10-15% voids, fine channels and vughs; *Coarse Mineral*: C:F 25:75, moderately well sorted with coarse silt and fine sand-size quartz, chalk, and shell, with very few mica and rock fragments; very few medium to very coarse sand; 2 examples of horizontal oriented 3 mm long shell; *Organic/Anthropogenic*: rare to occasional fine charcoal (max. 2.5 mm); *Fine fabric*: SMT 2a – mainly finely speckled, cloudy greyish brown (PPL), moderate interference colours (close porphyric, speckled, unistrial and crystallitic b-fabric, XPL), mainly grey (OIL); thin humic staining, rare amorphous fine organic matter and fine charred OM; traces of phytoliths; *Pedofeatures*: *Textural*: many intercalations developing into thin (50-100 µm) dusty clay void coatings; rare chalky very fine void infills; *Crystallitic*: rare traces of micritic void infills; *Amorphous*: occasional ferruginous impregnations, often picking out 250 µm thick laminae; *Fabric*: occasional burrow mixing. BD (2538A): 1.32% LOI, 0.562 mg g^{-1} phosphate-P, 6.9 x 10^{-8} SI χ, 0.343% χ_{conv} 140-190 mm: very similar to M2538B (SMT 1), but fewer chalk gravel, and co-eval many fine (0.5 mm) to very fine (200 µm) rooting (channel formation) and burrowing (vughs); 25% voids; *Pedofeatures*: as below; *Textural*: abundant broad infills, intercalations and microlaminated dusty to impure void coatings.	**Unphased Palaeochannel 327003** Fine clayey to fine sandy generally calcareous sediment, with included fine charcoal, and textural pedofeatures indicating 'muddy' and finely laminated deposition at times; later inwash of chalky alluvium (above) and moderate iron mottling. As below, but with marked co-eval biological activity and inwash.
Microfacies type 1 (SMT 1)	**M2538B**	310-390 mm SM: homogeneous; *Structure*: massive with traces of broad layering; 20% voids, very fine (<1 mm) channels and planar voids, with fine (<2 mm) chambers, very fine (200 µm) vughs; *Coarse Mineral*: Coarse:Fine (C:F limit at 10 µm) 60:40, very poorly sorted; dominant medium and coarse silt-size, fine to very coarse sand-size quartz (common chalk, very few shell,	**Unphased Palaeochannel 327003** A now massive, once poorly layered calcareous sediment of poorly sorted chalk gravel and coarse silt through to coarse sand, showing a broad mineralogy (till-derived); sediment was rooted and partially

		fossil, mica, and rock fragments – greensand, metamorphic, sedimentary and igneous material), with frequent gravel-size chalk (subangular to subrounded; max. 8 mm); *Organic/Anthropogenic*: occasional traces of rooting/root traces (now Fe replaced etc), some 250 μm and coarse; *Fine fabric*: SMT 1 - cloudy greyish, brownish and dark reddish (PPL), isotic to moderately high interference colours (close porphyric, undifferentiated to crystallitic b-fabric, XPL), pale yellow to dark orange (OIL); trace amounts of humic staining and amorphous fine organic material; *Pedofeatures*: *Textural*: abundant broad (500 μm) impure clay infills and associated intercalations and 150 μm thick microlaminated finely dusty void coatings; *Depletion*: probable rare depletion of calcium carbonate and iron; *Crystalline*: trace amounts of micritic and microsparitic void infills; *Amorphous*: very abundant ferruginous nodular impregnations and poorly pseudomorphic organic matter (eg, roots) replacement. BD (2538B): 1.68% LOI, 0.351 mg g^{-1} phosphate-P, 6.7 x 10^{-8} SI χ, 0.137% χ_{conv}	burrow-mixed and history of dusty to impure clay inwash (alluviation?) and minor secondary calcium carbonate formation, which was succeeded by major hydromorphic iron impregnation, and probably associated calcium carbonate and iron depletion (mottling).

NB * - 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%

MFT 1: Chalk gravel-rich poorly sorted alluvium that was rooted, affected by sediment inwash, secondary calcium carbonate formation and – lastly – strong iron impregnation. Apparently sterile.

MFT 2: Fine silty clay alluvium, with traces of laminae and including fine charcoal – reflecting low energy flow and human impact on the landscape.

MFT 3a: Generally non-calcareous gravel rich alluvium, with trace amounts of fine bone.

MFT 3b: Weakly humic and iron stained mineralogenic coarse silt with gravel-size flint including rare burned flint and fine charcoal.

MFT 4: Humic to highly humic peats and mineralogenic silty peats, containing occasional to many charcoal – and possible charred laminae, much rooting and showing the effects of mesofaunal activity; occasional iron mottling. Low energy organic and mineralogenic sedimentation in an environment experiencing human impact; with periodic low water tables encouraging faunal activity.

MFT 5: A heterogeneous and mottled fine loamy fill, composed of fine charcoal-rich soil with many small soil inclusions of compact slaked soil (Type 1) and burned very humic soil (Type 2) etc.; with very abundant textural pedofeatures indicative of mixing and slaking; examples of fine bone, burned flint and a fungal body – along with general character – indicate occupation deposits that have been likely trampled under wet conditions – presumably by stock in the waterhole.

MFT 6: (6a) Homogeneous, compact calcareous and chalky sediment containing fine charcoal, some mainly fine pot fragments, examples of bone and burned flint, and numerous inclusions of organic fragments – possibly some of which is dung/stabling refuse; sediment is iron mottled but some staining may come from animal slurries – trampling producing many textural features and a compact (once-muddy) deposit. (6b) includes burrowed-in non-calcareous but 'trampled' silty soil.

MFT 6c: Very poorly sorted, compact calcareous deposits that show horizontal fissuring/layering (and evidence of structural collapse – intercalations and closed vughs), and which contain fragments of possible stabling refuse (and fungal material) and are heavily stained yellowish brown (Fe and P?). Likely stock trampled deposit – near stabling area?.

MFT 7: Moderately heterogeneous non-calcareous fine loam with very abundant inclusions of slaked subsoil and probable humic/humic stained (now iron and manganese replaced) soil clasts, and fragments of textural pedofeatures, set in a matrix dominated by textural pedofeatures of different phases – some possibly humic stained; only rare obvious anthropogenic inclusions present; all affected by mottling.

Trampling by stock have produced a soil with multiple phases of slaked mixing, and likely inputs of humic waste and humic soils and (traces of dung); mesofauna such as earthworms and/or dung beetles were present and their burrows have been partially infilled with slaked soil.

MFT 8a: Heterogeneous, mainly calcareous, chalk-rich and land snail-rich much burrowed deposits, containing evidence of occasional slaking and mixing; only small amounts of anthropogenic indicators, eg, of bone and mixed-in once-humic soil.

MFT 8b: Massive, heterogeneous, probable part earthworm burrowed non-calcareous fill, that has been slaked and trampled?, with inclusions of once-humic soil clasts and clayey material (from local stock activity); small amounts of included fine charcoal.

MFT 9: Homogeneous, moderately well sorted coarse silt and sand infilling – silting; affected by fine rooting, weak iron staining, and later phases of silting produced some thin dusty clay coatings; or total iron depletion.

MFT 10: Poorly sorted gravel-rich lower ditch fill, containing coarse mineral of substrate, and showing initial probable earthworm working of the fine fill, major clay inwash (alluviation?, fine settling) and slaked mixed fill (trampling/cleaning?); all followed by iron impregnation and possible phosphate enrichment phase?

MFT 11: Iron stained calcareous fill containing gravel and occasional to many charcoal, and evidence of burrowed-in more humic and fine charcoal-rich soil.

MFT 12: Earthworm mixed anthropogenic deposit composed of fine charcoal rich anthropogenic soil (SMT 11) with likely included ash, and very abundant daub materials including charcoal rich poorly burned calcareous material alongside, strongly burned clay loam and examples of chalky cob-like material; burned chalk also present. Anthropogenic character is partially paralleled by the bulk chemistry, compared to lower pit deposits (see MFT 11)

MFT 13: Well sorted calcareous silt inwash with likely rooting between a succeeding inwash phase.

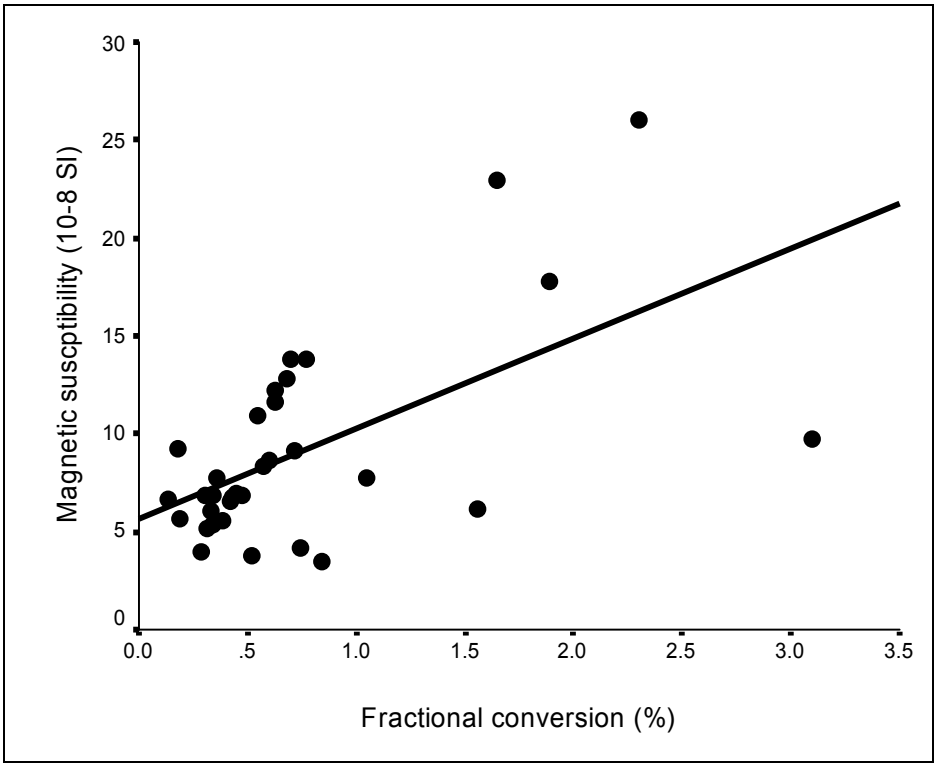
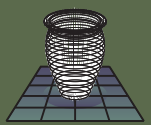


Figure 30.1: Plot of relationship between χ and χ_{conv} ($r = 0.585$; $p<0.001$)



Framework Archaeology

London BAA Stansted