WINCHESTER
A CITY IN THE MAKING

Archaeological excavations between 2002 – 2007
on the sites of Northgate House, Staple Gardens and the former Winchester Library, Jewry St

Section 17

Soil Micromorphology, Chemistry and Magnetic Susceptibility
by Richard Macphail and John Crowther
with pollen contribution from Gill Cruise

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Contents

Tables

Plates

10 Photomicrograph of M311A, Late Roman, Context 5059; note concentrated amorphous organic matter staining the soil and implying the presence of an animal pound
11 Photomicrograph of M226A (see Fig 4); detail of vitrified 'crucible' material with vesicles (v) and embedded burned daub (BD), associated with a very strongly enhanced magnetic susceptibility that together indicate use of a furnace/hearth and industrial activity
12 As Plate 11, under crossed polarized light (XPL); only traces of the original quartz sand are present; the quartz has melted to produce a vesicular glass – requiring temperatures of 1,000-1,200°C – implying use of bellows
13 Detail of Plate 11EDAX map of Si (quartz sand residues) invesicular glass
14 As Plate 13; EDAX map of Fe
15 Photomicrograph of M253E (4230); trampled charcoal and ash-rich domestic hearth rakeout
16 As Plate 15, under XPL; calcite ash crystals scattered throughout
17 Photomicrograph of M253B (4192); detail of bone fragment – kitchen waste
18 As Plate 17, under blue light (BL); note high autofluorescence of bone
19 Photomicrograph of M187B (2366); detail of cess embedding plant material and amorphous organic matter
20 As Plate 19, under BL; very high autofluorescence implies calcium phosphate (hydroxyapatite) chemistry for this cess, consistent with very strongly enriched amounts of phosphate P

Summary

A total of 34 contexts and sub-units was identified and described from 21 thin sections and 17 associated chemical and magnetic susceptibility analyses; pollen assessment data also contributed to the investigation.

Winchester Discovery Centre Context CC3409 is clearly a Middle Iron Age holloway accumulation which shows the effects of trampling, including the inclusion of dung residues. Context CC6001 records a probable pre-Roman arable soil, developed over the local natural Eb horizon of typical palaeoargillic brown earth soil (Carstens soil series). Contexts CC1356, CC1357 and CC1358 are Late Saxon (Phase 4.2) domestic floor deposits (eg CC1357), and dumps/spreads rich in ash and phosphate-rich materials such as bone and coprolites, and include much burned food/kitchen waste.

Northgate House Contexts NH4436/NH4393 are typical decalcifying weakly humic and biologically worked dark earth that originated from soil formation in 'urban' middens on waste(?) ground, and includes coarse resistant relict Roman material (coprolites, bone, burned daub and iron slag, for example). In contrast, the overlying Late Roman dark earth (NH4412) records both middening (including domestic ash waste) and inputs of probable dung residues. Context NH5059 seems to have been influenced by *in situ* animal pounding – such 'rural' signatures in NH4412 and NH5059 are recorded elsewhere in late Roman deposits and dark earth. The Phase 5 sequence recorded in Monolith NH226 reveals a sequence of floor and occupation deposits associated with industrial/craft activity, with very strongly burned hearth and furnace/crucible debris indicating temperatures of 1,000-1,200ºC being employed, and enrichment in lead and some enrichment in copper and zinc, also being recorded. In contrast, the Phase 4.2-5 sequence sampled in Monolith NH253 found multiple floors and associated domestic/kitchen hearths; these were probably regularly renewed/reconstructed because they became eroded when ashes were raked out.

Occasionally, the balance of floor deposit sources varied from dominantly domestic kitchen hearth rakeout, to mixed deposits containing industrial and stable waste. At both NH226 and NH253, material included from outside space was recorded. A poorly preserved sample from Monolith NH559 indicates mainly domestic (kitchen hearth?) use of space. Similarly, monolith NH187 records a pit containing intercalated cess and domestic floor sweepings.

Introduction

The site was investigated after a field evaluation and microstratigraphic assessment (Macphail *et al.* 2005). The sites are composed of: natural deposits and soils, Iron Age and Roman features, dark earth, late Saxon and medieval occupation and floor sequences. The 2005 field visit and assessment of thin sections, pollen slides and a series of chemical and magnetic susceptibility analyses guided this present post-excavation investigation of the soils and deposits at Northgate House and Winchester Discovery Centre.

Samples and Methods

Selected monoliths employed in the assessment of Northgate House and newly evaluated from Winchester Discovery Centre, were subsampled for bulk analyses (chemistry and magnetic susceptibility) and thin sections (Tables 1 and 4). In all, 17 bulk samples and 21 thin sections were analysed.

Chemistry and magnetic susceptibility

Each sample was analysed for: loss-on-ignition (LOI), which provides an estimate of the organic matter concentration, together with any charcoal present; phosphate, enrichment of which is associated with inputs of organic materials, most notably cess, animal manures, midden materials and especially bone (see reviews by Bethel and Máté 1989; Crowther 1997; Heron 2001); magnetic susceptibility, which is indicative of burning (Clark 1996; Scollar *et al.* 1990); and heavy metals (lead [Pb], zinc [Zn] and copper [Cu]), which may provide insight into metal working, etc.

Analysis was undertaken on the fine earth (i.e. < 2 mm) fraction 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 (P_i), using 1N HCl as the extractant (after a slight excess of HCl has been added to remove any carbonate present); and then on the residue following alkaline oxidation with sodium hypobromite (P_o), using 1N H_2SO_4 as the extractant. Phosphate-P (total phosphate) has been derived as the sum of phosphate-P_i and phosphate-P_o, and the percentages of inorganic and organic

phosphate calculated (ie phosphate-P_i:P and phosphate-P_o:P, respectively). LOI (loss-on-ignition) was determined by ignition at 375ºC for 16 hours (Ball, 1964) – previous experimental studies having shown that there is normally no significant breakdown of carbonate at this temperature; and Pb, Zn and Cu by atomic absorption spectrophotometry following extraction with 1N HCl.

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). 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 MS2 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).

Soil micromorphology

Monolith subsamples were impregnated with a clear polyester resin-acetone mixture; samples were then topped up with resin, ahead of curing and slabbing for 75x50 mm-size thin section manufacture by Spectrum Petrographics, Vancouver, Washington, USA (Goldberg and Macphail 2006; Murphy 1986). Some monoliths had been impregnated and conserved during the 2005 assessment, and thin section samples were selected on the basis of questions posed in the Updated Research Design. In the case of Monolith CC130 (which was in a rather poor condition, but still the best option for this part of the site), large parts of the monolith were impregnated with resin, to enable the best selection of intact stratigraphy for thin section analysis – this proved a successful tactic. Nine new thin sections were manufactured making 21 thin sections available for study (Plates 1-6). On receipt from the manufacturer, thin sections were cleaned and also given an extra polish employing 1000 grade grit paper;

each thin section was then digitally scanned to help identify layering, structure, biological activity etc (Arpin *et al*. 2002). These were analysed using a 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; BL is particularly useful in the identification of bone (apatite) which is autofluorescent, and altered bone (coprolitic bone, burned bone). In addition, neoformed calcium phosphate (eg, hydroxyapatite) in the form of cess or as secondary impregnations in ash and chalk, are also autofluorescent (Courty *et al*. 1989; Macphail and Goldberg in press). Thin sections were described, ascribed soil microfabric types (MFTs) and microfacies types (MFTs) (see Tables 4 and 5), and counted according to established methods (Bullock *et al*. 1985; Courty 2001; Courty *et al*. 1989; Goldberg and Macphail 2006; Macphail and Cruise 2001; Stoops 2003). In addition, previous investigations of similar archaeological sequences from both European and English Roman and early medieval settlements were consulted (Cammas 2004; Gebhardt and Langohr 1999; Macphail 2003b; Macphail *et al*. 2007b; Macphail *et al*. 2004; Milek 2006). The identification of strongly burned materials was based upon earlier observations and experiments (Berna *et al*. 2007; Courty *et al*. 1989); a vitrified mineral fragment was studied through X-ray analysis (SEM-EDAX; quantitative and element mapping studies) (Plate 4).

Results

Chemistry and magnetic susceptibility

The LOI, phosphate-P, heavy metals and magnetic susceptibility data are presented in Table 2, with key features relating to individual samples highlighted; and the phosphate fractionation data in Table 3. Here a broad overview of the individual soil properties is presented.

Loss-on-ignition

All of the samples are largely minerogenic, though it should be noted that the contexts are likely have been subject to significant post-depositional decomposition which will have reduced their organic matter content. LOI ranges from 1.75% in the underlying natural (context CC6000) to 12.2% in context NH4186. Samples with LOI values ≥ 5.00% are highlighted in Table 2. The majority of these contain appreciable amounts

of charcoal (which contribute to their higher LOI), with samples from contexts NH4186 (12.2% LOI) and NH4370/NH4394 (5.95%) being particularly charcoal-rich.

Phosphate (phosphate-P_i, P_o, P, P_i:P and P_o:P)

The phosphate-P concentrations are mostly quite high, particularly when compared with a concentration of 1.07 mg g^{-1} recorded in the natural (context CC6000), and undoubtedly reflect enrichment through anthropogenic activity. Contexts with phosphate-P concentrations of ≥ 5.00 mg g^{-1} have been identified as showing some degree of enrichment in Table 2. Of these, six (categorised here as 'very strongly enriched') have concentrations ≥10.0 mg g^{-1} (maximum, 13.5 mg g^{-1} in context NH3492), which very likely reflect the presence of at least some bone-derived phosphate. As would be anticipated, the very strongly enriched contexts include NH2361 and NH2366 (cessy fills of pits – Phase 4.2). More interestingly, the remaining four are contexts: NH3489 (Phase 5 dump) and NH3492 (Phase 5 floor: hearth/domestic spreads); and CC1356/57 (refuse accumulation?) and CC1357/58/60 (floor deposits?) associated with Phase 4.2 floors. As is commonly the case in archaeological contexts, the majority of the phosphate is an inorganic form (phosphate-P_i:P range, 82.0–90.6%; Table 3), which reflects the degree of post-depositional organic decomposition that has occurred – i.e. much of the original organic phosphate has been mineralised and is 'fixed', along with bone-derived mineral phosphate, in an inorganic form within the soil. Only the natural (context CC6000) contains a notably lower proportion of inorganic phosphate (75.5%).

Heavy metals: Pb, Zn and Cu

On the basis of the sample of natural (context CC6000), it would seem that background levels of Pb, Zn and Cu (38.6, 83.7 and 15.4 μg g^{-1}, respectively) are quite low. Although none of the remaining contexts have exceptionally high concentrations, the analytical data reveal some evidence of enrichment. Contexts with notably higher concentrations have been categorised in Table 2 as being 'slightly enriched' or 'enriched' in Pb, Zn and Cu. Those in the enriched category are from contexts NH2361 (cessy fill of Phase 5 pit), NH3489 (Phase 5 dump) and NH4186 (Phase 5 floor occupation/hearth rake out) show enrichment in Pb, and context NH3492 (Phase 5 floor: hearth/domestic spreads) enrichment in Cu. Interestingly, the latter context is the only one that shows signs of at least 'slight enrichment' in all three metals, though concentrations of these relatively low magnitudes are not

sufficient in themselves to provide unequivocal evidence of non-ferrous metal working (which is suggested as a possibility in the context details supplied).

Magnetic susceptibility (χ, χ_{max} and χ_{conv})

In UK archaeological contexts χ_{conv} values ≥ 5.00% are often taken to be indicative of magnetic susceptibility enhancement through burning, and values ≥ 20.0% are regarded as being very high. On this basis the magnetic susceptibility data have been categorised according to the degree of enhancement. Apart from contexts CC6000 (natural), CC6001 (subsoil below Roman Street CC1703) and CC3409 (soil from hollow way CC7000) all of the contexts display clear evidence of susceptibility enhancement as a result of burning, with the majority having χ_{conv} values ≥ 20.0%. Two contexts have exceptionally high χ_{conv} values: NH3489 (Phase 5 dump, 65.4%) and NH4207 (Phase 4.2 ashy layer over floor, 53.7%).

It should be noted that the χ_{max} values are quite variable, though none is especially high. This variability largely reflects differences in iron (Fe) content, which accounts, for example, for the very low value recorded for context NH4207 (ashy layer, 268 x 10^{-8} SI). In contrast, the two highest values were recorded for contexts NH4230 (Phase 4.2 chalk floor, 2090 x 10^{-8} SI) and NH3489 (dump, 1910 x 10^{-8} SI), and the likelihood that these have a somewhat higher Fe content is something that should be taken into account in interpreting these particular contexts.

Soil micromorphology and discussion of contexts

34 contexts and sub-units were identified and described from the 21 thin sections analysed, and of these, 26 were specifically counted employing some 34 identified characteristics (Tables 4-5). Thin section scans, photomicrographs and SEM-EDAX images are employed to illustrate findings (Plates 1-20).

Winchester Discovery Centre (Jewry Street)

Natural and Iron Age deposits

CC6001 – subsoil below Roman (pre-AD70?) street CC1703 (lower subsoil and top of natural CC6000) (thin section CCM602). Context CC6001 is a silt loam with frequent coarse flint, burned flint, occasional chalk inclusions, and with examples of possible iron fragments and a glass(?) shard. The fine fabric is weakly humic with included very fine charcoal, matrix and void textural pedofeatures and contemporary burrow mixing, and occurs over very poorly humic silt loam soil with very few flint (CC6000); rare inwash of dark, fine charcoal-rich soil was recorded.

CCM602 sampled the junction between the silty clay loam lower natural subsoil (CC6000)(Eb horizon of Typical palaeoargillic brown earth Carstens soil series) of Plateau Drift over 'Clay-with-Flints' origin (Jarvis *et al*. 1984, 115-117) and the slightly more humic and physically disturbed/homogenised pre-AD70? subsoil (CC6001) (Plate 1). Context CC6001 is chemically very slightly more humic and phosphate-rich (Table 2), and the presence of fine charcoal and more coarse flint and burned flint, which occur alongside a homogenised fine fabric and textural pedofeature evidence of physical disturbance suggest that this is a possible plough soil (Gebhardt 1992; Goldberg and Macphail 2006, 202-207; Macphail *et al*. 1990). Thus, pre-Roman arable activity is recorded in CCM602, which also includes evidence of post-depositional rare burrowing-in and inwash from overlying Roman activities.

CC3409 lower – Holloway CC7000 leading to exit from Middle Iron Age enclosure (thin section CCM332B). This is an extremely heterogeneous flint-rich deposit composed of decalcified silty clay loam soil clasts (which sometimes embed flint and are Bt horizon fragments characterised by textural pedofeatures) and poorly to strongly calcareous (fine chalky) silty clay loam soil, rich in partially iron and manganese-replaced tissue and amorphous/humified organic matter (dung residues?) (Plate 2). Also present are partially weathered and fragmented biogenic calcite (earthworm granules and Arionid plates; (Canti 1998) and moderately compact soil featuring closed vughs and vesicles and associated matrix intercalations and void coatings. Later features include very broad burrow fills (chalk gravel and fine charcoal-rich rich soil containing fine burned mineral material and coarse examples of blue light autofluorescent coprolitic bone fragments).

Lower context CC3409 is a very heterogeneous, colluvium-like, deposit (eg, Bourne Valley, West Sussex and White Horse Stone, Kent on drift over chalk; Macphail 2007) containing eroded fragments of local decalicified soil cover (Carstens soil series – see above), mixed with chalk (from eroded brown calcareous earths and brown rendzinas – see relationship to topography in Jarvis *et al*. (1984, fig 32). It differs from some Holocene colluviums, *sensu stricto* (Macphail 1992; Van Vliet-Lanoë *et al*. 1992), by containing high amounts of, now mainly mineralised, anomalous humified organic matter (see below) and by being a compact soil characterised by closed vughs and vesicles associated with matrix intercalations and

void coatings. The latter all indicate *thixotropy* from the physical mixing and collapse of wet soil (Courty *et al*.1989, 151-3) and localised deposition of slurries.

In the context of the site, this deposit can be best interpreted as drove-way accumulation mainly formed by the trampling of stock along this putative holloway, with the mineralised amorphous organic matter probably being relict dung residues, found in trackways/holloways elsewhere on chalk (Macphail and Crowther 2006a) and on other parent materials (Macphail 2003a; Macphail and Crowther 2005). Bulk analysis, which specifically targeted this 'subsoil' material (SMT 2a) and not the later (Roman?) burrow fills of anthropogenic material, found slight phosphate-P enhancement compared to the natural soil (CC6000) consistent with this holloway theory, but, presumably because of mineralisation little preserved organic matter was recorded in the LOI (Table 2).

CC3409 upper – Holloway CC7000 leading to exit from Middle Iron Age enclosure (thin section 332A). The soil micromorphology is similar to that in CCM332B, but here drove-way slurries have produced totally homogeneous, massive and compact deposits, with more strongly developed textural pedofeature and occasional micropanning evidence of wet trampling (Plate 7-8). Equally, high amounts of assumed dung residues occur. The slurry soil has become more homogeneous, presumably because of the trampling effect of stock and other traffic; experimental studies of muddy soils trampled by people have comparable microstructures, but without the evidence of dung inputs (Rentzel and Narten 2000). Both CCM332A and CCM332B contain strong evidence of stock movement and traffic along this putative holloway leading to the Middle Iron Age enclosure.

Late Saxon (Phase 4.2)

CC1358, CC1360 Phase 4.2 Floors (thin section 130B). These contexts are composed of coarse chalk and finely fragmented chalky material, which occur alongside patchy concentrations of very fine charcoal, amorphous organic matter and very fine soil inclusions. In addition, very abundant coarse charcoal, bone and burned bone, fine coprolitic material, oyster shell and earthworm granules are present; some fragmented deposits (poorly intact sample) show earlier-formed calcitic coatings and infills.

These layers represent coarse and finely fragmented floor deposits, of likely refuse dump origin that include coarse charcoal and chalk, as well as coprolitic

material, bone and partially weathered ash. The deposits show evidence of being burrowed and have features indicative the dumps experiencing slaking/inwash, which together suggest that CC1358 and CC1360 were 'exposed' refuse dumps and probably reworked chalk floor material.

CC1357 Phase 4.2 floors (thin sections 130A and 130B) (Plate 3). These contexts are thin to broadly layered ashy deposits, very rich in charcoal, burned (calcined) bone, iron-stained bone, and contain trace amounts of burned eggshell and weakly heat altered quartz (Courty *et al*. 1989, 109) with few quartz silt and many chalk fragments present. Most coarse pieces of chalk showing partial phosphatisation, edges and patches of the chalk display BL autofluorescence indicative of hydroxyapatite impregnation. Only small amounts of humic staining are present and bioworking is only represented by very thin burrows and excrements.

These are poorly sorted trampled ash and charcoal spreads that are of probable domestic/kitchen hearth origin, as indicated by the presence of iron-stained bone butchered fragments and coarse very strongly burned calcined bone, alongside examples of burned eggshell and traces of slightly heat altered quartz. The presence of organic waste, bone and secondary phosphate concentrations and burned material are all equally suggested by bulk analyses (Table 2), which also indicate slight (Zn) enrichment in CC1357 lower. In contrast, the finely laminated domestic ash rich trampled floor accumulations at medieval Spitalfield Hospital, London (Goldberg and Macphail 2006, fig 11.15) showed Pb enrichment (Macphail and Crowther 2006b). 12th century beaten floors of presumed cookshop origin at the London Guildhall were also characterised by burned bone and eggshell (Macphail *et al*. 2007b, 98).

Although dominantly characterised by micro-inclusions indicative of domestic kitchen hearth inputs, the presence of quartz silt, chalk, and organic matter in the fine fabric and as measured through LOI (Table 2), may suggest that trampling incorporated material from other areas, which were used differently. Organic residues of dung and refuse may have been incorporated in this way. Different floor deposits from stables and domestic areas have been studied from experiments and archaeological sites; these have been described, defined and modelled including at Butser Ancient Farm and at the Guildhall (Macphail *et al*. 2007a; Macphail *et al*. 2004; see also Cammas 1994; Cammas *et al*. 1996b; Courty *et al*. 1994; Milek 2005; Milek and French 2007). Soil micromorphology and palynological analysis of the

essentially domestic floor in the Pimperne House, actually included a heterogenous pollen spectra and fragments of dung trampled-in from various outside areas.

CC1356 (thin section CCM130A). In contrast to the still intact layered CC1357 deposit (Plate 3), CC1356 is a biologically worked chalky and ashy deposit rich in charcoal and bone. It also contains much oyster(?) shell and examples of clay, burned clay and small dog/human coprolites, and has a fine fabric rich in amorphous organic matter, some partially charred. This biologically worked deposit was affected by major inwash of chalky and ashy fine material containing silt and charcoal.

CC1356 is a biologically worked deposit of ash and chalk floor residues, rich in charcoal and humifying organic matter, and includes oyster shell(?), bone and coprolitic waste material, presumably mainly from domestic kitchen waste and general refuse disposal. The deposit underwent biological working, and therefore was probably exposed and/or in neglected 'domestic' space. Later inwash of fine matrix material indicates possible exposure to the elements (eg leaky roof?) and/or likely trampling of overlying CC1356? and above ash deposits.

Northgate House (Staples Gardens)

Roman and Late Roman Dark earth

NH4436/NH4393: Subsoil/Natural interface (thin section NHM272D), below dark earth NH4412. This is a poorly 'humic' and poorly calcitic brown silty soil. It is biologically worked and somewhat weathered(?) calcite earthworm granule are present. Fragments of probably coprolitic bone (BL autofluorescent) and a large fragment of (relict Roman?) iron slag were recorded. Pollen assessment showed a consistently poorly preserved pollen spectra to be present.

This is a biologically homogenised moderately humic calcareous brown earth (dark earth) soil formed out of local silty and chalky soils, with 'resistant' relict Roman cultural material (weathered brickearth building clay, iron slag, coprolitic bone, pot) being present. The inclusion of this cultural material is consistent with phosphate-P enrichment and enhanced magnetic susceptibility (Table 2). There is the possibility of this dark earth, which includes weathering earthworm granules and consistently poorly preserved pollen spectra, being an earlier-formed mature dark earth, ie dark earth that developed *during* the Roman Period, before Late Roman times. From dark earth studies elsewhere, it can be suggested that such a mature dark

earth and one which contains weathering calcite earthworm granules, is likely to have developed over many decades (Cammas 2004; Cammas *et al*. 1996a; Macphail 1994; Macphail *et al*. 2003; Macphail and Linderholm 2004). The poorly preserved pollen spectra also supports this view (Macphail and Cruise 1993; Scaife 1980). In any case, NH4436/NH4393 now 'acts' as a subsoil to later dark earth strata - NH4412 - at this location (see below).

NH4412: Late Roman dark earth (thin section NHM272A). This is a 'humic' silt-dominated soil material, with both calcareous and non-calcareous humic material. Reddish amorphous organic matter – possible relict humified dung – is scattered throughout, with humic/possible Ca-P staining occurring. Chalk, charcoal, coprolitic remains (bone and coprolites), and ashes are present; many *unweathered* earthworm granules occur throughout (Plate 9), but there is also bioworking is by smaller fauna. Bulk analyses (Table 2) show that NH4412 is more strongly enriched in phosphate-P and has more strongly enhanced magnetic susceptibility, and higher LOI, compared to NH4436/NH4393 (NHM272D). It has a pollen spectra similar to NH4436/NH4393 but also includes occasional, poorly preserved *Alnus*, *Corylus t*. and weeds.

NH4412 is a strongly homogenised dark earth/calcareous brown earth soil. It is a moderately mature biologically worked dark earth with typical poor pollen preservation, but does not show the decalcification of many typical Roman dark earth soils (such as NH4436/4393 some 20 cm below). This late Roman dark earth therefore probably formed through middening (see wider pollen spectra compared to NH4436/NH4393), and this middening included dumping of ashes – hence the dark earth's calcitic character – and inputs of 'dung'. The possible phosphate-staining of the microfabric that was recognised may originate from some *in situ* stock pounding (cf. phosphatisation of chalk floor at the Moel-y-gar stable, Butser Ancient Farm; Macphail *et al*., 2004). Clearly, this late Roman dark earth records a markedly different land use compared to that which formed dark earth NH4436/NH4393.

NH5059: Late Roman dark earth (thin section NHM311A). This is a 'humic' and mixed moderately calcitic brown silty soil with fabric mixing, and many inclusions of humified organic matter (dung/ashed-dung residues) (Plate 10). Bone - some partially weathered/digested and coprolitic - earthworm granules (including both weathered and unweathered ones) and an example of burned eggshell occur. The dark earth is

not totally homogeneous, and includes intercalated/mixed midden material and soil with chalk, land snail shell, and decalcified soil clasts (cf. Carstens soil series – see NHM332). The deposit is more strongly enriched in phosphate-P and has a more strongly enhanced magnetic susceptibility, and higher LOI, compared to NH4436/NH4393. In addition, rare badly preserved *Corylus t*. pollen is present.

This late Roman dark earth (NH5059) probably recordsmiddening/occupation, rather than simple abandonment, which like NH4412 is consistent with the pollen, chemical and magnetic susceptibility data (Table 2). This location was affected by inputs of domestic waste, ash and possibly dung and ashed dung residues, with coprolitic inputs and burned material contributing to the chemical and magnetic susceptibility signature. It can be suggested that the presence of both weathered and unweathered calcite earthworm granules, indicates the presence of both soil relict of earlier dark earth formation, and late Roman dark earth development; this may also be implied from what poorly preserved pollen is present.

Dark earth formation at Northgate House

Although only three thin sections and three bulk samples were analysed, along with their pollen assessment, some insights into dark earth formation at this location in Winchester can be made. At the London sites of Courages Brewery and Colchester House and 7-11, Bishopsgate and at Whitefriars, Canterbury dark earth began forming during the Roman Period itself, and had as its parent material mainly domestic waste associated with a dominantly ‘urban’ use of space (Macphail 2003b; Macphail and Crowther 2007; Macphail *et al*. 2003; Macphail and Linderholm 2004). An apparently different use of ‘urban’ space is recorded in Late Roman contexts at Whitefriars (eg, road deposits), Deansway, Worcester and possibly at Free School Lane, Leicester (dates to be confirmed), where in addition to typical ash-middening, noticeable inputs of dung indicate a possible change in use of ‘urban’ space to one that is apparently more ‘rural’ in character - ie where stock management becomes a more important activity than before (Macpail and Crowther 2007; Macphail 2004). It can also be noted that during post-Roman times and immediately before late Saxon deposition at Deansway, Worcester the development of pasture is recorded (Greig 2004), while at No 1, Poultry and the London Guildhall in London inputs of dung were noted prior to Late Saxon sedimentation (Macphail *et al*. 2007b; Macphail and Linderholm in press). The few samples of dark earth investigated from Northgate House may

possibly indicate a similar change in use of 'urban' space, from 1: 'urban' middening, to 2: general site abandonment (and the formation of a maturing dark earth; Blume and Runge 1978; Macphail 1994) and through to 3) renewed occupation and middening but possibly with more of an emphasis on stock management (Plate 10) - land use becoming more 'rural' in character. As a caveat, it is noted that at the special site of Pevensey Castle (*Anderida*) dark earth seems to have included inputs of dung throughout its *continuous* post-Roman, British and Saxon occupation (Macphail 2002).

Phase 5 floors – Monolith NH226 sequence

NH3488/3489: Phase 5 floors/'dump' (thin section NHM226E). These contexts are composed of a series of fine and coarse layered deposits, including compacted layers. The fine material is often ashy with rubefied fine soil, coarse clay soil fragments and much burned eggshell. Fine bone and charcoal are ubiquitous, while examples of very strongly burned material occur. A chalk floor layer is present. At the top of the thin section coarse fragments of partially burned coprolites occur that are very strongly autofluorescent under BL. NH3489 is very strongly enriched in phosphate-P, enriched in lead (Pb), and has a very strongly enhanced magnetic susceptibility with the $\%\chi_{conv}$ being the highest recorded at the combined sites. Pollen assessment showed very poorly preserved Poaceae (grass) and Lactuceae (dandelion t.) to be present, alongside occasional well-preserved *Corylus t.* (hazel) pollen indicating a mixed origin/materials for this deposit.

The lower part (165-200 mm) of NH3488 is an ash- and charcoal-rich trampled floor, containing burned and very strongly burned/vitrified material ('industrial' hearth debris?) and semi-altered burned silty soil, burned daub and burned bone, which occur together with thin spreads of silty soil and earthworm granules, which also indicates trampling-in of soil from 'outside' areas (as also indicated by pollen traces). There may also be a possible link between the presence of bark and occasional well-preserved *Corylus t*. (hazel), perhaps from the use of hazel wattle in spring (when flowering) (Cruise pers. comm. 2007; Macphail *et al*. 2007); the inclusion of bark in general implies the use of timbers with bark on, rather than sawn timbers (Damian Goodburn, pers. comm. 2007).

The upper part (135-165 mm) of NH3488 is a constructed chalk floor/spread with fine ash and charcoal trample, which again includes strongly burned mineral material, apparently from hearth debris.

Lastly, NH3489 (120-135 mm) is a soil and coprolite-rich spread with mixed ashy material. This clearly indicates a change in use of space from occupied 'room' to disuse and *in situ* middening. The bulk data also show that strongly burned debris was dumped alongside material enriched in lead (Pb), implying waste from industrial activities was also included.

The common occurrence of strongly burned mineral material, where quartz has been partially melted (eg, vitrified) implies that more than an open domestic fireplaces/hearths were present, because in general the high temperatures (1,000-1,200ºC) required to melt quartz can only be generated by the use of bellows (Berna *et al*. 2007; Courty *et al*. 1989, 110).

NH3349 Phase 5 'floor' (thin section NHM226B). This floor accumulation is composed of layered ash and charcoal-rich deposits containing burned daub embedded in ash, burned soil and vitrified mineral material, with oyster shell, bone and burned bone, and traces of burned eggshell. Burned daub embedded in ash is clearly a fragment of hearth rake-out.

These trampled floor layers include interior hearth rake out deposits that include both domestic kitchen waste as well as likely industrial traces, local soil (silt and fine sand).

NH3493 (-NH3492) Phase 5 floors (thin section NHM226B). This is a coarsely fragmented, bioworked and poorly sorted ashy deposit containing much coarse chalk and unburned subsoil Bt horizon material. The ashy fine material includes bark and amorphous organic matter as well as coprolites and bone. Of particular note are enigmatic materials embedded in amorphous phosphate (which include crystalline vivianite), which are reddish under OIL (oblique incident light), and appear to rubefied iron fragments that became embedded in mineralised cess. Occasional vitrified and altered quartz and mineralogenic soil also occur. This appears to be a refuse dump containing ashes and strongly burned material as evidence of local industrial activity. The possible identification of iron-working debris embedded in phosphate (local cess dumping?), indicates a local association with industrial and/or

craft activity. The disposal of refuse (and cess) is consistent with the high LOI and very strongly enriched phosphate-P, while industrial activity also indicated by slight enrichment in Cu, Pb and Zn, and a very strongly enhanced magnetic susceptibility.

NH3325 Phase 5 floor make-up (thin section NHM226A) (Plate 4). This is a very heterogeneous, poorly sorted layer containing coarse silty 'brickearth' from floors constructed elsewhere (?), very coarse chalk, and strongly burned flint and possible sand-dominated semi-vitrified crucible (cf. Bodmin; Macphail and Crowther 2008; Merkel pers. comm. UCL, 2008) and/or burned daub furnace(?) fragments and rounded melted quartz. One example is fused to strongly burned daub (Plates 11-12). Traces of its quartz sand content are visible, as confirmed by X-ray analysis (SEM-EDAX) indicating that it may have been a fragment of sand-dominated crucible (Merkel, UCL). No heavy metals were detected in this silica-dominated vesicular glass (13-14), however, only fine included iron fragments (89.54% Fe) and ashy material (eg. Ca, K and P). Ash, charcoal, mixed soil material and coprolitic material all occur.

This floor make up includes coarse chalk stones, associated brickearth (including material likely recycled from earlier-constructed 'clay' floors), coarse bone fragments and vitrified quartz-rich 'soil' crucible and furnace fragments(?). Also present are a variety of ashy fine fabrics containing various amounts of included amorphous organic matter (refuse and/or dung residues).

NH3348 Phase 5 floor (thin section NHM226A). These are biologically worked, calcareous and ashy layered deposits, which include brown amorphous fragments – humified dung and possible stabling crust fragments. Cess/coprolitic bone and coprolites occur alongside oyster shell and burned eggshell and many burned mineral soil fragments with coarse altered material (possible crucible fragments?). Upwards, layers become more silt rich and humic, with probable dung residues.

These are trampled floors containing much ash and charcoal, but with also probable inclusions of stabling waste, as also found at the Pimperne House, Butser Ancient Farm and at the London Guildhall (Macphail *et al*. 2004; 2007). These trampled floors become richer in stabling waste upwards, along with included chalky silt and sand from local soils, indicating a greater incidence of trampling-in from outside space and the local presence of stock. Nevertheless, the ubiquitous inclusion

of strongly burned mineral material from hearth, furnaces and possibly crucibles, which have a high 'sand' content (Merkel pers. comm.) indicates continuing industrial activity.

In summary, these ashy floor sequence sampled by monolith NH226 records floor trample, floor make-up and refuse dumping. The soil micromorphology, chemistry and magnetic susceptibility data provide a clear signal of industrial activity strongly influencing this area of the site throughout the Phase 5 Period. Strongly burned hearth and vitrified remains of probable furnaces and/or crucibles occur, while very strongly enhanced magnetic susceptibility measurements were recorded alongside enriched amounts of Pb; instances of slight Cu and Zn enrichment were also found. Other inputs include kitchen/domestic hearth waste (burned bone, burned eggshells and burned oyster(?) shell), general middening that includes both human and probable dog (coprolites, coprolitic bone, cess) that contributes to the very strong enrichment in phosphate-P and amorphous and humified organic matter/dung and stabling refuse, which has helped produce a relatively high LOI throughout this sequence (Table 2). In fact, the amount of stabling waste seems to increase at the top of the sampled sequence, inferring a change in the balance of the different inputs here.

Phase 4.2-Phase 5 floor and hearth sequence – Monolith NH253

NH4230: Phase 4.2 chalk floor and occupation (thin section NHM253E) (Plates 5).

NH4230 lower: This subunit is a micro-layered (0.5-2mm thick layers), compact, moderately sorted ash, charcoal and burned fine bone-rich deposit (Plates 15-16). It also contains coarse chalk, burned flint and shell; charred amorphous organic matter also present. Bulk analyses show that it is enriched in phosphate-P and lead (Pb), and has a very strongly enhanced magnetic susceptibility.

NH4230 upper: This upper subunit is composed of compact chalk and rubefied brickearth (including brickearth clay fragments), with included coprolitic bone and coarse charcoal, occurring over a very coarsely burrowed junction with lower NH4230.

NH4230 is made up of chalk floors intercalated with trampled microlayered deposits of ash, charcoal and fine burned bone. These are of near-domestic hearth (kitchen) origin (NH4230 lower), and are sealed by a constructed and compact burned brickearth and chalk floor (NH4230 upper), which includes burned brickearth clay

and silts (loess) of hearth origin in its make-up. Small inputs of stabling residues are also probably present.

NH4229 *Phase 4.2 floor (thin section NHM253D).* NH4229 is composed of partly layered and partly compact-massive, ash and charcoal-rich deposits. Much burned eggshell and fine bone, with coprolitic bone and patches of humified organic matter (dung residues) are present. There are layers that are ash-dominant (SMT3a) and layers that include ash-charcoal-dung residues (SMT6a).

NH4229 is characterised by trampled interior floors of mainly kitchen hearth origin, which have formed alongside minor inputs of stabling waste.

NH4228 10-12th century floor (thin section NHM253D). This is a massive, compact layer of coarse (15 mm) chalk with a very coarse (35 mm) flint pebble, and fine chalk and a micritic chalk matrix. NH4228 is a floor constructed from compacted/rammed(?)chalk, crushed chalk and flint, over the beaten floor layers of NH4229.

NH4227/NH4226: Phase 4.2 occupation (thin section NHM253C)

NH4227 (thin section NHM253D). This is a layer of moderately compact chalk stones (and decalcifying fragments of mortar) and silty brickearth soil, mixed with charcoal, bone, burned eggshell. It features a large burrow-fill of very charcoal-rich soil and burned fine burned (rubefied) bone ('fired sand'?).

NH4227 is probably the remains of either 1) a bioworked floor with a chalk and brickearth floor make-up, or 2) a dump of chalk floor material (that includes weathering mortar of unknown origin; medieval or recycled Roman?). Overall homogenisation also suggest *in situ* bioworking, while a coarse burrow fill of 'hearth' debris may include domestic cooking fire rakeout, indicating dumped material above. All these features suggest that this is no longer an extant occupied domestic 'room'/kitchen area, but neglected interior space probably employed for localised dumping.

NH4226 (thin section NHM253C). This is a highly heterogeneous compact material, with large flints, chalk, and a dominant matrix of moderately humic calcitic brickearth silt. There are numerous inclusions of clay soil fragments that contain bone and

phosphate (presumably trampled-in from other areas?), as well fine and large coprolitic bone, coprolite, shell and charcoal. The presence of many earthworm granules indicate trample or mixing-in of soils in exterior space as well as *in situ* bioworking(?). The layer becomes more calcitic upwards with chalky material, ash, bone, burned bone. Overall it has a moderately high LOI, enriched phosphate-P and very strongly enhanced magnetic susceptibility (Table 2).

NH4226 is composed of homogenised silty and chalky beaten floor soil deposits, with many earthworm granules and has a moderately humic character. These all indicate major trampling-in from exterior areas. The presence of fine bone, coprolite, shell and charcoal are in addition indicative of middening dumps. A change in use of space from domestic/kitchen rooms to 'exposed' deposits where land snails could become incorporated, indicate a very poor status for this space. The renewed ashy deposition recorded at the top of the thin section indicates further dumping, but more likely of interior kitchen floor origin.

NH4207-NH4205 Phase 4.2 floor and hearth (thin section NHM253F). 4207 is made up of layered and lenticular structured ash-rich layers with much strongly burned brickearth/daub (from a nearby hearth?), burned bone and eggshell, but also much burned fine coprolitic material. There are also examples of heat altered sandy soil and dung fragments, as well as charred probable dung residues. This context has a strongly enriched phosphate-P and very strongly enhanced magnetic susceptibility.

NH4207 is characterised by trampled floor deposits mainly composed of hearth rakeout, including many fragments of strongly burned daub (perhaps why the local hearth was renewed/reconstructed as NH4205 - see below). Hearth debris includes much burned food waste (bone and eggshells), but also burned coprolitic/latrine and stabling waste. Construction of overlying hearth NH4205 (see below) produced lenticular structure in the top of 4207 because of compaction and secondary $CaCO_3$ features developed as the result of downwash of calcitic water from the construction of this hearth.

NH4205 is a compact brickearth and chalk layer with closed vughs and void coatings, and brickearth that shows strong rubefication (burned). It has a topmost layer of ash containing fine chalk and burned earthworm granules.

NH4205 is a hearth constructed by compacting wet chalk and brickearth - wet compaction causing lenticular structure and secondary $CaCO_3$ features below in the

top of NH4207 (see above). Primary use of the hearth is recorded by an ash-rich layer at top of thin section. This is an *in situ* domestic/kitchen hearth, without significant amounts of very strongly heat-altered mineral material (cf. Monolith NH226), rather the rubefication/reddening found here occurs at temperatures of 400ºC (Berna *et al*. 2007; Dammers and Joergensen 1996). Equally, the associated trampled deposits (eg, 4207) show no enrichment in heavy metals (Table 2). It is quite clear that regular hearth cleaning was carried out in these kitchens, and that this resulting hearth rakeout included fragments of the hearths themselves, hence the probable need to regularly reconstruct and renew them.

Phase 5 NH4191 (floor), NH4192 (occupation), NH4193 (floor) (thin section NHM253B) (Plate 6)

NH4193 This is a massive, compact layer of chalk, calcareous silty soil and burned brickearth inclusions, which is characterised by closed vughs and associated textural pedofeatures. NH4193 is a floor/hearth layer which was constructed by compacting a wet chalk, brickearth and local calcareous brown earth soil mixture.

NH4192 This is formed of micro- to broadly layered very charcoal-rich deposits, and contains strongly burned soil and flint, with much ash, including ash clasts and examples of ashed reworked dung (insect pellets?), burned eggshell and bone. Closed vughs are present.

NH4192 is a finely to broadly layered trampled floor/surface deposit originating from kitchen hearth rakeout, which is rich in charcoal, and includes ash and burned food residues. Construction of NH4191 floor above caused some minor slaking of this layer and the development of closed vughs.

NH4191 This floor/hearth is compact with coarse chalk, crushed chalk and brickearth soil, with closed vughs. NH4191 is a floor/hearth that was constructed by compacting a wet chalk and brickearth mixture. Such a wet chalky mixture, is prepared by removing as much air as possible (although some may be 'found' as closed vughs), to produce a building material known as 'clunch' (eg, reference material from Butser Ancient Farm; Goldberg and Macphail 2006, 282).

NH4184?, NH4185, NH4186: Phase 5 floor/hearth(?) and occupations (thin section NHM253A)

NH4186 This is a partially rooted (woody roots) and layered ash and charcoal rich deposit, which includes burned bone, shell, eggshell, with flint, soil and chalk; some inclusions show heat alteration. Patches of weakly charred amorphous organic matter (dung residues?) also occur. Bulk analyses found a markedly high LOI, and strongly enriched phosphate-P, enriched lead (Pb) and slightly enriched copper (Cu) content, with a strongly enhanced magnetic susceptibility. Pollen assessment found rare, poorly preserved *Alnus, Corylus t.* and *Poaceae,* and in addition the presence of *r*are, well-preserved *Rumex* spp.

NH4186 seems to be mainly made up of domestic hearth/kitchen rakeout, but includes some heat altered mineral material and enriched lead (Pb) and slightly enriched copper (Cu), which together may infer some local inputs from industrial/craft activities. Lastly, the high LOI and presence of probable dung residues indicates additions of sediment from outside space and/or byres; the pollen spectra also indicate the presence of mixed materials. This may suggest a change in the balance of activities affecting this space.

NH4185 This context is a massive compact layer of chalk and Clay-with-Flints, with some flints showing weak rubefication. NH4185 is a constructed floor/edge of a constructed hearth.

4184? This is a loose mixture of coarse charcoal, ash, coarse bone and fine burned bone and eggshell, flints and chalk. NH4184? Is another typical spread and/or trample of hearth rakeout and domestic kitchen waste.

Thin section NHM253A records a series of a) trampled floor deposits mainly from hearth rake-out, but with important inputs from possible byres and debris associated with industrial activity, b) *in situ* hearth constructed of Clay-with-Flints, and c) further trampled occupation/rake out which is again dominated by domestic kitchen hearth waste.

NH4370/NH4394: Phase 4.2 floor and occupation (thin section NHM559). Although the monolith sample was very poorly preserved, these contexts are apparently composed of dominantly massive chalk, and crushed chalk, which has a chalky fine

fabric, closed vughs and chalky void coatings. Occupation material includes fine charcoal, rare bone and fine coprolite (both BL autofluorescent), and burned bone and amorphous organic matter. Overall, the contexts have a moderately high LOI, an enriched in phosphate-P content, and display a very strongly enhanced magnetic susceptibility.

NH4370/NH4394 comprise a chalk floor constructed of compacted (wet) chalk stone and crushed chalk slurry (cf. 'clunch' see above) with minor spread/trample of charcoal-rich hearth-rake which includes calcined bone – domestic kitchen waste. This context has a domestic signature.

Phase 4.2 Pit fills: Monolith NH187

NH2366: Phase 4.2 'cessy pitfill' (thin section NHM187B). This context is broadly layered with ash and phytolith-rich alternating laminae at the base (310-330 mm), which is sealed by coarse chalk and micritic layer (280-310 mm). The deposit contains abundant charcoal, soil fragments and BL autofluorescent cess and coprolitic material, with much phosphate impregnation/hypocoatings also being in evidence.Further fine laminae of pure cess (Plates 19-20), ash, phytoliths and shell occur at 250-280 mm, for example. Overall, the layer has a high LOI, a very strongly enriched phosphate-P and a very strongly enhanced magnetic susceptibility.

NH2366 is composed of layers and laminae deposited under wet conditions. These waterlain laminae of phytoliths and ash, possibly result from an input of sweepings (grass and/other monocotyledonous plants or cereal material from cereal processing, and/or floor coverings etc), and occur in between chalky slurry dumps and additions of cess. For example, the upper layers received very high amounts of cess, including coprolitic bone, coprolites and amorphous Ca-P embedding organic matter. The fill reflects mainly domestic waste disposal of floor and hearth debris, alongside direct inputs of cess. While cereal pollen could in part result from cess disposal, grass pollen likely derives from floor deposits and coverings. *Alnus* pollen probably comes from the use of Alder in the structure (see presence of hazel pollen elsewhere at Northgate House).

NH2361: Phase 4.2 'cessy pitfill' (thin section NHM187A). This is a loose chalky layer (95-135 mm) over moderately well laminated (where not burrowed) ash and charcoal-rich sediments, which contain shell and much strongly burned mineral

material including heat altered quartz soil. There are high amounts of fine coprolites and coprolitic bone (leached and poorly autofluorescent under BL), but with only occasional cess (both Ca-P and Ca-P-Fe types), compared to NH2366. Earthworm granules and more amorphous organic matter are present; laminations associated with textural pedofeatures occur. Bulk analysis found a high LOI, a very strongly enriched phosphate-P, very strongly enhanced magnetic susceptibility, slight enrichment in Zn and enriched in Pb.

NH2361, although similar to NH2366, differs by being homogeneous and including more amorphous organic matter, coprolitic bone and coprolites, and much strongly burned mineral material; NH2366 is very much more rich in *in situ* dumped cess. Floor sweepings again contributed to the fill, and long articulated phytoliths may be of bedding/mat origin. General (biologically worked) refuse which included earthworm granules, also contributed alongside probable industrial residues. Nevertheless, material has still been disposed of a wet pit, but liquid cess now seems to be a minor component compared to industrial and general refuse. This change in refuse disposal components may indicate a modification in the balance of activities here. This lower NH2361 deposit was sealed by a chalk and soil layer (NH2361 upper).

References

Arpin, T., Mallol, C., and Goldberg, P., 2002, A new method for analyzing and documenting micromorphological thin sections using flatbed scanners: applications in geoarchaeological studies: *Geoarchaeology*, v. 17, p. 305-313.

Ball, D.F., 1964, Loss-on-ignition as an estimate of organic matter and organic carbon in non-calcareous soils.: *Journal of Soil Science*, v. 15, p. 84-92.

Berna, F., Behar, A., Shahack-Gross, R., Berg, J., Boaretto, E., Gilboa, A., Sharon, I., Shalev, S., Shilstein, S., Yahalom-Mack, N., Zorn, J.R., and Weiner, S., 2007, Sediments exposed to high temperatures: reconstructing pyrotechnological processes in Late Bronze Age and Iron Age Strata at Tel Dor (Israel): *Journal of Archaeological Science*, v. 34, p. 358-373.

Bethell, P.H., and Máté, I., 1989, The use of soil phosphate analysis in archaeology: A critique., *in* Henderson, J., ed., *Scientific Analysis in Archaeology.*, Volume Monograph No.19: Oxford, Oxford University Committee, p. 1-29.

Blume, H.-P., and Runge, M., 1978, Genese und Okologie innerstadtischer Boden aus Bauschutt: *Zeitschrift fur Pflanzenernahrung und Bodenkunde*, v. 141, p. 727-40.

Bullock, P., Fedoroff, N., Jongerius, A., Stoops, G., and Tursina, T., 1985, *Handbook for Soil Thin Section Description*: Wolverhampton, Waine Research Publications, 152 p.

Cammas, C., 1994, Approche micromorphologique de la stratigraphie urbaine à Lattes: premiers résultats, Lattara 7, Volume 7: *Lattes*, A R A L O, p. 181-202.

—, 2004, Les "terre noires" urbaines du Nord de la France: première typologie pédo-sédimentaire., *in* Verslype, L., and Brulet, R., eds., *Terres Noires - Dark Earth*: Louvain-la-Neuve, Université Catholique de Louvain, p. 43-55.

Cammas, C., David, C., and Guyard, L., 1996a, La question des terre noires dans les sites tardo-antiques et médiéval: le cas du Collège de France (Paris, France), *Proceedings XIII International Congress of Prehistoric and Protohistoric Sciences*, Volume Colloquim 14: Forlì,, ABACO, p. 89-93.

Cammas, C., Wattez, J., and Courty, M.-A., 1996b, L'enregistrement sédimentaire des modes d'occupation de l'espace, *in* Castelletti, L., and Cremaschi, M., eds., Paleoecology; *Colloquium 3 of XIII International Congress of Prehistoric and Protohistoric Sciences*, Volume 3: Forli, ABACO, p. 81-86.

Canti, M., 1998, Origin of calcium carbonate granules found in buried soils and Quaternary deposits: *Boreas*, v. 27, p. 275-288.

Clark, A., 1990, *Seeing Beneath the Soil: prospecting methods in archaeology*: London, Batsford.

Courty, M.A., 2001, Microfacies analysis assisting archaeological stratigraphy, *in* P. Goldberg, Holliday, V.T., and Ferring, C.R., eds., *Earth Sciences and Archaeology*: New York, Kluwer, p. 205-239.

Courty, M.A., Goldberg, P., and Macphail, R.I., 1989, *Soils and Micromorphology in Archaeology*: Cambridge, Cambridge University Press, 344 p.

—, 1994, Ancient people - lifestyles and cultural patterns, *Transactions of the 15th World Congress of Soil Science, International Society of Soil Science, Mexico*, Volume 6a: Acapulco, International Society of Soil Science, p. 250-269.

Crowther, J., 1997, Soil phosphate surveys: critical approaches to sampling, analysis and interpretation: *Archaeological Prospection*, v. 4, p. 93-102.

—, 2003, Potential magnetic susceptibility and fractional conversion studies of archaeological soils and sediments: *Archaeometry*, v. 45, p. 685-701.

Crowther, J., and Barker, P., 1995, Magnetic susceptibility: distinguishing anthropogenic effects from the natural: *Archaeological Prospection*, v. 2, p. 207-215.

Dammers, K., and Joergensen, R.G., 1996, Progressive loss of Carbon and Nitrogen from simulated daub on heating: *Journal of Archaeological Science*, v. 23, p. 639-648.

Dick, W.A., and Tabatabai, M.A., 1977, An alkaline oxidation method for the determination of total phosphorus in soils: *Journal of the Soil Science Society of America*, v. 41, p. 511-14.

Gebhardt, A., 1992, Micromorphological analysis of soil structural modification caused by different cultivation implements, *in* Anderson, P.C., ed., *Prehistoire de l'Agriculture: nouvelles approaches experimentales et ethnographiques,* Volume Monogaphie de CRA No. 6: Paris, Centre Nationale de la Recherche Scientifique, p. 373-392.

Gebhardt, A., and Langohr, R., 1999, Micromorphological study of construction materials and living floors in the medieval motte of Werken (West Flanders, Belgium): *Geoarchaeology*, v. 14, p. 595-620.

Goldberg, P., and Macphail, R.I., 2006, *Practical and Theoretical Geoarchaeology*: Oxford, Blackwell Publishing, 455 p.

Greig, J., 2004, Buried soil pollen, *in* Dalwood, H., and Edwards, R., eds., *Excavations at Deansway, Worcester, 1988-89: Romano-British small town to late medieval city*., Volume CBA Research Report No 139: York, Council for British Archaeology, p. 556-558.

Heron, C., 2001, Geochemical prospecting, *in* Brothwell, D., and Pollard, A.M., eds., *Handbook of Archaeological Sciences*: Chichester, Wiley.

Jarvis, M.G., Allen, R.H., Fordham, S.J., Hazleden, J., Moffat, A.J., and Sturdy, R.G., 1984, *Soils and Their Use in South-East England*: Harpenden, Soil Survey of England and Wales.

Macphail, R.I., and Crowther, J., 2007, *Freeschool Lane and Vine Street, Leicester: soil micromorphology, chemistry and magnetic susceptibility*: Leicester, Leicester University Archaeological Service, p. 68.

—, 2008, *A30 (Bodmin to indian Queens): soil micromorphology, chemistry and magnetic susceptibility*: Oxford, Oxford Archaeology, p. 47.

Macphail, R.I., 1992, Soil micromorphological evidence of ancient soil erosion, *in* Bell, M., and Boardmand, J., eds., *Past and Present Soil Erosion*, Volume Monograph 22: Oxford, Oxbow, p. 197-216.

—, 1994, The reworking of urban stratigraphy by human and natural processes, *in* Hall, A.R., and Kenward, H.K., eds., *Urban-Rural Connexions: Perspectives from environmental Archaeology*, Volume Monograph 47: Oxford, Oxbow, p. 13-43.

—, 2002, *Pevensey Castle: soil micromorphology and chemistry of the Roman deposits and 'dark earth'*: Reading, University of Reading.

—, 2003a, *Scanian Road profiles (A1316 and A1317): Soil Micromorphology (with reference to chemistry)*: Umeå, Department of Archaeology and Sami Studies, Umeå University.

—, 2003b, Soil microstratigraphy: a micromorphological and chemical approach, *in* Cowan, C., ed., *Urban development in north-west Roman Southwark Excavations 1974-90*, Volume Monograph 16: London, MoLAS, p. 89-105.

—, 2004, Soil micromorphology, *in* Dalwood, H., and Edwards, R., eds., *Excavations at Deansway, Worcester, 1988-89: Romano-British small town to late medieval city*., Volume CBA Research Report No 139: York, Council for British Archaeology, p. 558-567.

—, 2007, Soil micromorphology in Prehistoric and Medieval environment in Old Town, Eastbourne: studies of hillwash in the Bourne Valley, Star Brewery site, by M. Allen: *Sussex Archaeological Collections*, v. 145, p. 40.

Macphail, R.I., Courty, M.A., and Gebhardt, A., 1990, Soil micromorphological evidence of early agriculture in north-west Europe: *World Archaeology*, v. 22, p. 53-69.

Macphail, R.I., and Crowther, J., 2005, *Stanstead Airport (Long Stay Car Park and Mid Stay car Park - BAACPOO and BAAMPOO): Soil Micromorphology, Chemistry and Magnetic Susceptibility*: Oxford, Oxford Archaeology.

—, 2006a, *Homestead Farm, Baldock: soil micromorphology, chemistry and magnetic susceptibility*: Bedford, Albion Archaeology.

—, 2006b, *Spitalfields: microstratigraphy (soil micromorphology, microprobe, chemistry and magnetic susceptibility)*: London, Museum of London Archaeological Service.

—, 2007, *Whitefriars, Canterbury: Soil micromorphology, chemistry and magnetic susceptibility*: Canterbury, Canterbury Archaeological Trust, p. 43.

Macphail, R.I., Crowther, J., and Cruise, G.M., 2007a, Micromorphology and post-Roman town research: the examples of London and Magdeburg., *in* Henning, J., ed., *Post-Roman Towns and Trade in Europe, Byzantium and the Near-East. New methods of structural, comparative and scientific methods in archaeology*.: Berlin, Walter de Gruyter & Co. KG, p. 303-317.

—, 2007b, Microstratigraphy: soil micromorphology, chemistry and pollen, *in* Bowsher, D., Dyson, T., Holder, N., and Howell, I., eds., *The London Guildhall. An archaeological history of a neighbourhood from early medieval to modern times*, Volume MoLAS Monograph 36: London, Museum of London Archaeological Service, p. 18, 25-6, 35, 39, 55-6, 57, 59, 76, 90, 97, 98, 134, 154-5, 428-430.

Macphail, R.I., and Cruise, G.M., 1993, *King Edward Buildings: assessment of soils and pollen (KEB92).* London, Museum of London.

—, 2001, The soil micromorphologist as team player: a multianalytical approach to the study of European microstratigraphy, *in* Goldberg, P., Holliday, V., and Ferring, R., eds., *Earth Science and Archaeology*: New York, Kluwer Academic/Plenum Publishers, p. 241-267.

Macphail, R.I., Cruise, G.M., Allen, M.J., Linderholm, J., and Reynolds, P., 2004, Archaeological soil and pollen analysis of experimental floor deposits; with special reference to Butser Ancient Farm, Hampshire, UK: *Journal of Archaeological Science*, v. 31, p. 175-191.

Macphail, R.I., Galinié, H., and Verhaeghe, F., 2003, A future for dark earth?: *Antiquity*, v. 77, p. 349-358.

Macphail, R.I., and Goldberg, P., In press, Archaeological materials, *in* Stoops, G., Marcelino, V., and Mees, F., eds., *Micromorphological Features of Soils and Regoliths. Their Relevance for Pedogenic Studies and Classifications*: Amsterdam, Elsevier.

Macphail, R.I., and Linderholm, J., 2004, 'Dark earth': recent studies of 'dark earth' and 'dark earth-like' microstratigraphy in England, *in* Verslype, L., and Brulet, R., eds., *Terres Noire; Dark Earth*: Louvain-la-Neuve, Université Catholique de Louvain, p. 35-42.

—, In press, No. 1, Poultry (Saxon): Soil micromorphology, *in* Treveil, P., ed., *Saxon No. 1 Poultry*: London, Museum of London Archaeological Service.

Milek, K., 2005, Soil micromorphology, *in* Sharples, N.M., ed., *A Norse farmstead in the Outer Hebrides: Excavations at Mound 3, Bornais, South Uist*.: Oxford, Oxbow, p. 98-104.

—, 2006, *Houses and Households in Early Icelandic Society: Geoarchaeology and the Interpretation of Social Space* [PhD thesis]: Cambridge, University of Cambridge.

Milek, K., and French, C., 2007, Soils and sediments in the settlement and harbour at Kaupang., *Kaupang in Skiringssal*: Aarhus, Aarhus University Press, p. 321-360.

Murphy, C.P., 1986, *Thin Section Preparation of Soils and Sediments*: Berkhamsted, A B Academic Publishers.

Rentzel, P., and Narten, G.-B., 2000, Zur Entstehung von Gehniveaus in sandig-lehmigen Ablagerungen - Experimente und archäologische Befunde (Activity surfaces in sandy-loamy deposits - experiments and archaeological examples), *Jahresbericht 1999*: Basel, Archäologische Bodenforschung des Kantons Basel-Stadt, p. 107-27.

Scaife, R.G., 1980, *Pollen analysis of some dark earth samples*: London, Ancient Monuments Laboratory.

Scollar, I., Tabbagh, A., Hesse, A., and Herzog, I., 1990, *Archaeological prospecting and remote sensing*: Cambridge, Cambridge University Press.

Stoops, G., 2003, *Guidelines for Analysis and Description of Soil and Regolith Thin Sections*: Madison, Wisconsin, Soil Science Society of America, Inc., 184 p.

Tite, M.S., 1972, The influence of geology on the magnetic susceptibility of soils on archaeological sites: *Archaeometry*, v. 14, p. 229-236.

Van Vliet-Lanoë, B., Helluin, M., Pellerin, J., and Valadas, B., 1992, Soil erosion in Western Europe: from the last interglacial to the present, *in* Bell, M., and Boardman, J., eds., *Past and Present Soil Erosion*, Volume Monograph 22: Oxford, Oxbow, p. 101-114.

Table 1: Details of samples

Sample	Context	Description
Northgate House (NH)		
187a	2361	Cessy fill of pit
187b	2366	Cessy fill of pit
226b	3492	9–12th C 'floor': hearth/domestic spreads; non-ferrous metal working?
226e	3489	Dump
253a	4186	Floor occupation
253f	4207	Ashy layer over floor
253c	4226	Floor occupation
253e	4230	10–12th C chalk floor: domestic occupation floor; near hearth?
272a	4412	Late Roman dark earth
272d	4436/4393	'Natural and subsoil' (actually dark earth)
311a	5059	Late Roman dark earth
559a	4370/4394	10–12th C floor: domestic trample
Winchester Discovery Centre (CC)		
1357(u)	1356/57	Late Saxon floors: refuse accumulation?
1357(l)	1357/58/60	Late Saxon floors: floor deposits?
3409	3409	Soil from hollow way leading to Middle Iron Age enclosure
6001	6001	Subsoil below Roman (pre-AD70?) street
6000	6000	Natural

Table 2: Analytical data (excluding phosphate fractionation)

Sample	Context	LOI[a] (%)	Phosphate-P[b] (mg g^{-1})	Pb[c] (µg g^{-1})	Zn[c] (µg g^{-1})	Cu[c] (µg g^{-1})	χ[d] (10^{-8} SI)	χ_{max}[e] (10^{-8} SI)	χ_{conv}[d,e] (%)
Northgate House (NH)									
187a	2361	**6.19***	**10.6*****	**735****	**166***	33.2	187	616	**30.4*****
187b	2366	**5.42***	**12.3*****	182	123	30.5	151	710	**21.3*****
226b	3492	**7.41***	**13.5*****	**355***	**213***	**241****	282	1020	**27.6*****
226e	3489	**6.93***	**10.4*****	**502****	92.1	31.4	1250	1910	**65.4*****
253a	4186	**12.2****	**8.31****	**587****	118	**68.1***	124	660	**18.8****
253f	4207	2.41	**8.68****	73.4	120	19.0	144	268	**53.7*****
253c	4226	**5.07***	**6.11***	216	74.7	15.4	**473*****	nd	nd
253e	4230	4.38	**6.47***	**303***	66.8	28.6	430	2090	**20.6*****
272a	4412	4.31	**7.80****	194	123	46.8	116	912	**12.7****
272d	4436/4393	2.69	**5.46***	49.2	84.3	30.9	94.7	1090	**8.69***
311a	5059	3.93	**8.85****	204	121	47.5	105	1110	**9.46***
559a	4370/4394	**5.95***	**5.84***	104	89.2	30.5	130	645	**20.2*****
Discovery Centre (CC)									
1357(upper)	1356/57	**6.81***	**12.6*****	190	148	36.4	172	772	**22.3*****
1357(lower)	1357/58/60	**8.06***	**11.6*****	108	**177***	36.8	136	355	**38.3*****
3409	3409	1.89	2.65	34.1	46.6	13.6	35.5	1100	3.23
6001	6001	2.27	2.06	24.6	59.5	49.2	38.2	1130	3.38
6000	6000	1.75	1.07	38.6	83.7	15.4	37.3	1620	2.30

[a] **Loss-on-ignition:** Figures highlighted in bold have notably higher LOI values: * = 5.00–9.99%, ** = 10.0–19.9%

[b] **Phosphate-P:** Figures highlighted in bold show signs of phosphate-P enrichment: * = enriched (5.00–7.49 mg g^{-1}), ** = strongly enriched (7.50–9.99 mg g^{-1}), *** = very strongly enriched (≥ 10.0 mg g^{-1}) – phosphate fractionation data are presented in Table 3

[c] **Pb, Zn and Cu:** Figures highlighted in bold show likely enrichment: * = slightly enriched, ** = enriched (criteria differ for each metal)

[d] **χ and χ_{conv}:** Figures highlighted in bold show signs of magnetic susceptibility enhancement: * = enhanced (χ_{conv} = 5.00–9.99%), ** = strongly enhanced (χ_{conv} = 10.0–19.9%), *** = very strongly enhanced (χ_{conv} ≥ 20.0% or, if χ_{conv} not determined, $\chi \geq 200 \times 10^{-8}$ SI)

[e] nd = not determined because of insufficient sample

Table 3: Phosphate fractionation data

Sample	Context	Phosphate-P_i (mg g^{-1})	Phosphate-P_o (mg g^{-1})	Phosphate-P (mg g^{-1})	Phosphate-P_i:P (%)	Phosphate-P_o:P (%)
Northgate House (NH)						
187a	2361	8.76	1.88	10.6	82.3	17.7
187b	2366	10.8	1.50	12.3	87.8	12.2
226b	3492	12.0	1.45	13.5	89.2	10.8
226e	3489	8.82	1.56	10.4	85.0	15.0
253a	4186	6.96	1.35	8.31	83.8	16.2
253f	4207	7.65	1.03	8.68	88.1	11.9
253c	4226	5.01	1.10	6.11	82.0	18.0
253e	4230	5.86	0.607	6.47	90.6	9.4
272a	4412	6.66	1.14	7.80	85.4	14.6
272d	4436/4393	4.77	0.690	5.46	87.4	12.6
311a	5059	7.38	1.47	8.85	83.4	16.6
559a	4370/4394	5.08	0.759	5.84	87.0	13.0
Discovery Centre (CC)						
1357(upper)	1356/57	11.1	1.52	12.6	88.0	12.0
1357(lower)	1357/58/60	10.4	1.19	11.6	89.7	10.3
3409	3409	2.24	0.408	2.65	84.6	15.4
6001	6001	1.72	0.336	2.06	83.7	16.3
6000	6000	0.806	0.262	1.07	75.5	24.5

Table 4: Northgate House, Staples Gardens and Winchester Discovery Centre: soil micromorphology

Thin section	Relative depth	Context	MFT	SMT	Voids	Coarse flint	Burned flint	Chalk
		Northgate House (NH)						
M187A	95-170 mm	2361	E4/E5	5b	20% (50%)		a	aaaaa
M187B	250-330 mm	2366	E4, E5	5b	20%(50%)		a-1	aaaaa
M226A	180-205 mm	3348	E1, E2, E3	5a, 5b	20-30%	*	a*	aaaaa
M226A	205-260 mm	3325	C1	3b over 3d	25-30%			aaa
M226B	260-340 mm	3349-3493-3492	C3	3d, 3b, 2a, 1c	30-35%		a-1	aaaaa
M226E	120-200 mm	3488?/3489	C1(C4)	3d	30%(505)			aa(aaaaa)
M253A	90-130 mm	(4184?) 4185	C4	3d	eg 20-30%	*	aa	a(aaaaa)
M253A	130-170 mm	4186	F4(F1)	1c, 3b	20%	aaaaa	aa	aaa
M253B	180-260mm	4191, 4192, 4193	F1	3a, 3b, 6a	30%	a		aaa
M253F	430-475 mm	4207, 4205, 4204, 4203	F2 over F1 over F2	6b,1c/6a/2a,6b	10%/20%/15%		aa	aaaaa
M253F	475-550 mm	4207	F2	6b (3a)	10%	*		aaaaa
M253C	630-665 mm	4226	F1	3a, 3b	35%	*		aaa
M253C	665-720 mm	4227	F3	1c, 2a, 3a, 6a,6b	25%	f	a*	aa
M253D	720-820mm	4228, 4229	F2	1c, 2a, 6a,6b	25%	f		aaaaa
M253E	840-920mm	4230	F1 below F2	3a, 6a below 6b	20% (45%)	*	a	aaaaa
M272A	80-160 mm	4412	F1 below F2	6a	20% (60%)	f	a	aaaaa
M272D	380-460 mm	4436/4393	D2	4a, 4b	40%	*		aa
M311A	20-100 mm	5059	D1	4a	35%	f	a	aaa
M559	20-90 mm	4370/4394	D3	4b (1c)	50%	*		aaaa
		Winchester Discovery Centre (CC)	F2(F1)	6b(6a)	10%			aaaaa
M130A	75-115mm	1356, 1357	C2	3b	40%	a*		aaaaa
M130A	115-150mm	1357	C2	3b	40%	a-1	a*	aaaa
M130B	170-205 mm	1357	C1	3a	30%			aaa
M130B	205-245 mm	1358, 1360	C1	3a	30%	a*		
M332A	0-75mm	3409	C3	3c	50%	a-1		aaaaa
M332B	75-150mm	3410	B2	2a (2b)	15-20%	*		aaa
M602	80-145mm	6001	B1	2a (1c)/ (2b)	15-20%(35%)	f		aaa
M602	145-160mm	6000	A2 over A1	1b over 1a	25%	ff	aaa	aa

* - 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%

Thin section	Context	Mortar	Glass?	Iron fragment	Iron slag	Burned daub	Charcoal	Alterred quartz
	Northgate House (NH)							
M187A	2361						aaaaa	
M187B	2366					a	aaaaa	aa
M226A	3348						aaaaa	a
M226A	3325		a-1?			aa	aaaaa	aa
M226B	3349-3493-3492					aa	aaa	a
M226E	3488?/3489					a	aaaaa(aaa)	a
M253A	(4184?) 4185					aaa	aa(aaaaa)	aa
M253A	4186						a	
M253B	4191/4192/4193						aaaaa	a
M253F	4207/4205/4204/4203					aaa	(aaaaa)	(a)
M253F	4207					aaaaa		
M253C	4226					aaaa	aa	a
M253C	4227						aa	a*
M253D	4228, 4229	a-2					aaa	a*
M253E	4230					a	aaaaa	a*
M272A	4412					aaaa	aaaaa	a
M272D	4436/4393						a	
M311A	5059				a-1	a-1	a	
M559	4370/4394						a	
	Winchester Discovery Centre (CC)						aa	
M130A	1356, 1357						aaaa	
M130A	1357						aaaa	
M130B	1357						aaaaa	a*
M130B	1358, 1360						aaaa	a*
M332A	3409						aaaaa	
M332B	3410						a*(aa)	
M602	6001						a*(aa)	
M602	6000		a-1?	a-2?			a	

* - 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%

Thin section	Context	Vitrified mineral	Ash	OM/dung residues	Coprolite	Cop bone	Burned bone	Bone
	Northgate House (NH)							
M187A	2361		aaaaa	aa	aaa	a	a	a
M187B	2366		aaaaa	**aa**	aa	aa	a*	
M226A	3348		aaaaa	**a**	a	aa		
M226A	3325	aa	aaaaa	aaa	aa	a		
M226B	3349-3493-3492	aa	aaaaa	aa	a	a		
M226E	3488?/3489	a-1	aaaaa		a	a	a	
M253A	(4184?) 4185	a-1	aaaaa		a(aaa)	a	a	
M253A	4186		a			a	a	
M253B	4191/4192/4193		aaaaa	aaa			aa	a
M253F	4207/4205/4204/4203		(aaa)	(a*)		a	aa	
M253F	4207		aa					
M253C	4226	a?	aaaaa	aaa	aa	aa	aa	
M253C	4227		aaa	aa?	a			
M253D	4228, 4229		aa	aa?	a		a	
M253E	4230		aaaaa	aaa	a	a	aa	
M272A	4412		aaaaa	aaa?	a	a	aaa	
M272D	4436/4393		a(aaaa?)	(aaaa)	aa	aa		
M311A	5059				a	aa		a
M559	4370/4394		a(aaaa?)	(aaaa)	a	aa	a	a
	Winchester Discovery Centre (CC)		a	a	a*		a	
M130A	1356, 1357		aaa	aaa	a	aaa		
M130A	1357		aaa	(aaaaa?)	a*			aaa
M130B	1357		aaaaa	(aaa?)			aaaa	aaa
M130B	1358, 1360		aaaaa	(aa)	a*			aa
M332A	3409		aaa		a		aaa	
M332B	3410			aaaaa		(a-1)		
M602	6001			aaaaa		(a-3)		

M602 6000

* - 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%

Thin section	Context	Cess	Eggshell	Oyster? shell	Landsnail	Biogen. calcite	Matrix intercal.	Dusty clay coatings
	Northgate House (NH)							
M187A	2361	aaa		a*				
M187B	2366	aa		a		a	aa	a
M226A	3348	aaaaa	a*	a			aaa	
M226A	3325		a*	a				
M226B	3349-3493-3492		a*	a		a*		
M226E	3488?/3489		a*	a				
M253A	(4184?) 4185		a	a*		a		
M253A	4186		a*				a	
M253B	4191/4192/4193		a*	a				
M253F	4207/4205/4204/4203		a*	a*			aa	a
M253F	4207					a*	aaa	a
M253C	4226	aa	a*	a				
M253C	4227		a*	a	a*	aaa		
M253D	4228, 4229		a*	a	a*	aaa		
M253E	4230		aa	a			(aa)	
M272A	4412			a			(aa)	
M272D	4436/4393					aaa		
M311A	5059			a*		aa		
M559	4370/4394		a*	a*	a-1	aaa		
	Winchester Discovery Centre (CC)						aaa	
M130A	1356, 1357			aa				(aaaa)
M130A	1357		a*	aaa				aaaa
M130B	1357		a*	a*				
M130B	1358, 1360		a*	a				

M332A	3409	a*	a	a*		aa
M332B	3410			a	aaaaa	aaaa
M602	6001			a	aaaa	aaa
M602	6000			a*	aaaa	aa

* - 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%

Thin section	**Context**	**Fine clay coatings**	**Broad 2mm burrows**	**Weak 2nd Fe**	**Weak 2nd Fe-Mn**	**2nd CaP**	**2nd CaCO3**	**Thin excrts.**
	Northgate House (NH)							
M187A	2361			a			a*	
M187B	2366		(aaa)	a*		a*		
M226A	3348		aa		a*	aaaaa		
M226A	3325							aaa
M226B	3349-3493-3492							aaa
M226E	3488?/3489		(aaa)					aaa
M253A	(4184?) 4185							
M253A	4186							
M253B	4191/4192/4193		aa					aa
M253F	4207/4205/4204/4203							
M253F	4207							
M253C	4226						aa	aa
M253C	4227		aaaaa					
M253D	4228, 4229		aaaaa					
M253E	4230		aaa					
M272A	4412		aaaaa				a*	
M272D	4436/4393		aaaaa			a		aaa
M311A	5059		aaaaa				a*	aaa
M559	4370/4394		aaaaa					aaa
	Winchester Discovery Centre (CC)							
M130A	1356, 1357		aaaa			aaaaa		
M130A	1357		aaa	aaa		a		
M130B	1357			aa		aa		a

M130B	1358, 1360			a		a	aa
M332A	3409		aaa				a
M332B	3410		aaaaa		aaaaa	a*	
M602	6001		aaaaa		aaaaa	a*	
M602	6000	a*	aaaa	aaa		a-1	

* - 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 5: Northgate House (Staples Gardens) and Winchester Discovery Centre (Jewry Street), Winchester: Soil Micromorphology (Descriptions and preliminary interpretations)

Microfacies type (MFT)/Soil microfabric type (SMT)	**Sample No.**	**Depth (relative depth) Soil Micromorphology (SM)**	**Preliminary Interpretation and Comments**
			Northgate House
MFT E5/SMT 5b MFT E4/SMT 5b	NHM187A	95-170 mm 95-135 mm Dominated by loose coarse chalk, with many soil clasts, occasional charcoal and rare coprolitic bone. 135-170 mm SM: moderately homogeneous SMT 5b (includes patches of abundant amorphous organic mmater); *Microstructure*: broadly (2-4-5mm) laminated/bedded (+subangular blocky loose inclusions), 20% voids - fine vughs, closed vughs and channels, with chambers and simple packing voids (50% voids); *Coarse Mineral*: C:F (limit at 10 µm), 65:35, moderately sorted with silt (quartz) and fine and medium sand-size anthropogenic inclusions; *Coarse Organic and Anthropogenic*: very abundant charcoal and ash, many strongly burned/melted mineral, coprolites and coprolitic bone (poorly autofluorescent under BL) – eg's of burned bone and soil clasts, occasional shell, burned shell, amorphous Ca-P (cess) and amorphous Ca-P-Fe (cess) embedding fine organic matter and ferruginised material; rare examples of earthworm granules and coarse burned flint; example of semi-horizontally oriented 2mm long articulated phytoliths (floor covering); *Fine Fabric*: as SMT 5b; *Pedofeatures*: *Textural*: rare calcitic void coatings (50µm) associated with laminae; trace of organic/Fe-stained very thin (25 µm) void coatings; *Amorphous*: rare ferruginous staining and impregnation of	NH2361: Phase 4.2 'cessy pitfill' Loose chalky layer (95-135 mm) over moderately well laminated (where not burrowed) ash and charcoal-rich sediments, containing shell and much strongly burned mineral material – altered quartz soil (cf NHM187B), with high amounts of fine coprolites and coprolitic bone (leached and poorly autofluorescent under BL), with only occasional cess (both Ca-P and Ca-P-Fe types), compared to NHM187b; earthworm granules and more amorphous organic matter present (cf NHM187B); laminations associated with textural pedofeatures. (High LOI, very strongly enriched phosphate-P and very strongly enhanced χ, and slightly enriched in Zn and enriched in Pb). *Although similar to NHM187B, the homogeneous character, and inclusion of more amorphous organic matter, coprolitic bone and coprolites, and much strongly burned mineral material, compared to NHM187B (which is very much more rich in in situ dumped cess) indicates dumping of both domestic floor sweepings (including long articulated phytoliths –from mats?), general refuse (including earthworm granules) and industrial residues. Still, material has still been disposed into*

Microfacies type (MFT)/Soil microfabric type (SMT)	**Sample No.**	**Depth (relative depth)** **Soil Micromorphology (SM)**	**Preliminary Interpretation and Comments**
		organic inclusions. Pollen: Only very scarce, badly preserved pollen present.	*a wet pit, but cess is now a minor component compared to industrial and general refuse, all indicating disposal a likely change in emphasis of activities here. This lower NH2361 deposit was sealed by a chalk and soil layer (NH2361 upper).*
MFT E3/SMT 5a MFT E2/SMT 5b MFT E1/ SMT 5a	NHM187B	250-330 mm 250-280 mm Layered with laminae; as 310-330 mm, but with burned eggshell and abundant semi-layered amorphous yellow Ca-P (BL) cess; patches of articulated phytoliths, horizontally oriented thin shell. 280-310 mm SM: (sealing phytoliths-rich laminae below) Massive with very abundant coarse and fine chalk; *Microstructure*: massive, 30% voids, closed vughs and; *Coarse Mineral*: C:F (limit at 10 µm), 70:30, very abundant coarse chalk; *Coarse Organic and Anthropogenic*: abundant coarse charcoal and soil clasts; very abundant amorphous yellow cess, with included organic matter; rare bone and coprolites; rare burned soil; *Fine Fabric*: SMT 5b: dotted grey (PPL), high interference colours (close porphyric, crystallitic (micritic) b-fabric, XPL), white, greyish brown to greyish yellow (OIL); abundant fine charred and many amorphous fine OM; *Pedofeatures*: *Textural*: abundant chalky intercalations forming 50-100 µm void coatings; *Amorphous*: rare Mn impregnation of chalky deposit; very abundant Ca-P (BL autofluorescent) cess. 310-330 mm SM: homogeneous; *Microstructure*: layered with laminae; 20% voids, with semi-closed medium and fine vughs; *Coarse Mineral*: C:F (limit at 10 µm), 60:40, well sorted mainly silt; *Coarse Organic and Anthropogenic*: 250µm thick alternating humic stained (and some times phosphate stained/embedded)	NH2366: Phase 4.2 'cessy pitfill' Broadly layered with ash and phytoliths-rich alternating laminae at the base (310-330mm), which is sealed by coarse chalk and micritic layer (280-310 mm), containing abundant charcoal, soil fragments and cess and coprolitic material, with much phosphate impregnation/hypocoatings. Further fine laminae of pure cess, ash, phytoliths and shell occur at 250-280 mm. (High LOI, very strongly enriched phosphate-P and very strongly enhanced χ). *Layers and laminae deposited in wet conditions – waterlain laminae of phytoliths and ash, possibly reflecting sweepings input (grass and/other monocotyledonous plants or cereal material from cereal processing, and/or floor coverings etc – and in between occurs a chalky slurry dump, with upper layers receiving very high amounts of cess, including coprolitic bone, coprolites and amorphous Ca-P embedding organic matter. Domestic space waste disposal of floor and hearth debris, cereal pollen of probable cess origin, where grass pollen likely from floor coverings. Alnus pollen probably from use of Alder.*

Microfacies type (MFT)/Soil microfabric type (SMT)	**Sample No.**	**Depth (relative depth) Soil Micromorphology (SM)**	**Preliminary Interpretation and Comments**
		phytoliths and poorly articulated phytoliths laminae, and humic stained ash, with fine charcoal and amorphous OM fragments (SMT 5a); included fine cess fragments; Pollen: Rare badly preserved pollen including cereal t. and Poaceae (grass). Also rare well-preserved *Alnus* (probable inclusion).	
MFT C1/SMT 3b over 3d	NHM226A	180-260 mm 180-205 mm NH3348 Broadly (3-10mm) layered and fragmented (25-30% voids), with very abundant coarse charcoal (4mm), occasional chalk, semi-horizontally oriented rare oyster shell and occasional very thin (coprolitic) bone (cess inclusions with vivianite) and melted, sometimes rounded quartz sands/sandy soil (4mm) – melted sandy 'soil' may be crucible fragments; fine fabric becoming more humic with included organic refuse/possible dung residues upwards (from SMT 3d to 3b), with humified organic matter as inclusions (dung) as microlayers; fragments of articulated phytoliths, possibly from stabling crust of floor mats.	NH3348-NH3325: Phase 5 'layer'/floor make-up NH3348 Biologically worked, calcareous and ashy layered deposits including brown amorphous fragments – humified dung and possible stabling crust fragments, with cess/coprolitic bone and coprolites (and oyster shell and burned eggshell; many burned mineral soil fragments with coarse altered material – possible crucible fragments; layers become more silt rich and humic (dung residues, upwards). *Trampled floors containing much ash and charcoal, but with also probable inclusions of stabling waste (as at GYE), that become more dominant upwards along with included chalky silt and sand from local soils; ubiquitous inclusion of strongly burned mineral material from hearth, furnaces and possibly crucibles (which have a high 'sand' content – Merkel pers. comm.).*
MFT C3/SMT 3d, 3b, 2a, 1c		205-260 mm NH3325 SM: very heterogeneous with abundant very coarse chalk, an example of burned and rubefied flint gravel, many fragments of SMT 1c (subsoil Bt), calcareous silty SMT 2a, probable	NH3325 Very heterogeneous, poorly sorted layer containing coarse silty 'brickearth' from constructed floors elsewhere (?), very coarse chalk, and strongly burned flint and possible furnace/semi-vitrified crucible/burned daub furnace(?) fragments and

Microfacies type (MFT)/Soil microfabric type (SMT)	**Sample No.**	**Depth (relative depth) Soil Micromorphology (SM)**	**Preliminary Interpretation and Comments**
		'brickearth floor' material (including textural pedofeatures typical of constructed brickearth clay floors), ashy SMT 3d and more humic variants, with much amorphous organic matter (SMT 3b); occasional coprolitic fine bone and coprolitic material, with phosphate-embedded parenchymatous material and articulated phytoliths (probable cess inclusions); coarse (8mm) rounded melted quartz coarse silt-fine sand with embedded black burned daub – possibly strongly and altered burned hearth/furnace material; bioworked (30-35% voids); *Fabric* and *Excrements*, as M226.	rounded melted quartz; ash, charcoal, mixed soil material, coprolitic material in general. *Floor make up includes coarse chalk stones, associated brickearth, coarse bone fragments and slag (iron slag and vitrified quartz-rich 'soil' crucible and furnace fragments(?)); and variety of ashy fine fabrics containing various amounts of included amorphous organic matter (refuse and/or dung residues).*
MFT C4/SMT 3d	NHM226B	260-340 mm 260-310 mm NH3493 (-NH3492) Similar components to below, but very poorly sorted with very abundant coarse (25mm+) chalk, and many argillic Bt horizon soil fragments (SMT 3c)(max 3mm); fragmented with fine subangular blocky clasts (60% voids); only many charcoal; many fine fragments of amorphous organic matter (with scatter of cess and fine bone; partially BL autofluorescent bone/coprolitic bone); examples of enigmatic ferruginous (rubefied/burned) fragments embedded in amorphous phosphate (with vivianite); examples of fine opaque material embedded in ash, 500 μm in size – black under OIL – possibly lead, with another 2mm long (with few fine vesicles) – under OIL black metallic lustre and thin reddish margin (lead oxide?).	NH3492: Phase 5 'floor' and dark brown silt NH3493 (-NH3492) Coarsely fragmented, bioworked and poorly sorted ashy deposit containing much coarse chalk and unburned subsoil Bt horizon material; ashy fine material includes bark and amorphous organic matter (coprolites and bone present); of particular note are enigmatic materials embedded in amorphous phosphate (which include crystalline vivianite), which are metallic black, with red rims, or completely reddish (possibly lead and lead oxide, respectively); occasional vitrified and altered quartz and mineralogenic soil. *Refuse dump containing ashes and strongly burned material and possible lead and lead oxide embedded in phosphate (cess dumping) and ash; industrial activity inclusions – refuse (and cess) dumping consistent with high LOI and very strongly enriched phosphate, and industrial activity also indicated by slightly enriched Cu, Pb and Zn, and very strongly enhanced magnetic*

Microfacies type (MFT)/Soil microfabric type (SMT)	**Sample No.**	**Depth (relative depth)** **Soil Micromorphology (SM)**	**Preliminary Interpretation and Comments**
MFT C1/SMT 3d		310-340 mm NH3349 SM: mainly homogeneous *Microstructure*: moderately coarsely layered (2.5-5mm) – very finely laminated in places, 30% voids, open vughs and horizontal fissures; *Coarse Mineral*: moderately sorted with very coarse inclusions, *Coarse Organic and Anthropogenic*: very abundant ash, sometimes as bio-worked aggregates, very abundant charcoal (max 2mm), often horizontally oriented along with occasional oyster shell fragments; examples of ash-embedded burned daub, vitrified siliceous material (vesicular, very pale green/yellow, with vesicles showing ferruginous infills; 0.5mm – smaller than fragment in NHM226E; rare strongly burned silty and fine sandy soil; occasional coarse chalk and very fine burned mineral/soil and rare fine bark fragments; occasional coprolitic and bone fragments; traces of burned eggshell; *Fine Fabric*: SMT 3d; *Pedofeatures*: *Fabric*: many very thin and thin burrows; *Excrements*: occasional very thin to thin excrements.	*susceptibility.* NH3349 'floor' Layered ash and charcoal-rich deposits containing burned daub embedded in ash, burned soil and vitrified mineral material, with oyster shell, bone and burned bone, traces of eggshell. *Floor trample layers including interior hearth rake out deposits that include domestic kitchen waste as well as likely industrial traces, local soil (silt and fine sand).*
MFT D4/SMT 3d	NHM226E	120-200 mm 120-135 mm – very heterogeneous, with similar SMT 3d as 165-200mm, with coarse silty soil fragments; notable also includes spread of cess/coprolitic fragments (4mm)(parenchymatous plant cell embedded material, some blackened material – pig?dog?human. 135-165 mm – Coarsely layered coarse chalk, burned chalk and burned mineral material, becoming finer and ash and fine charcoal-rich upwards, and including strongly burned iron-stained inclusions. 165-200 mm – poorly micro-layered (20-30% voids) ash and	3488?/3489: Phase 5 C floors/'dump' Fine and coarse layered deposits; compacted layers, often ashy with rubefied fine soil and coarse clay fragments; much burned eggshell; examples of very strongly burned material; chalk floor laid down; fine bone and charcoal ubiquitous; top of thin section characterised by coarse fragments of partially burned coprolites – that are very strongly autofluorescent under BL. (Very strongly enriched phosphate-P, enriched in lead (Pb), and very strongly enhanced magnetic

Microfacies type (MFT)/Soil microfabric type (SMT)	**Sample No.**	**Depth (relative depth)** **Soil Micromorphology (SM)**	**Preliminary Interpretation and Comments**
		charcoal-rich deposit, with sub-horizontally oriented charcoal, bark and burned eggshell; chalk, burned chalk, flint, burned flint and very strongly burned flint, strongly burned daub and burned soil/ altered quartz, burned bone; occasional very thin (250-500 µm) 5-6mm long horizontal 'spreads of silty clay (drift soil – as at Pimperne House floor) – rare earthworm granules; *Fine Fabric*: SMT 3d: dotted grey to heavily dotted dark grey (PPL), high interference colours (open porphyric, crystallitic b-fabric, XPL), dotted greyish brown with occasional red specks (OIL); abundant fine charcoal and charred and uncharred reddish fragments (including lignified bark fragments?); monocot/straw charcoal present. Pollen: very poorly preserved Poaceae (grass) and Lactuceae (dandelion t.). Also occasional well-preserved *Corylus t.* (hazel) indicating mixed origin/materials.	susceptibility (χ_{conv} highest on site); *120-135 mm(NH3489): soil and coprolite-rich spread with mixed ashy material; change in use of space from occupied 'room' to disuse and in situ middening.* *135-165 mm (NH3488?): constructed chalk floor/spread with fine ash and charcoal trample, including strongly burned mineral material – hearth debris spread – floor trample.* *165-200 mm(NH3488?): Ash- and charcoal-(including bark – possibly related to presence of* well-preserved *Corylus t.* (hazel) *) rich trampled floor deposits, containing burned and very strongly burned/vitrified material and semi-altered silty soil, burned daub and burned bone, with thin spreads of silty soil and earthworm granules indicating trampling of both 'outside' areas (also pollen traces) and 'industrial' hearth debris.*
MFT F1/SMT 1c	NHM253A	90-170 mm 90-95 mm (NH4184?) Loose mix of coarse charcoal (including twigwood), ash, chalk, flint and clay (SMT 1c), with coarse bone (10mm), very fine burned bone and example of very strongly burned eggshell.	NH4184?, NH4185, NH4186: Phase 5 floor/hearth(?) and occupations NH4184? Loose mixture of coarse charcoal, ash, coarse bone and fine burned bone and eggshell, flints and chalk.
MFT F4/SMT 1c, 3b		95-130 mm (NH4185) Massive coarse flint (18mm) (some weakly rubefied) and clay (subsoil Bt /Ct horizon – Clay-with-Flints – SMT 1c), over discontinuous chalk gravel-rich compact SMT 6b; 20% voids, closed vughs and fissures.	*Spread/trample of hearth rakeout and domestic kitchen waste.* NH4185 Massive compact layer of Clay-with-Flints – some flints showing weak rubefication – and chalk.
MFT F1/SMT 3a, 3b, 6a		130-170 mm (NH4186) SM: heterogeneous *Microstructure*: massive, with broad	*Constructed floor/edge of constructed hearth.* NH4186

Microfacies type (MFT)/Soil microfabric type (SMT)	**Sample No.**	**Depth (relative depth) Soil Micromorphology (SM)**	**Preliminary Interpretation and Comments**
		layering, relict layering and subangular blocky; 30%, coarse vughs and chambers; *Coarse Organic and Anthropogenic*: very abundant coarse (12mm) wood charcoal, abundant chalk gravel and ashes (as micritic material and clasts); occasional burned bone, rare shell, burned shell, burned eggshell; chiefly wood ash, but with high amounts of little charred yellowish brown organic matter in patches – humified refuse/dung residues(?); traces of heat altered soil; occasional fine and medium woody root traces (associated very thin excrements); *Fine Fabric*: SMT 3a, 3b and 6a. Pollen: Rare, poorly preserved *Alnus, Corylus t. and Poaceae*. Rare, well-preserved *Rumex* spp. (mixed materials).	Part rooted (by woody roots) and layered ash and charcoal rich deposits including burned bone, shell, eggshell, with flint, soil and chalk inclusions – some heat altered; patches of weakly charred amorphous organic matter (dung residues?). *Hearth rakeout from mainly domestic kitchen hearth (see Pb and Cu), with additions from exterior (dung residues – see pollen).* (Markedly high LOI; strongly enriched phosphate-P, enrich lead (Pb) and slightly enriched copper (Cu) and strongly enhanced magnetic susceptibility). *A series of a) trampled hearth rake-out, possibly of mixed origins, floor deposits; b) in situ hearth constructed of Clay-with-Flints, and c) further trampled occupation/rake out.*
MFT F2/SMT 1c, 6b MFT F1/SMT 6a	NHM253B	180-260mm 180-200 mm (NH4191) Massive chalk (gravel-size – 16mm), aggregates (17mm) of crushed chalk (SMT 6b) and brickearth (SMT 1c), with fine chalk, decalcifying chalk and strongly burned daub; very compact 10% voids – closed vughs. 200-230 mm (NH4192) Micro- to broadly-layered; 20% voids, mainly closed fine and coarse vughs (with thin 100 µm-thick, blackish [charcoal] void coatings); very abundant coarse (6mm) and very fine charcoal (SMT 6a), many ash, ash clasts, burned brickearth fragments, chalk, occasional burned flint (8mm); rare burned bone, eggshell/shell, heat altered sandy soil; examples of pot (10mm) and burned/ashed dung.	NH4191 (floor), NH4192 (occupation), NH4193 (floor) NH4191 Compact with coarse chalk, crushed chalk and brickearth soil, with closed vughs. *Floor constructed by compacting wet chalk and brickearth mixture.* NH4192 Micro- to broadly layered very charcoal-rich deposits, with strongly burned soil and flint, with much ash, including clasts and examples of ashed dung; burned eggshell and bone, and example of pot, also present; closed vughs present. *Finely to broadly layered trampled floor deposits originating from kitchen hearth rakeout –rich in*

Microfacies type (MFT)/Soil microfabric type (SMT)	**Sample No.**	**Depth (relative depth) Soil Micromorphology (SM)**	**Preliminary Interpretation and Comments**
MFT F2/SMT 2a, 6b		230-4193 mm (NH4193) Massive chalk (sand to small gravel-size – 6mm) and brickearth (with few burned brickearth fragments; compact (15% voids) with fine channels, closed vughs and fissures, with calcitic soil (SMT 2a and chalky SMT 6b) intercalation and very thin void coatings.	*charcoal, with ash and burned food residues; construction of NH4191 floor caused some minor slaking of this layer.* NH4193 Massive, compact layer of chalk, calcareous silty soil and burned brickearth inclusions; closed vughs and associated textural pedofeatures. *Floor constructed by compacting wet chalk, brickearth and local calcareous brown earth soil mixture.*
MFT F2/SMT 6b (3a) MFT F1/SMT 3a and 3b	NHM253F	430-475 mm (NH4205) Massive, compact coarse chalk (25mm) and strongly rubefied brickearth (coarse silt-very fine sand-size quartz, with C:F of 90:10, with few reddish clay matrix – SMT 6b) – mixed with chalk, calcareous soil, chalk fossils with closed vughs (10% voids + horizontal fissures) and 50 µm thick void coatings; micritic matrix with fine chalk and closed vughs and calcitic intercalations; uppermost layer is composed of fine chalk and ash, with burned chalk and burned earthworm granules; with coarse inclusions of coarse coprolitic bone, charcoal and rubefied clay loam. 475-550 mm (NH4207) SM: very heterogeneous layered components/fine fabric SMT 3a and 3b; *Microstructure*: massive, broadly layered and just below NH4205 – lenticular, 35% voids; *Coarse Mineral*: *Coarse Organic and Anthropogenic*: moderately poorly sorted ash (as micritic material and as clasts, clasts showing thin excrements and as re-burned aggregates), chalk, burned chalk and burned mixed brickearth-chalk hearth/floor material (daub-like without plant tempering), with occasional coarse	NH4205 hearth; NH4207 floor NH4205 Compact brickearth and chalk layer with closed vughs and void coatings, and brickearth showing rubefication (burned), with topmost layer of ash containing fine chalk and burned earthworm granules. *Hearth constructed by compacting wet chalk and brickearth – wet compaction causing lenticular structure and secondary $CaCO_3$ features below in the top of NH4207; use of hearth recorded in ash-rich layer at top of thin section. Likely reconstruction/renewal of hearth here.* NH4207 Layered and lenticular structured ash-rich layers with much strongly burned brickearth/daub (from previous hearth?), burned bone and eggshell, but also much burned fine coprolitic material, with examples of heat altered sandy soil and dung fragments, as well as charred probable dung residues. (Strongly enriched phosphate-P and very

Microfacies type (MFT)/Soil microfabric type (SMT)	**Sample No.**	**Depth (relative depth) Soil Micromorphology (SM)**	**Preliminary Interpretation and Comments**
		charcoal (8mm)(but very abundant fine charcoal and charred organic matter), fine burned bone and coprolitic bone, burned fine cess and coprolitic fragments, examples of dung pellet and burned variants, fine charred humified organic matter, lignin/bark, burned eggshell, fine flint, rubefied/burned flint/iron stone, shell, heat altered sands; *Pedofeatures*: *Crystalline*: many very thin secondary calcitic hypocoatings and infills below NH4206; *Excrements*: examples of very thin excrements – in ash clasts.	strongly enhanced magnetic susceptibility – highest at Staples Gardens). *Trampled floor deposits mainly composed of hearth rakeout, including many fragments of strongly burned daub (perhaps why hearth 4207 was renewed/reconstructed); hearth debris includes much burned food waste (bone and eggshells), but also burned coprolitic/latrine and stabling waste. Construction of overlying hearth produced topmost lenticular structure and secondary CaCO3 features.*
MFT F3/ 1c, 2a, 3a, 6a, 6b	NHM253C	630-720 mm 630-665 mm (NH4226); 665-720 mm (NH4227) SM: very heterogeneous, with SMT 2a, 3a, 6a; 3a layer at top of thin section; *Microstructure*: massive (burrowed), 25%, fine channels, vughs and coarse chambers; *Coarse Mineral*: C:F (limit at 10 μm), very poorly sorted overall, with SMT 2a, 60:40, with well sorted coarse silt-very fine sand size quartz, fine to medium sand-size chalk in lower part NH4227); *Coarse Organic and Anthropogenic*: very abundant coarse chalk (15mm), occasional flint (15mm), coarse charcoal (2mm), but very abundant in SMT 6a (burrow fill); many earthworm granules, shell and burned shell, rubefied flint, clasts of clayey SMT 1c, examples of heat altered quartz soil, coprolitic bone; rare burned eggshell; examples of land snails, mortar and decalcifying mortar (8mm), chalky matrix (SMT 6b) with closed vughs (constructed chalk floor material), and pottery; ash becoming abundant in SMT 3a at top of thin section; *Fine Fabric*: SMT 1c, 2a, 3a, 6a and 6b, as described elsewhere; *Pedofeatures*: *Fabric*: very abundant broad burrows.	NH4227/NH4226: Phase 4.2 'fired sand' and occupation 4226: highly heterogeneous compact material, with large flints, chalk, and main matrix of moderately humic calcitic brickearth silt; numerous inclusions of clay soil fragments that contain bone and phosphate (trampled-in from other areas); fine and large coprolitic bone, coprolite, shell and charcoal; presence of many earthworm granules indicate trample/or mixing-in of soils in exterior space as well as *in situ* bioworking(?); becomes more calcitic upwards with chalky material, ash, bone, burned bone. (Moderately high LOI, enriched phosphate-P and very strongly enhanced χ (magnetic susceptibility). *Homogenised silty and chalky beaten floor soil deposits, with many earthworm granules and moderately humic character- all indicating major trampling-in from exterior space; Presence of fine bone, coprolite, shell and charcoal are in addition*

Microfacies type (MFT)/Soil microfabric type (SMT)	**Sample No.**	**Depth (relative depth) Soil Micromorphology (SM)**	**Preliminary Interpretation and Comments**
MFT F2/ 1c, 2a, 6a,6b		Pollen (NH4226): Occasional, poorly preserved *Corylus* t., *Cereal* t. and unidentifiables (more cereal t. noted here than in other samples.) Also rare well-preserved *Quercus* (oak) and *Erica* spp. (mixed origins/materials).	*indicative of middening dumps; change of use of space from rooms to exposed features (land snails?); renewed interior ashy deposition forming at the top is probably the result of further dumping.* NH4227 A layer of moderately compact chalk stones (and decalcifying fragments of mortar) and silty brickearth soil, mixed with charcoal, bone, burned eggshell; features large burrow-fill of very charcoal-rich soil and burned fine burned (rubefied) bone ('fired sand'?) – burrowed in from domestic cooking fire rakeout. *This is probably the remains of a bioworked chalk floor and brickearth floor make-up or dump of chalk floor material (that includes weathering mortar of unknown origin); a coarse burrow fill of 'hearth' debris and overall homogenisation also suggest in situ bioworking.* All suggests that this is no longer occupied interior space.
MFT F2/SMT 6b (6a) MFT F1/SMT 3a, 6a	NHM253D	720-820 mm 720-755 mm NH4228 Massive, compact coarse (15 mm) chalk with very coarse (35mm) flint pebble, with fine chalk and micritic chalk matrix (SMT 6b). 755-820 mm NH4229 SM: moderately heterogeneous, with layers of SMT 3a and more dominant 6a; *Microstructure*: massive and weakly layered in places, compact with 20% (also burrowed and	NH4228 Massive, compact coarse (15 mm) chalk with very coarse (35mm) flint pebble, with fine chalk and micritic chalk matrix. *Floor constructed from compacted/rammed(?)chalk, crushed chalk and flint.* NH4229 Partly layered and partly compact-massive, ash and charcoal-rich deposits, with much burned eggshell and fine bone, with coprolitic bone and

Microfacies type (MFT)/Soil microfabric type (SMT)	**Sample No.**	**Depth (relative depth) Soil Micromorphology (SM)**	**Preliminary Interpretation and Comments**
		coarsely fragmented), vughs and channels; *Coarse Organic and Anthropogenic*: moderately well sorted ash, charcoal, silt-size quartz, with many coarse chalk (and very fine chalk), patches of humified amorphous organic matter (dung residues?) and fine burned bone and coprolitic bone (possible tooth and bird bone fragments), occasional burned eggshell, fine flint, rubefied/burned flint/iron stone, shell and rare ash clasts and heat altered sands; *Pedofeatures*: many very broad burrows in one part of the sequence.	patches of humified organic matter (dung residues) present; layers of ash-dominant (3a) and layers of ash-charcoal-dung residues (6a). *Trampled interior floors of mainly kitchen hearth origin, alongside minor inputs of stabling waste.*
MFT F2/SMT 6a MFT F1/SMT 6a	NHM253E	840-920mm 840-880 mm Chalk floor Massive, compact coarse chalk (30mm) and strongly rubefied brickearth (coarse silt-very fine sand-size quartz, with C:F of 90:10, with reddish clay matrix) with coarse inclusions of coarse coprolitic bone, charcoal and rubefied clay loam. (C:F of 40:60); 880-920 mm Trampled floor SM: mainly homogeneous (SMT 6a); *Microstructure*: micro-layered (0.5-2mm)(with very open and coarsely burrowed fragments), 20% voids, vughs, fine channels and sub-horizontal fissures; *Coarse Organic and Anthropogenic*: moderately well sorted ash, charcoal, silt-size quartz, with many coarse chalk (and very fine chalk – from trampling) and fine burned bone, occasional fine flint, rubefied/burned flint, shell and examples of burned coprolite (rubefied with enclosed calcite?); traces of ash clasts and heat altered sands; *Fine Fabric*: SMT 6a: dotted reddish grey (PPL), high interference colours (close porphyric, crystallitic b-fabric, XPL), reddish brown (OIL); very abundant very fine charcoal and charred OM and micritic ash/OM stained ash; *Pedofeatures*: *Crystalline*: trace of secondary calcitic hypocoatings and	NH4230: Phase 4.2 chalk floor (and occupation) NH4230 upper Compact chalk and rubefied brickearth (including brickearth clay fragments), with included coprolitic bone and coarse charcoal, over (very coarsely burrowed junction) NH4230 lower Micro-layered (0.5-2mm), compact, moderately sorted ash, charcoal and burned fine bone-rich deposits, with coarse chalk, burned flint and shell (charred amorphous organic matter also present). (Enriched phosphate-P and lead (Pb), and very strongly enhanced magnetic susceptibility) *Chalk floors intercalated with trampled ash, charcoal and fine burned bone-rich microlayered deposits of near-domestic hearth (kitchen) origin (NH4230 lower), sealed by constructed and compact burned brickearth and chalk floor – burned brickearth clay and silts (loess) of hearth origin. (Small inputs of stabling residues likely)*

Microfacies type (MFT)/Soil microfabric type (SMT)	**Sample No.**	**Depth (relative depth)** **Soil Micromorphology (SM)**	**Preliminary Interpretation and Comments**
		infills; *Fabric*: very abundant very coarse burrowing and fragmentation.	
MFT D2/SMT 4a and 4b	NHM272A	80-160 mm SM: moderately heterogeneous (SMT 4a and burrow-mixed 4b); *Microstructure*: poorly formed prisms with subangular blocky, 40% voids, mainly poorly accommodated planar voids, chambers and channels; *Coarse Mineral*: C:F (as NHM272D), *Coarse Organic and Anthropogenic*: occasional coarse flint and chalk, and coprolites (7mm) and coprolitic bone; rare charcoal; many biogenic calcite (earthworm granules and slug plates) with rare weathering examples; abundant amorphous organic matter in some patches (dung residues); rare recognisable ashes (druses etc), but probably abundant overall; *Fine Fabric*: SMT 4b: dark reddish brown (PPL), finely patchy high interference colours ((close porphyric, crystallitic b-fabric, XPL), dark brown (OIL); humic with abundant very fine charcoal; *Pedofeatures*: *Amorphous*: occasional possible Ca-P hypocoatings; *Fabric* and *Excrements*, as NHM272D. Pollen: Occasional, poorly preserved *Alnus, Corylus t.* and weeds; Lactuceae and *Sinapis t.* Consistent preservation characteristics.	NH4412: Late Roman dark earth (Phase 2.4) 'Humic' silt-dominated soil material, with both calcareous (as SMT 4a) and non-calcareous humic material (SMT 4b); reddish amorphous organic matter – possible humified dung relict – scattered with humic/possible Ca-P staining (as Moel-y-gar chalk floor); chalk, charcoal, coprolitic remains, and ashes present; unweathered earthworm granules throughout, but there is also bioworking is by smaller fauna; charcoal and bone, coprolitic material are ubiquitous. (More strongly enriched phosphate-P and strongly enhanced magnetic susceptibility, and higher LOI, compared to NHM272D). *Strongly homogenised dark earth calcareous brown earth soil; moderately mature biologically worked dark earth (typical pollen), but does not show the decalcification of some dark earth soils(?). Dark earth probably formed through middening (wider pollen spectra compared to NHM272D), which included dumping of ashes – hence calcitic character – and inputs of 'dung' (possible phosphate-staining and enrichment may originate from some in situ stock pounding. (Not same parent material as NHM272D below, and different land use – cf Deansway, Worcester)*
MFT D1/SMT 4a	NHM272D	380-460 mm SM: homogeneous; *Microstructure*: massive and channel, 35% voids, fine channels and chambers; *Coarse Mineral*: C:F (limit	NH4436/NH4393: 'subsoil'/natural Poorly 'humic' and poorly calcitic brown silty soil; biologically worked with earthworm granules

Microfacies type (MFT)/Soil microfabric type (SMT)	**Sample No.**	**Depth (relative depth)** **Soil Micromorphology (SM)**	**Preliminary Interpretation and Comments**
		at 10 μm), poorly sorted coarse silt and very fine sand-size quartz, with medium to very coarse sand size quartz, chalk and flint, few stone-size (max 20mm) flint; *Coarse Organic and Anthropogenic*: examples of burned flint, burned daub (6mm), pot, shell and burned shell, occasional bone, coprolitic bone (4mm) and iron slag (5mm); occasional partially weathered biogenic calcite (granules and plates); rare charcoal; *Fine Fabric*: SMT 4a: dark greyish brown (PPL), moderately high interference colours (close porphyric, crystallitic b-fabric, XPL), greyish, pale brown with black flecks (OIL); moderate humic staining with many very fine amorphous and occasional charred OM; *Pedofeatures*: *Crystalline*: rare traces of thin calcitic hypocoatings and possible root pseudomorphs; *Fabric*: very abundant thin to broad burrows, some u-shaped channel fills; *Excrements*: total excremental fabric, with very thin to broad organo-mineral excrements. Pollen: Rare, badly preserved Lactuceae and unidentifiable pollen. Consistent preservation characteristics.	which look somewhat weathered?; odd bits of bone (BL autofluorescent); large fragment of (relict Roman?) iron slag; *Biologically homogenised moderately humic calcareous brown earth (dark earth) formed out of local silty and chalky soils, with 'resistant' relict Roman cultural material (iron slag, coprolitic bone, pot – as indicated by enriched phosphate-P and enhanced magnetic susceptibility) and weathered brickearth building clay. There is the possibility of this dark earth, which includes weathering earthworm granules and consistently poorly preserved pollen spectra, being an earlier mature dark earth, but which now acts as a subsoil to later dark earth strata.*
MFT D3/SMT 4b(SMT 1c)	NHM311A	20-100 mm SM: mainly homogeneous SMT 4b, with common included fragments of SMT 1c in topmost few mm; *Microstructure*: massive, coarse prismatic, 60% voids, coarse chambers, interpedal fine channel and vugh; *Coarse Mineral*: as NHM272D, with abundant chalk gravel; *Coarse Organic and Anthropogenic*: as NHM272A, with both unweathered and weathering biogenic calcite; example of burned eggshell; *Fine Fabric*: SMT 4b; *Pedofeatures*: *Fabric* and *Excrements*, as NHM272D. Pollen: Rare badly preserved *Corylus t.,* Lactuceae and unidentifiables.	NH5059: Late Roman dark earth 'Humic' and mixed brown moderately calcitic silty soil with fabric mixing, many inclusions of humified organics (dung/ashed dung residues); inclusions of bone – some partially weathered/digested and coprolitic, earthworm granules – both relict weathered ones (from 'earlier dark earth') and contemporary earthworm granules etc; intercalated/mixed midden dark earth that has not been totally homogenised – includes heterogeneous soil with chalk, land snail shell and decalcified soil clasts (Carstens soil series – see NHM332). (More strongly enriched phosphate-P

Microfacies type (MFT)/Soil microfabric type (SMT)	**Sample No.**	**Depth (relative depth) Soil Micromorphology (SM)**	**Preliminary Interpretation and Comments**
			and strongly enhanced magnetic susceptibility, and higher LOI, compared to NHM272D). *Dark earth probably recording middening/occupation, rather than simple abandonment (consistent with pollen); inputs of domestic waste, ash and possibly dung and ashed dung residues – coprolitic inputs and burned material contributing to chemical and magnetic susceptibility signature.*
F2 (F1)/6b (6a)	NHM559	20-90 mm Fragmented and mixed (from sampling) massive mixture of chalk (18mm) and crushed chalk, with relict compact closed vughy porosity (10% voids) and chalky void coatings; examples of very strongly burned (calcined) bone, cess (organic matter embedded in amorphous phosphate), amorphous organic matter, fine coprolitic material, and abundant charcoal present.	NH4370/NH4394: Phase 4.2 floor and occupation Dominantly massive chalk, crushed chalk with chalky fine fabric - closed vugh and chalky void coatings; fine charcoal, rare bone and fine coprolite, very fine bone scatter (BL autofluorescent); burned bone and amorphous organic matter. (Moderately high LOI, enriched in phosphate-P, with very strongly enhanced magnetic susceptibility) *Chalk floor constructed of compacted (wet) chalk stone and crushed chalk slurry with minor spread/trample of charcoal-rich hearth-rake which includes calcined bone – domestic kitchen waste.*
			Winchester Discovery Centre
MFT C2/SMT 3b	CCM130A	75-150mm 75-115mm (CC1356, upper CC1357) SM: generally homogeneous; *Microstructure*: crumb and fine to medium subangular blocky within massive; 40% voids, poorly accommodated planar voids and complex packing voids; *Coarse Organic and Anthropogenic*: example of coarse flint (16mm), many bone (14mm) and very fine bone,	CC1356, upper CC1357 Biologically worked chalky and ashy deposit rich in charcoal and bone, but also containing much oyster(?) shell and examples of clay, burned clay and small dog/human coprolites; fine fabric is rich in amorphous organic matter, some partially charred. Biologically worked deposit was affected

Microfacies type (MFT)/Soil microfabric type (SMT)	**Sample No.**	**Depth (relative depth) Soil Micromorphology (SM)**	**Preliminary Interpretation and Comments**
MFT C1/MFT 3b		occasional shell fragments (10mm); abundant charcoal (9mm), many ash and coarse ash aggregates, with silt-size quartz, fine chalk and gravel size chalk; trace amounts of clayey soil (SMT 1c) and bark(?); abundant very fine amorphous organic matter (dung residues?? Or simply organic waste from refuse dumping); examples of sand-size (human/dog?) coprolites; *Fine Fabric*: SMT 3b: dotted and speckled cloudy greyish brown (PPL), moderately high (close porphyric b-fabric, XPL), heavily dotted greyish brown (OIL); very abundant charred and humifying organic matter and charcoal; *Pedofeatures*: *Textural*: abundant 200µm to 2mm calcitic cloudy dusty grey void coatings and channel infills, includes charcoal and silt; *Crystalline*: rare probable CaP infills and phosphatisation of chalk fragments; *Amorphous*: very abundant humic/phosphate amorphous staining; *Fabric*: abundant broad (2-4mm) burrows; *Excrements*: many broad excrements. 115-150mm (Lower CC1357) SM: broadly (1.5-6mm) layered, sloping, moderately homogeneous; *Microstructure*: layered, 30% voids, chambers and poor horizontal fissures, complex packing voids; *Coarse Mineral*: poorly sorted composed of coarse organic and anthropogenic inclusions; *Coarse Organic and Anthropogenic*: many coarse (max 10mm) rounded chalk – most showing decalcification/ phosphatisation; abundant calcined bone (max 7mm) and finer iron-stained bone fragments and weakly rubefied bone; abundant wood charcoal (7mm+), possible charred fine seed; occasional burned shell; abundant fine chalk, and chalk fossils; rare quartz sand, trace amounts of slightly altered quartz; very abundant and dominating amounts of ash, mainly as micritic aggregates and recrystallised sparitic void infills; examples of burned eggshell; *Fine Fabric*: SMT	by major inwash of chalky and ashy fine material containing silt and charcoal. *Biologically worked ash and chalky floor residues, rich in charcoal and humifying organic matter with oyster shell, bone and coprolitic waste material being included, presumably from domestic kitchen waste source. Deposit underwent biological working (therefore probably exposed) and later inwash of fine matrix material, indicating probable full exposure to the elements and likely trampling of overlying (CC1356? and above) ash deposits. (Presence of organic waste, phosphate concentrations and burned material equally suggested by bulk analyses of CC1357 – Table 2)* Lower CC1357 – Phase 4.2 floors Thin to broadly layered ashy deposits, very rich in charcoal, burned (calcined) bone, iron-stained (butchered?) bone, with traces of burned eggshell and weakly heat altered quartz; few quartz silt and many chalk fragments present, most coarse pieces showing decalcification/ phosphatisation; small amounts of humic staining present and bioworking – very thin burrows and excrements. *Poorly sorted trampled ash and charcoal spreads, probably from domestic/kitchen hearths (iron-stained bone butchered fragments and coarse calcined very strongly burned bone present, alongside example of burned eggshell and traces of slightly heat altered quartz).*

Microfacies type (MFT)/Soil microfabric type (SMT)	**Sample No.**	**Depth (relative depth) Soil Micromorphology (SM)**	**Preliminary Interpretation and Comments**
		3a: cloudy greyish, with black dots and patchy yellow staining (PPL), high interference colours (very open porphyric, crystallitic b-fabric, XPL), whitish yellow (OIL); abundant thin humic/phosphate staining, very abundant fine charcoal; *Pedofeatures*: *Crystalline*: occasional probable CaP infills and phosphatisation of chalk fragments; *Amorphous*: very abundant humic/phosphate amorphous staining; *Fabric*: abundant very thin burrow; *Excrements*: occasional very thin (ashy) excrements.	*(Presence of organic waste, phosphate concentrations and burned material equally suggested by bulk analyses – Table 2, which also may reflect better preserved ash concentrations [Zn] here)*
MFT C1/MFT 3b MFT C3/SMT 3c	CCM130B	170-205 mm (Upper CC1357) SM: As Lower CC1357 (CCM130A), described above, with thin to broad (2-6mm thick) sloping mainly homogenous SMT 3a, with very abundant wood ash, charcoal (mainly wood, but possible monocot charcoal), occasional burned bone and oyster shell, rare traces of burned eggshell and fine coprolite. 205-245mm (CC1358, CC1360) SM: mainly homogeneous (fragments of slightly different layers?); *Microstructure*: currently loose crumb and fine subangular blocky; 50% voids, mainly simple packing voids; *Coarse Mineral*: as CCM130A, with very abundant chalk (max 25mm), example of flint gravel; *Coarse Organic and Anthropogenic*: abundant wood charcoal (max 10mm), many bone and burned bone; rare fine coprolites; many fine 'soil' inclusions (both chalky and decalcified) and ash – included stained aggregated material; rare oyster shell; examples of burned eggshell and earthworm granules; *Fine Fabric*: MFT 3b: cloudy greyish, with black specks and some with fine brownish specks and staining (PPL), high interference colours (open and close porphyric, crystallitic b-fabric, XPL), whitish grey and yellow (OIL); some with very abundant fine charcoal and fine amorphous OM; *Pedofeatures*: *Textural*: occasional	Lower CC1357 – Phase 4.2 Floors *Poorly sorted trampled ash and charcoal spreads, probably from domestic/kitchen hearths (iron-stained bone butchered fragments and coarse calcined very strongly burned bone present, alongside examples of burned eggshell).* CC1358, CC1360 Coarse and fine fragmented fine chalky material, containing patchy concentrations of very fine charcoal and amorphous organic matter and very fine soil inclusions; with very abundant coarse charcoal and chalk, bone and burned bone, fine coprolitic material, oyster shell and earthworm granules present; some fragmented deposits show earlier-formed calcitic coatings and infills (as in MFT C2). *Coarse and fine fragmented floor deposits, showing likely refuse dumps that included coarse charcoal and chalk, as well as coprolitic material, bone and partially weathered ash; burrowed and with previous evidence of slaking/inwash features – exposed dump and probably reworked chalk*

Microfacies type (MFT)/Soil microfabric type (SMT)	**Sample No.**	**Depth (relative depth)** **Soil Micromorphology (SM)**	**Preliminary Interpretation and Comments**
		relict patches with 100µm calcitic cloudy dusty grey void coatings and channel infills; as CCM130A upper (upper CC1357).	*floor material.*
MFT B1/SMT 2a, 2b	CCM332A	0-75mm SM: As CCM332B; heterogeneous with dominant SMT 2a (more homogeneous than in CCM332B) and very broad burrow fills of SMT 2b; *Microstructure*: massive and compact 15-20%, fine vughs, vesicles and channels; *Coarse Mineral*: chalk gravel in SMT 2b/very broad channel fills; *Coarse Organic and Anthropogenic*: example of 6mm coprolitic bone in SMT 2b; *Fine Fabric*: as SMT 2a and 2b; *Pedofeatures*: as CCM332B, but with very abundant matrix intercalations associated with 50-150µm thick vesicle and closed vugh void coatings, with very poorly developed micro-pans.	CC3409 – Holloway? leading in from Middle Iron Age enclosure *As below, but here drove-way slurries have produced totally homogeneous, massive and compact deposits, with more strongly developed textural pedofeature evidence of wet trampling. Similarly high amounts of assumed dung residues occur. The slurry soil has become more homogeneous because of the trampling effect of stock and other traffic. Both CCM332A and CCM332B contain strong evidence of stock movement and traffic along this holloway leading in from the Middle Iron Age enclosure.*
MFT B1/SMT 2a(1c), 2b	CCM332B	75-150mm SM: extremely heterogeneous with common SMT 2a and 2b, and very few 1c; *Microstructure*: massive with prismatic and very coarse burrows; compact 15-20% (very fine [250 µm] closed vughs, vesicles and channels) with coarsely burrowed 35% - chambers and channels; *Coarse Mineral*: C:F (limit at 10 µm), very poorly sorted coarse silt-size quartz (as CCM602) and fine to coarse sand (mainly flint, with chalk and chalk fossils), with stone size (30mm+) flint and frequent sand to gravel-size chalk; soil fragments of Clay-with-Flints Bt horizon; *Coarse Organic and Anthropogenic*: in matrix: many patches of abundant humified organic matter – partially replaced with Fe-Mn (dung residues?), with rare fine charcoal; examples of weathered biogenic calcite; in broad 'chalky' burrows are rare biogenic calcite (earthworm granules), many	CC3409 – Holloway? leading in from Middle Iron Age enclosure Extremely heterogeneous flint-rich deposit composed of: decalcified silty clay loam soil clasts (SMT 1c), which sometimes embed flint (with textural pedofeatures – Bt horizon fragments), and poorly to strongly calcareous (fine chalky) silty clay loam soil (SMT 2a), rich in partially iron and manganese replaced tissue and amorphous/humified organic matter (dung residues); also present are partially weathered and fragmented biogenic calcite (earthworm granules and Arionid plates); moderately compact soil is characterised by closed vughs and vesicles and associated matrix intercalations and void coatings.

Microfacies type (MFT)/Soil microfabric type (SMT)	**Sample No.**	**Depth (relative depth)** **Soil Micromorphology (SM)**	**Preliminary Interpretation and Comments**
		coarse coprolitic bone and coprolitic material (max 4mm), rare examples of partially phosphatised chalk; examples of burned daub, occasional mainly fine charcoal and very fine burned mineral material; *Fine Fabric*: SMT 1c (subsoil CwF Bt, eg embedding flint): orange brown (PPL), low interference colours (close porphyric, speckled and grano-striate b-fabric, XPL), pale yellowish orange (OIL); SMT 2a (mixed calcareous brown earth and Bt soil): dotted and speckled brown and greyish brown (low to high interference colours (close porphyric, speckled and crystallitic b-fabric, XPL); reddish black mottled greyish brown (OIL); many to abundant tissue and amorphous organic matter (often Fe-Mn impregnated; rare fine charcoal; SMT 2b (anthropogenic calcareous soil mixing): dotted cloudy grey (PPL), moderately to high interference colours (close porphyric, crystallitic b-fabric, XPL), dotted greyish brown (OIL); rare fine amorphous organic matter, abundant fine charred OM; *Pedofeatures*: *Textural*: abundant matrix intercalations associated with 50-100µm thick vesicle and closed vugh void coatings; *Crystalline*: examples of phosphatisation of chalk fragments; *Amorphous*: very abundant moderate Fe-Mn fine impregnation; *Fabric*: very abundant chaotic mixing; abundant very broad (4-15mm) burrow/biochannel infills (SMT 2b); Excrements: occasional broad to very broad organo-mineral excrements, some mamilated.	Later very broad burrow fills (fine charcoal-rich SMT 2b, rich in chalk gravel, and containing fine burned mineral material and coarse examples of blue light autofluorescent coprolitic bone fragments. *Very heterogeneous, colluvium-like, deposit (e.g., Bourne Valley, White Horse Stone on drift over chalk) containing eroded fragments of local decalicified soil cover (Carstens soil series – see below), mixed with chalk (from eroded brown calcareous earths); but differs from simple colluvium by containing high amounts of, now mainly mineralised, humified organic matter (probable dung residues) and characterised by compact soil with closed vughs and vesiscles associated with matrix intercalations and void coatings, all indicating physical mixing of wet soil, forming slurries, and here best interpreted as drove-way deposit accretion formed by trampling by stock. (Bulk analysis specifically targeted SMT 2a material, and found slight phosphate-P enhancement compared to the natural soil (CC6000), but, presumably because of mineralisation little preserved organic matter – very low LOI; see Table 2).* *Later burrow and biochannel infills are rich in chalk, fine charcoal and burned mineral material, and several coarse examples of coprolitic bone are present, presumably of Roman origin.*
MFT A2/SMT 1b over MFT A1/SMT 1a	**CCM602**	80-160mm 80-145 mm (base of CC6001)	CC6001 – subsoil below Roman (pre-AD70?) street (lower subsoil and top of natural CC6000)

Microfacies type (MFT)/Soil microfabric type (SMT)	Sample No.	Depth (relative depth) Soil Micromorphology (SM)	Preliminary Interpretation and Comments
		SM: mainly homogeneous (SMT 1a with burrow mixing from above); *Microstructure*: fine to medium prismatic; 25% voids, very fine(0.5mm) poorly accommodated planar voids, broad (2mm) channels/burrows and coarse (6mm) chambers; *Coarse Mineral*: C:F (limit at 10 µm), 60:40, poorly sorted coarse-silt, with fine and medium sand-size quartz (with chert, feldspar, mica, flint and opaques – limonite, trace of calcite), with frequent gravel to stone-size angular to rounded flint (very few chalk, rounded iron nodules) and coarse anthropogenic material; *Coarse Organic and Anthropogenic*: rare fine (<1mm) charcoal, occasional coarse burned flint, occasional chalk, 2 rounded gravel-size iron fragments, possible 3mm-size glass shard, trace amount of biogenic calcite (earthworm granule fragments); *Fine Fabric*: SMT 1b: speckled pale dark brown (PPL), low to very interference colours (close porphyric, speckled b-fabric, XPL), pale brownish orange (OIL); many patches of (iron-stained) humic staining, occasional fine charred OM and many fine amorphous organic matter; *Pedofeatures*: *Textural*: 1 contemporary: abundant matrix intercalations, with associated occasional mainly very thin (25-50 µm) dusty clay void coatings; 2: rare trace of very thin fine clay void coatings; 3: post-depositional rare thick (100-150 µm) blackish brown, poorly oriented fine charcoal-rich impure void coatings (associated with rare 'dark earth'-like burrow fills in upper part of thin section); *Crystalline*: example of phosphatisation of chalk fragment; *Amorphous*: many fine weak iron mottling; *Fabric*: abundant fabric intercalations and broad burrows. 145-160 mm (CC6001) SM: as above, few coarse flint; SMT 1a:	Silt loam (CC6001) with frequent coarse flint, burned flint, occasional chalk, with examples of possible iron fragments and a glass? shard; weakly humic with included very fine charcoal, matrix and void textural pedofeatures and contemporary burrow mixing, over very poorly humic silt loam with very few flint (CC6000), consistent with chemistry; rare inwash of dark, fine charcoal-rich soil. *Junction between natural (CC6000) subsoil B silty clay loam (Eb horizon of Carstens soil series) of Plateau Drift over 'Clay-with-Flints' origin and slightly more humic and phosphate-rich physically disturbed/homogenised possible plough soil, with included fine charcoal and more coarse flint and burned flint – pre-Roman arable activity. Post-depositional rare burrowing-in and inwash from overlying Roman activities.*

Northgate House (Staples Gardens) and Winchester Lending Library (Jewry Lane), Winchester: Soil Micromorphology Plates 1-14

Plate. 1: Scan of M602 showing junction between Context 6001 (natural Eb upper subsoil horizon and overlying Context 6000 (pre-Roman cultivated soil?). Frame width is ~50mm.

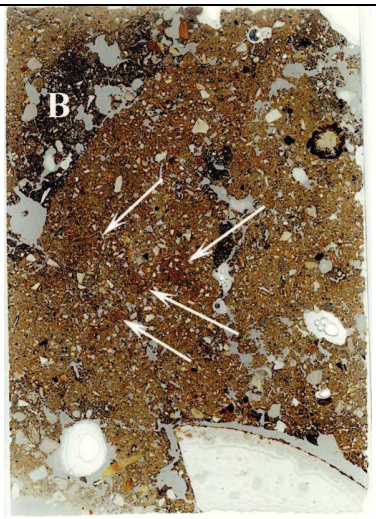


Plate 2: Scan of M 332B, base of Context 3409; a heterogeneous deposit containing coarse flint and subsoil clay (arrows). This is a colluvium-like deposit but with pedofeatures and probable dung residues indicative of trampling (holloway). Frame width is ~50mm.

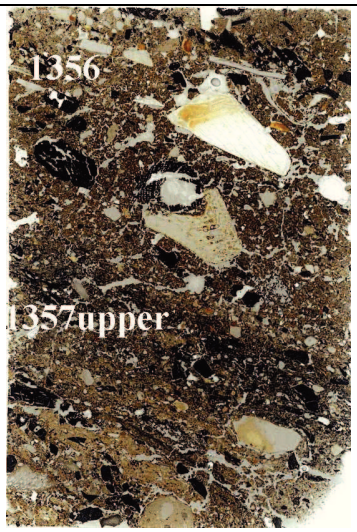


Plate 3: Scan of M130A showing layered and compacted floor layers 1357 upper and the more biologically-worked dumped 1356. Frame width is ~50mm.

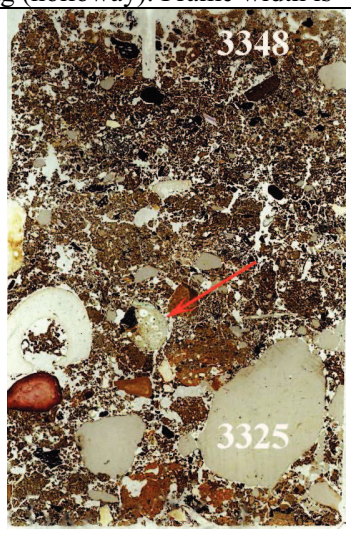


Plate 4: Scan of M226A; junction of Contexts 3348 and 3325; both contain very strongly burned mineral material (including vitrified sands/crucible fragment – arrow) and very strongly enhanced magnetic susceptibility indicative of industrial activity. Frame width is ~50mm.

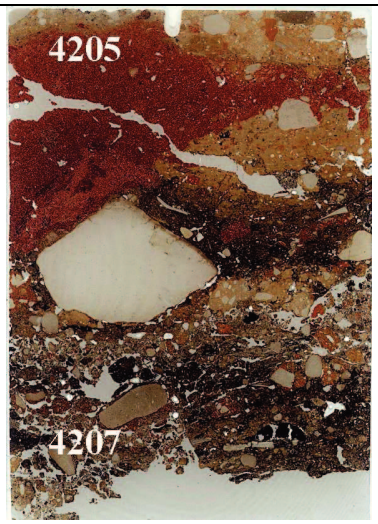


Plate. 5: Scan of M253E; trampled hearth rakeout 4207 sealed by burned and rubefied hearth layer 4205. Hearth constructed using local subsoil clay, chalk and chalky soil – compacted when wet as a form of 'clunch'. Frame width is ~50mm.

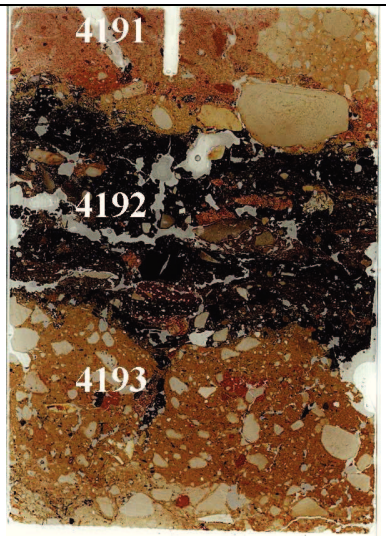


Plate 6: Scan of M253B, showing rubefied constructed hearth layers 4191 and 4193. Trampled charcoal and ash rich layer 4192 contains 'eroded' burned hearth material within this hearth rakeout. Burned bone, burned eggshell and burned mollusc shell (oyster) testify to the presence of a kitchen. Frame width is ~50mm.

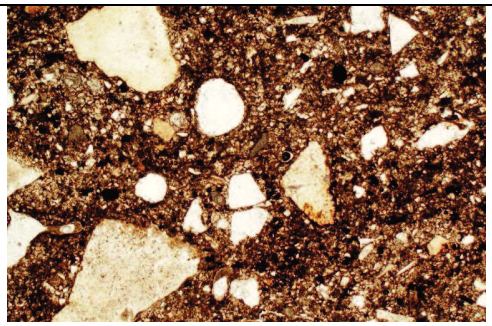


Plate. 7: Photomicrograph of M332A (Context 3409); compact once-humic, wet- trampled Holloway deposits. Plane polarized light (PPL), frame width is ~4.62mm.

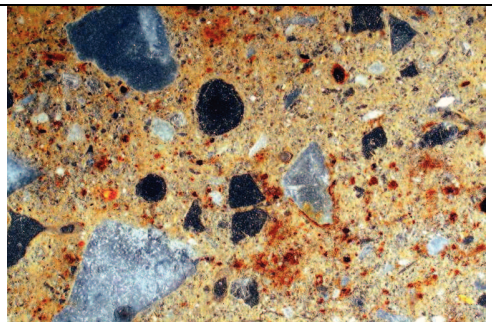


Plate 8: As Plate 7, under oblique incident light (OIL); compact deposit containing flint and burned flint (whitish) and the ferruginous remains of probable dung residues.

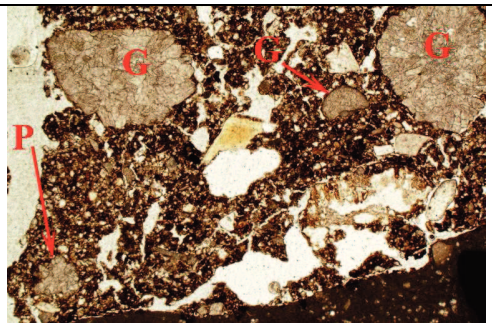


Plate 9: Photomicrograph of M272A, Late Roman dark earth Context 4412, which contains numerous earthworm granules (G) and

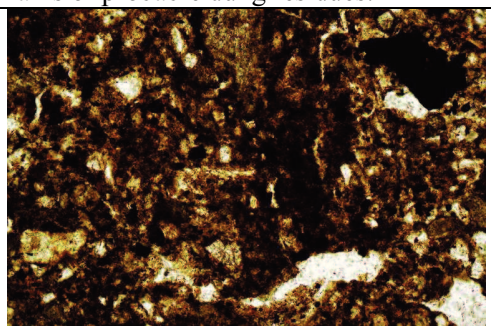
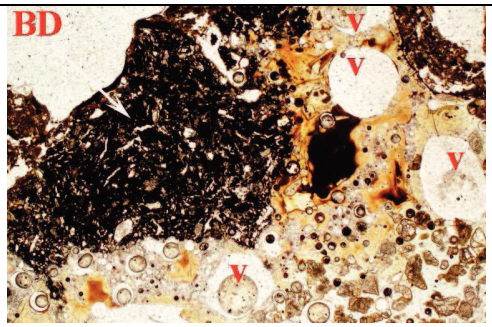
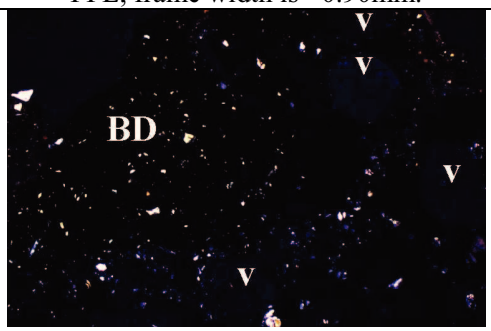


Plate10: Photomicrograph of M311A, Late Roman, Context 5059; note concentrated amorphous organic matter staining the soil and

possible slug plates (P). PPL, frame width is ~4.62mm.	implying the presence of an animal pound. PPL, frame width is ~0.90mm.
 Plate. 11: Photomicrograph of M226A (see Fig 4); detail of vitrified 'crucible' material with vesicles (v) and embedded burned daub (BD), associated with a very strongly enhanced magnetic susceptibility that together indicate use of a furnace/hearth and industrial activity. PPL, frame width is ~4.62mm.	 Plate. 12: As Plate 11, under crossed polarized light (XPL); only traces of the original quartz sand are present; the quartz has melted to produce a vesicular glass – requiring temperatures of 1,000-1,200°C – implying use of bellows.

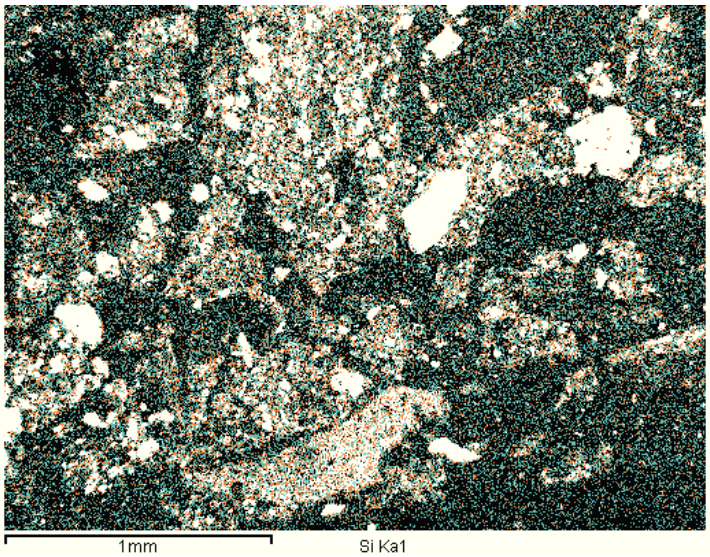


Plate. 13: Detail of Plate 11 EDAX map of Si (quartz sand residues) in vesicular glass.

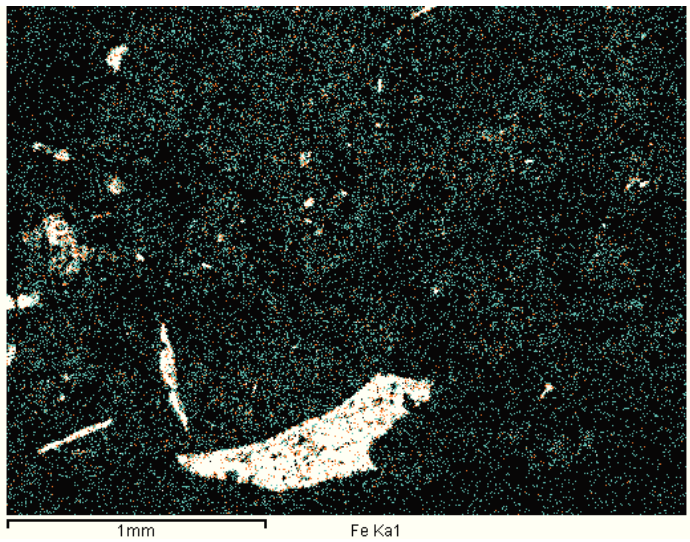


Plate 14: As Plate 13; EDAX map Fe.

WINCHESTER
A CITY IN THE MAKING

Archaeological excavations between 2002 – 2007
on the sites of Northgate House, Staple Gardens and the former Winchester Library, Jewry St

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